Safe Motherhood

Vaginal Birth after Caesarean Section

in Zimbabwe and the Netherlands

Wilbert Spaans

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Spaans, Willem Albert

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Voor Nyasha en Kudzai

When we go to a hospital, irrespective of the doctor's quality,
if the doctor shows genuine feeling and deep concern for us,
and if he or she smiles, then we feel all right.
But if the doctor shows little human affection,
then even though he or she may be a very great expert,
we may feel unsure and nervous.
This is human nature.

The XIV Dalai Lama, 1993

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List of Abbreviations

AMC	academic medical centre
ANC	antenatal clinic
CS	caesarean section
$CI_{95\%}$	95% confidence interval
CPD	cephalo pelvic disproportion
DVT	deep venous thrombosis
ERCS	elective repeat caesarean section
FTP	failure to progress
LUMC	Leiden university medical centre
MMR	maternal mortality ratio
MWH	maternity waiting home
NND	(early) neonatal death
OR	odds ratio
PNM	perinatal mortality
Prim.	primary
Prev.	previous
RCT	randomised controlled/clinical trial
RR	relative risk
SB	stillbirth
sd	standard deviation
Sec.	secondary
SVD	spontaneous vaginal delivery
TFR	total fertility rate
TNO	Nederlandse organisatie voor toegepast-natuurwetenschappelijk onderzoek
TOL	trial of labour
UNFPA	united nations population fund
USA	United States of America
VBAC	vaginal birth after caesarean section
VD	vaginal delivery
WHO	world health organisation

Chapter 1

General Introduction

1.1 The history of the caesarean section

Caesarean sections have been carried out since pre-Christian times. Very often the operation would only be performed when a woman died during pregnancy: for example, the ancient Hindus carried out the operation when the mother had died and there were detectable movements of the foetus. There is some evidence that the operation may have been known to the ancient Egyptians. The operation was probably performed also by the Jews. The Mischnagoth, published in 140 BC, and the Talmud, written between 200 and 600 AD, contained instructions for twins and surviving women after caesarean section (1-4).

In Greek mythology, several non-vaginal births have been described. Asklepios, the son of Apollo and the king's daughter Coronis, was born through an abdominal delivery after his mother had been killed by one of the arrows of goddess Artemis. Dionysos, god of wine and agriculture, was the son of Zeus and Semele. He was born preterm through an abdominal delivery. Pallas Athena, goddess of wisdom, daughter of Zeus and Metis, was born out of the head of her father (2).

There is some debate over the origin of the word 'caesarean'. It is incorrect to associate the term caesarean with the birth of Julius Caesar (100-44 BC) through an abdominal incision. At that time, caesarean sections on living women were almost always fatal. It is known that during his life Caesar wrote letters to his mother, who, presumably, was alive at the time. The legendary king Numa Pompilius (715-673 BC) of Rome introduced a law by which it was forbidden to bury a pregnant woman until her child had been removed from her abdomen, even if there was little if any chance of its survival (2;3). Under the rule of Caesar, this Lex Regia became the Lex Caesarea and thus, the practice became known as the caesarean operation. The historian Plinius (23-79 AD), however, supports a different explanation. The word caesarean section might come from the Latin 'caedere' and 'secare', both meaning 'to cut' (5).

There are no recorded attempts of performing a caesarean on a living woman in Europe before 1500. In 1581, François Rousset (1535-1590) wrote a paper, which opened the debate on the relative benefits of the operation and argued the case for the possibility of performing a caesarean on a living woman (6). Not a medical practitioner, however, but Jacob Nufer, a hog gelder of Sigerhausen, Switzerland, performed the first caesarean section with a surviving woman and child. He carried it out on his wife, Elisabeth Alespachin, during a prolonged and obstructed labour in 1500. Mrs Nufer is said to have gone on to deliver six more children vaginally. She is, therefore, also the first woman with a recorded vaginal birth

after caesarean (7). However, the report was written a hundred years later and only from hearsay. The first authentic case of caesarean section intentionally performed upon a living woman was on 22 April 1610 in Wittenberg, Germany, by Jeremias Trautmann and published by professor Sennert. A living child was born, but the mother died on the 25th postoperative day (6;8). In the Netherlands, Amsterdam, the first successful caesarean section was performed on Femmetje Janszoon-Jans, by Steven Vennekool on 16 June 1637, and described by Hendrick van Roonhuijse in 1663 (9;10). A very famous legend is the caesarean section on the wife of Jacob Egge by the horn of a tempestuous bull on 29 August 1647 (Figure 1.1). Husband and wife both died. The child died at the age of nine months. Mother and child were buried at the Westzijderchurch at Zaandam. Since then, this church was popularly called "bull's church" or "bullekerk". Not only in the Netherlands, but also in Japan and China, the attack of the bull was a desired theme on painted chinaware (2;11;12).

1.2 Development of the operative technique of caesarean section

Because of the dangers for mother and child, caesarean section remained controversial far into the nineteenth century. A monograph on caesarean section, the first on the subject, was published in Paris in 1581 by François Rousset (1535-1590), although he himself had never performed the operation, but described it based on conversation and correspondence with others (6). Jacques Guillimeau (1550-1613) opposed the ideas of Rousset, because the

Figure 1.1 *Caesarean section by a tempestuous bull at Zaandam*

caesareans he had witnessed were always fatal (8). Francois Mauriceau (1637-1709) was a determined opponent of caesarean section, but his accurate description of a post-mortem caesarean on a woman was used as an "instruction guide" by other surgeons. As a result, he influenced the progress and development of the caesarean operation. In Paris, in 1797, opponents of caesarean section, with Jean Saccombe as leader, formed an 'Ecole Anti-Caesarienne'. They strongly opposed a report from Baudelocque (1748-1810), addressed to the Society of Medicine in Paris, in which he said that the operation could lead to saving the lives of both mother and baby (13).

Throughout Europe, up to the second half of the nineteenth century, maternal mortality remained extremely high. In 1844, in his dissertation entitled "De eventu Sectionis Caesarea", C. Kayser of Copenhagen described maternal mortality related to caesarean section. From 1750 to 1839, he recorded 338 caesareans on women of whom 38% survived. Infection was the commonest cause of death, followed by haemorrhage (14). Gerben Ynzonides described the first 95 known caesarean sections in the Netherlands up to 1873; maternal mortality was 68%; perinatal mortality was 32% (9). Most women died of sepsis or haemorrhage.

At Kayser's time, it was universally accepted that the uterus should not be closed, and there had been little discussion about this dogma in the previous hundred years. By the early operators, the abdominal incision was made at the left or right side, sometimes obliquely, or longitudinally above the umbilicus. The sub-umbilical lower midline incision, through the linea alba, only gradually became the preferred approach. The uterine incision has varied in position as well. The majority of the earlier surgeons made the incision in a longitudinal direction in the corpus of the uterus. But also oblique or lateral incisions have been practised. The principal aim of the inventors of the various incisions was preventing the gaping of the uterine wound, because suturing of the wound was hardly ever done (15).

The caesarean operation was revolutionised by suturing the uterus. Early efforts were made by M. Lebas in France (1769), but he was not followed by others. In 1817, James Barlow, a surgeon who had performed the first successful caesarean section in England in 1793, reported the suturing of a severe bleeding uterine wound (16). In 1856 in the USA, Warren Brickel, a professor in obstetrics and gynaecology, advocated the use of uterine sutures; many, however, opposed the idea (15). In 1869, the Dutch obstetrician A.E. Simon Thomas was called to attend a woman in Zoetermeer. The woman was forty years old, it was her first pregnancy, and she had been in labour for two days. A forceps delivery failed and by way of a classical (median uterine incision) caesarean section a daughter was born. The

uterine muscle was closed with eight silver wires. Both mother and daughter did well after the operation (17;18).

In 1886, the German Max Sänger (1853 –1903) published his experience with a suturing technique, used for closing a vertical corporal incision. After this publication, there was an international breakthrough and suturing became widely accepted (15;19). Previous to the practice of suturing the uterine wound, about 50% of those who survived caesarean section sustained uterine scar rupture in a subsequent pregnancy. After suturing had become the norm, uterine scar rupture rates were reduced to 4 - 5.5% (7;20). At the same time, in 1882 Kehrer from Heidelberg described a low transverse uterine incision instead of the classical caesarean with the vertical scar in the corpus of the uterus, which used to be the common approach (15;21). In 1876, Porro of Pavia (Italy) developed his technique of amputating the body of the uterus, in order to lessen the dangers of haemorrhage and infection. There was opposition against this operation, because, due to the loss of her uterus, the woman was sterilised (22).

Another breakthrough came with the introduction of aseptic obstetrics by Semmelweiss (1846) and antiseptic surgery by Lister (1867) (15;23). In the Netherlands, by Van der Meij (Amsterdam) and Treub (Leiden), the aseptic techniques were fully supported by the end of the nineteenth century (23;24). For a short period, extra-peritoneal caesarean section was promoted in order to reduce the chance of infection. This technique was described by Fritz Frank in 1907, but never became popular because of complications of bladder and urethra (5;25). In 1908, Pfannenstiel advocated the horizontal abdominal incision through the skin and fascia. This incision was named after him. However, he adhered to a longitudinal incision of the peritoneum and the lower uterine segment (26).

Classical caesarean section with a vertical corporal incision in the uterus remained the standard technique in the Netherlands, United Kingdom and America until 1930. After previous classical caesarean section, repeat caesarean section was the treatment of choice, instead of the trial of labour. In 1921, Eardly Holland and Munro Kerr introduced the lower segment operation in the United Kingdom (27). Kerr recommended the semilunar incision with the curve directed upwards. It was not until after the publication of a paper by Wilson in 1931 that this operation came into common use (28). Also in the USA, the transverse incision in the lower segment became the favoured procedure. In the Netherlands, the transverse lower segment incision was supported by van der Hoeven in Leiden (1930) and Van Rooy (1921) in Amsterdam (29;30)

1.3 Caesarean section today

1.3.1 Surgical technique

The most common transverse abdominal incision is the Pfannenstiel, which is made 2 to 5 cm above the symphysis pubis, slightly curved extending through skin and subcutaneous fat to the level of the rectus sheath (Figure 1.2). Then, the rectus sheath is transversely incised on either side of the linea alba, which is cut separately, joining the two lateral incisions. Subsequently, it is separated from the underlying rectus muscles, which are again separated in the midline. Finally, the peritoneal cavity is entered longitudinally (26). Next, the transverse lower uterine segment incision is most commonly used (Figure 1.3, i.e. Kerr incision (27)). The advantages include less blood loss, and a low incidence of rupture during subsequent pregnancies. The major disadvantage of this incision is that significant lateral exposure is not possible without risking laceration of major blood vessels.

There are two types of vertical incisions: the low vertical and the classical vertical. The low vertical is performed in the lower uterine segment, but can be extended upwards into the fundus of the uterus, if necessary. The classical vertical incision is cut through the fundus of the uterus. This incision is associated with a higher risk of uterine scar rupture in subsequent pregnancies (4% - 9%), compared to low vertical (1% - 7%) and low transverse (0.2% - 1.5%) incisions (32;33).

When, with a scalpel in the centre of the lower segment, a small transverse incision is made, and entry into the uterine cavity is achieved, the incision can be laterally extended by either blunt expansion with the surgeon's fingers, or by employing a pair of scissors. In a study that evaluated these two techniques, it was found that sharp expansion of the uterine incision significantly increased intra-operative blood loss and the need for transfusion (34). A previous study, smaller in size, found no difference in intra-operative blood loss between blunt or sharp dissection of the uterine incision (35). Subsequently, the surgeon's hand is inserted into the uterine cavity to lift the presenting part and deliver the baby. The placenta is removed, either by spontaneous delivery (traction on the cord and the use of oxytocin to enhance uterine contractile expulsive efforts) or by manual removal. Controlled cord traction is preferable, since manual removal is reported to be associated with increased maternal blood loss (weighted mean difference 436 ml, $CI_{95\%}$ 348 - 524 ml) and with increased postpartum endometritis (OR 5.4; $CI_{95\%}$ 1.3-23.8) (36). Uterine exteriorisation, carried out by many surgeons, facilitates exposure and is associated with fewer postoperative febrile days (fever more than three days, OR 0.40; $CI_{95\%}$ 0.17 - 0.94) and a non-significant trend towards fewer

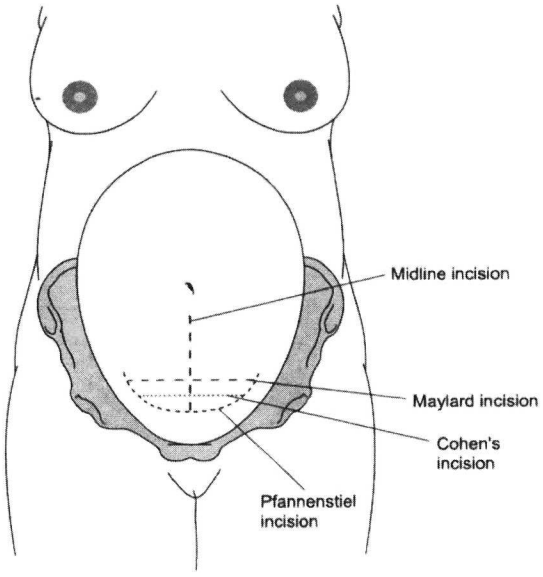

Figure 1.2 *Abdominal incisions for caesarean section (31)*

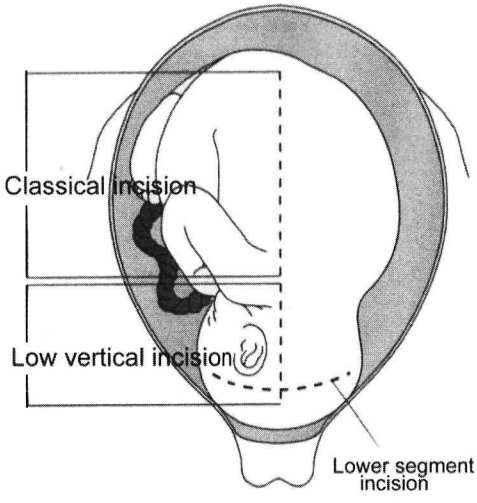

Figure 1.3 *Uterine incisions for caesarean section (31)*

infections. There is, however, also a non-significant trend towards more nausea and vomiting when exteriorisation was done under regional analgesia (37).

In the late 1980s, single layer closure of the uterus became routine clinical practice. Operation time was reported to be reduced (with 5.6 minutes), without significant differences in the use of extra haemostatic sutures, incidence of endometritis or use of blood transfusion (38;39). In particular, single layer closure did not increase the risk of wound dehiscence during the next pregnancy, compared to two layer repair (38;40;41). These findings were questioned, however, by a cohort study of 489 women with a single continuous interlocking suture, containing the entire thickness of the uterine wall from decidua to visceral peritoneum, and 1,491 women with a double layer closure of the uterine incision. The double layer consisted of a continuous interlocking suture through the myometrium and the decidua, followed by a continuous second layer, and by closure of the visceral peritoneum. In this cohort study, women with previous single layer closure experienced a higher rate of uterine rupture than women with previous double layer closure (OR 3.95; $CI_{95\%}$ 1.35-11.49) (42). But the only thorough way to determine the relative effects of single versus double layer uterine closure will be a randomised controlled trial of sufficient size. With a classical incision, the myometrium is thick and a double or even triple layer closure might be necessary, but there are no publications of studies comparing suturing techniques during classical caesarean section.

In a systematic review of four trials, it was found that non-closure of the visceral and parietal peritoneum saved operating time (mean difference 6.1 minutes, $CI_{95\%}$ 4.3 - 8.0) (43). In a study by Grundsell et al., postoperative wound infection and febrile morbidity occurred significantly less after non-closure of visceral and parietal peritoneum (44). There is no evidence that closing the peritoneum is of benefit to the patient and non-closure should therefore be the treatment of choice. The fascia must be closed with a delayed-absorbable suture, using a continuous stitch. Especially, with a vertical incision in high risk patients for fascial dehiscence, a delayed-absorbable monofilament (e.g. polydiaxanone, PDS) is recommended.

Closure of the subcutaneous layer was reported to be helpful in preventing postoperative wound disruption in women with at least 2cm of subcutaneous adipose tissue (45). Prevention of accumulation of serum and blood in the "dead space" is supposed to prevent wound seroma and subsequent wound breakdown and infection. This would support the idea of suturing subcutaneous tissue. However, a recent randomised trial, comparing subcutaneous closure with placement of a subcutaneous drain, or with no intervention,

showed no difference in the risk of wound complications (46). In a multiple logistic regression analysis, thickness of subcutaneous tissue depth of more than 3 cm appeared to be the only significant risk factor associated with abdominal wound infection after caesarean delivery (OR 2.8; $CI_{95\%}$ 1.3-5.9) (47). Subcutaneous suturing or the use of subcutaneous drains does not lower the risk of infection (48). At the end of the operation, reapproximation of the skin can be performed with staples or sutures.

1.3.2 Alternative surgical techniques

In 1954, S. Joel-Cohen developed a method for opening the abdomen in hysterectomy. At the Misgav-Ladach Hospital in Jerusalem, this technique was implemented and evaluated for caesarean section. The opening is performed by a superficial transverse straight cut in the cutis, about one and a half centimetres higher than the Pfannenstiel incision (Figure 1.2). The subcutaneous tissues are incised for three centimetres, only in the midline, to expose the fascia. The fascia is dissected laterally below the fat tissue, with the slightly opened tip of a scissors; the tendon plate is not freed upwards; after manual bilateral traction of the rectus muscles and the subcutis, the peritoneum is exposed and opened transversely. Then, the bladder peritoneum is opened and pushed down ("a bladder flap is made") and the uterus is opened in the lower segment. The fingers are used to extend the lower segment incision laterally. After delivering the child and the placenta, the uterus is closed with interrupted sutures in the original description of the operation. Continuous (non)-locking suture, however, has become common practice. The fascia is closed with continuous non-locking absorbable sutures and the skin with staples or sutures. Compared to the traditional Pfannenstiel incision, the Joel-Cohen technique was reported to have reduced blood loss and shorter mean operating time (250 versus 400 ml, and 20 versus 28 minutes) (49-54).

M.A. Pelosi developed a technique, combining a Pfannenstiel incision through the skin and fascia with blunt separation of the rectus muscles (Figure 1.2) (55). The subcutaneous tissue and the fascia are opened by electrocautery. After the peritoneum is perforated with a finger, the full thickness of the abdominal wall (skin, subcutaneous tissue, fascia, muscles, peritoneum) is stretched by both hands to the size of the skin incision. The traditional separation of the bladder peritoneum ("bladder flap") is not performed (56). The lower segment is sharply incised in the midline to the amniotic sac, and extended laterally by the index fingers or a pair of scissors. After delivering the child, the placenta is removed by controlled cord traction and the uterus is then closed in one layer with a continuous locking suture. Parietal and visceral peritoneum are not closed; the fascia is reapproximated with a

continuous nonlocking absorbable suture, and the skin with staples. In a study comparing the Pelosi technique with a Pfannenstiel, postoperative fever was 2.0 % and 9.8% respectively (RR 4.9; $CI_{95\%}$ 1.2-20.9) The mean operating time was 27 minutes in the Pelosi group versus 45 minutes in the traditional group (P = 0.01) (57). Another transverse approach has been described: the Maylard incision. A wide transverse suprapubic interiliac incision, which involves cutting the rectus muscles and ligating the inferior epigastric artery, provides good access in short obese women (Figure 1.2) (31).

1.3.3 Antibiotic prophylaxis

A Cochrane review of 81 trials examined the effect of prophylactic antibiotics with elective and non-elective caesarean delivery. Use of antibiotic prophylaxis substantially reduces the incidence of postoperative endometritis across elective and non-elective caesarean patients ((RR 0.38; $CI_{95\%}$ 0.22-0.64) and (RR 0.39; $CI_{95\%}$ 0.34-0.46) respectively). Wound infections are also reduced for elective and non-elective caesarean section ((RR 0.73; $CI_{95\%}$ 0.53-0.99) and (RR 0.36; $CI_{95\%}$ 0.26-0.51) respectively) (58). Ampicillin (2 grams i.v.) and first generation cephalosporins (1 gram i.v.) were similarly effective in reducing postoperative endometritis and there was no added benefit in utilising a multiple dose regimen. The optimal timing of administration (immediately after the cord is clamped versus pre-operative) could not be determined. A single dose of ampicillin or cefazolin is recommended for infection prophylaxis at caesarean section (59).

1.4 Maternal and neonatal risks due to caesarean section

1.4.1 Maternal mortality

Until the 20th century, the prohibitively high rates of maternal mortality after caesarean section limited its use as a surgical procedure. However, as technical advances in the procedure became available, along with techniques of antisepsis, maternal mortality rates fell rapidly. Continuing advances in anaesthesia, the introduction of intravenous fluid and blood replacement, and the use of antibiotics have further contributed to a safer caesarean birth. In 1928, German statistics showed a caesarean section mortality rate of 71‰ (60). In 1938, a caesarean section mortality rate of 52‰ was registered in the Netherlands, but by 1960 this rate was as low as 3.3‰ (61;62). Between 1966-71, 1972-78 and 1979-85 the caesarean section mortality rates further declined to 2.3‰, 0.7‰ and 0.4‰ respectively (63). In the USA, the following rates were registered: in Rhode Island, using data from 1965-73, the

caesarean delivery mortality rate was 0.3‰; in Georgia, using data from 1975-76, the caesarean delivery mortality rate was 0.6‰ (64;65); in Massachusetts, between 1976-84, the frequency of deaths, being directly related to caesarean section, was 0.06‰, with an overall mortality rate of caesarean section of 0.22‰ (66). In a confidential enquiry in the Netherlands into maternal deaths between 1983-92, a direct risk of dying from caesarean section of 0.13‰ was reported. After adding the associated risk of, for example pre-eclampsia and thrombosis, the estimated case fatality rate was 0.28‰ (67). In Washington state, between 1987-96, the pregnancy-related mortality for primiparas who delivered by caesarean section was 0.01‰ (68).

The risk of maternal mortality from caesarean section is, however, still higher than from vaginal birth. From Cape Town, between 1975-86, a sevenfold relative risk of maternal mortality associated with caesarean section was reported, compared to that of vaginal birth (RR 6.7; $CI_{95\%}$ 4.4-9.9). This risk decreased to five when women with medical or life-threatening complications were excluded (RR 4.7; $CI_{95\%}$ 2.0-9.9) (69). In the United Kingdom, between 1994-96, the case fatality rate of elective caesarean section was almost three times that of vaginal birth (OR 2.85; $CI_{95\%}$ 1.72-4.70) and for emergency caesarean section this was almost nine times (OR 8.84; $CI_{95\%}$ 5.60-13.94) (70). Calculated from the confidential enquiry in the Netherlands (1983-92), mortality related to caesarean section was three (direct risk) to sevenfold higher than vaginal delivery. The causes of death were mostly postoperative sepsis, haemorrhage or pulmonary embolism. The case fatality rate, directly associated with anaesthesia was about one per 25,000 caesarean sections (67). A study by Hawkins et al. reported data on the method of anaesthesia and its relation to maternal mortality. The case fatality rate with general anaesthesia was higher than with regional techniques, and was estimated at 3.2 and 0.19 per 100,000 live births respectively (71).

Mortality related to caesarean section is higher in low-income countries, but actual data are scarce. In a review, combining data on 8,446 caesarean sections from Tanzania, Malawi and Nigeria between 1971-84, the case fatality rate was 18‰ (range 6‰-50‰) (72-74). In a maternal mortality audit in the Midlands province of Zimbabwe, the case fatality rate for caesarean section was 17 times higher than the case fatality rate for vaginal delivery (75). In this audit, the maternal mortality rates after caesarean section and vaginal birth were 5.1‰ and 0.3‰ respectively. In Malawi, in a prospective observational study of 8,070 caesarean sections, Fenton et al. reported a maternal mortality rate of 10.5‰ (n=85). Obstructed labour was the major indication for caesarean section (63%). Ruptured uterus, maternal haemorrhage, sepsis, anaemia and general anaesthesia were associated with

increased maternal mortality. Without uterine rupture (n=7,737), the maternal mortality rate was 6.5‰; with a ruptured uterus (n=333) this was 110‰ (76).

1.4.2 Short-term maternal morbidity

The major morbidity related to caesarean section is due to infection, haemorrhage, injury to pelvic organs and thrombo-embolic disorders. Infectious complications following caesarean section include fever, wound infection, endometritis and urinary tract infection. Without antibiotic prophylaxis, the incidence of endometritis ranges from 25 to 85% and wound infection is reported to be 25%. Prophylactic antibiotics reduce the overall rate of infection by approximately 60% (58). In a retrospective study by van Ham et al., wound haematoma, wound infection and cystitis occurred after respectively 3.5%, 3% and 3% of caesarean deliveries; major infection of the pelvis and sepsis were reported after 1.5% and 0.3% of caesarean sections; bloodloss of more than 1,500 ml occurred in 2.4% of women; re-laparotomy was indicated in 1.6% of women; and postoperative ileus was managed conservatively in 1.5% of caesarean sections (77). In a study by Petitti et al., 1-2% of all patients delivering by caesarean section required blood transfusion (78). Urinary tract injuries are uncommon; bladder lesions were reported between 1.4 to 8 per 1,000 caesarean sections, and ureteric injuries between 0.27 to 0.9 per 1,000 caesarean sections (77;79;80). In these studies, scar tissue from a previous caesarean section increased the risk of bladder injury.

In low income countries, caesarean sections are performed by general practitioners (not by obstetricians), anaesthesia is given by specially trained nurses, and the expectant mothers are in a less favourable condition in terms of nutrition, anaemia and infection. Especially the HIV/AIDS epidemic increases pregnancy-related mortality and morbidity (81). De Muylder, in 1985-86, investigated caesarean morbidity in Zimbabwe in 643 women. His data were collected before the awareness and full outbreak of the HIV epidemic. Sepsis, postoperative endometritis, urinary tract infection and wound infection occurred in 5%, 11%, 4.5% and 6.1% of women respectively. Febrile morbidity was present in nearly one third of patients. Re-laparotomy was necessary in 1.6% of women for various reasons like sepsis, haemorrhage or burst abdomen. Haemorrhage was a major problem due to anaemia; 30% of women were transfused! Bladder injuries occurred in 1.7% of caesarean sections (82). When elective or early labour caesarean section was compared to emergency caesarean section, the complication rates were lower for elective procedures, both in high income and low income countries (77;82;83). There is no doubt, however, that in low income countries caesarean

section, elective or emergency, remains a major operation and is associated with a much higher morbidity than in Western countries.

Deep venous thrombosis of the lower leg (DVT) is a rare event and only large study populations have enough power to show a significant difference in DVT incidence between caesarean section and vaginal birth. Because DVT can be complicated by pulmonary embolism, which is still a major contributor to maternal mortality in association with caesarean section, DVT in the lower leg should be considered as major morbidity (84). In one study, involving 395,335 women with live births, the incidence of DVT after caesarean section was 178 per 100,000 births compared to 65 per 100,000 after vaginal birth (85). In another series of 268,525 births over an 11 year period, pulmonary embolism was strongly associated with caesarean section (19 of 36,479 caesarean sections compared to 4 of 232,032 vaginal deliveries) (86). In a meta-analysis DiMatteo et al. described a psychological side effect of caesarean section, which could be classified as caesarean morbidity. Caesarean mothers, compared to women who delivered vaginally, expressed less satisfaction with their delivery, short-term as well as long-term. Maybe as a result, breast-feeding failed more often in women who underwent caesarean section (87).

1.4.3 Long-term maternal morbidity

1.4.3.1 Fertility

There is a complex relationship between caesarean section and subfertility. Murphy et al. investigated 14,541 pregnant women and found that a history of previous caesarean section was associated with an increased risk of taking more than one year to conceive from the time of planning a pregnancy (OR 1.5; $CI_{95\%}$ 1.1-2.1). On the other hand, nulliparous women with a history of subfertility were at increased risk of delivery by caesarean section. After three years of subfertility, the odds ratio was 2.3 ($CI_{95\%}$1.6 - 3.3). Subfertility may both precede and be a consequence of caesarean section (88). It was not possible to draw a more specific conclusion from this study, due to the fact that the indications for caesarean section were not examined.

1.4.3.2 Placenta praevia and placenta accreta

Caesarean section increases the risk of abnormal placentation in future pregnancies. In a large meta-analysis by Ananth et al. (3.7 million women), the reported baseline frequency of placenta praevia was 1 in 200 deliveries (range 0.28-2%). Women with at least one previous

caesarean delivery were at 2.6 times greater risk of development of placenta praevia in subsequent pregnancy and this risk increased with the number of caesarean births ($CI_{95\%}$ 2.3 - 3.0) (89). Lydon-Rochelle et al. selected primiparous women with one previous caesarean section, and adjusted for maternal age, leading to a frequency of placenta praevia at second birth of 0.52%; a 1.4 times greater risk compared to women with one previous vaginal birth ($CI_{95\%}$ 1.1 - 1.6) (90). Studies by McMahon et al. and Gilliam et al. showed that the likelihood of placenta praevia was related to both parity and the number of previous caesarean sections. The odds ratio for the likelihood of placenta praevia for a primiparous woman with one caesarean section was 1.28 ($CI_{95\%}$ 0.82 - 1.99); for a woman with four or more deliveries and one previous caesarean section the OR was 1.72 ($CI_{95\%}$ 1.12 -2.64); and for a para 3 with three previous caesarean sections the OR was 4.09 ($CI_{95\%}$ 1.53 -10.96) (91;92). In two studies (Clark et al. and Chattopadhyay et al.), patients presenting with placenta praevia and an unscarred uterus had a 4.5-5% risk of placenta accreta. With a placenta praevia and one previous caesarean section, the risk of placenta accreta was 24-38%; this risk continued to increase to 59-67% with a placenta praevia after two or more previous caesarean sections (93;94). The increased rate of placenta praevia and accreta is of concern, due to the inherent risks of these disorders. For example, serious haemorrhage can lead to severe morbidity and even mortality, illustrated by Kastner et al. in a retrospective study, describing 47 peripartum hysterectomies; almost 50% was indicated because of placenta accreta (95).

1.4.3.3 Uterine rupture

It is essential to distinguish between a dehiscence of the uterine wall (visceral peritoneum intact) and a complete rupture of all layers with or without partial fetal extrusion in the abdominal cavity. Unfortunately, in many studies, dehiscence and uterine rupture are often commingled, and indistinguishable. Unless indicated differently, in this thesis uterine rupture is defined as: *separation of the entire thickness of the uterine wall in conjunction with caesarean section for suspected fetal distress, extrusion of any portion of the fetal-placental unit, intraperitoneal or vaginal haemorrhage, need for a hysterectomy, or bladder injury* (96;97). The risk of uterine rupture depends on the type and location of the previous incision in the uterus. During labour, the rates described by scar type are: 4 - 9% for a classical uterine incision; 4 - 9% for a T-shaped incision; 1 - 7% for a low vertical incision; and 0.2 - 1.5% for a low transverse incision (32;97-100). Rupture usually occurs during labour, but may occur antepartum. After previous lower segment caesarean section, the risk of antepartum rupture

was estimated 1.6 per 1,000 (101); after classical previous caesarean section, the antepartum dehiscence was reported to be as high as 6 - 9% (33;102).

Fetal bradycardia is the most common clinical manifestation of uterine rupture, but variable or late decelerations can also occur. More than 90% of uterine ruptures in Western countries are associated with previous caesarean delivery. Dehiscence of a previous caesarean scar is much less traumatic and, in a study by Kieser et al., maternal and perinatal outcome was almost without long-term sequelae (103). Complete extrusion of the foetus represents the worst spectrum of uterine rupture. In this subgroup of patients, Leung et al. reported 14% perinatal death, and 68% of neonates had an umbilical artery pH < 7.00 (104). Chauhan et al. reviewed the literature for morbidity and mortality rates that are related to uterine rupture during trial of vaginal labour. Per 1,000 TOLs, the following complication rates were identified: uterine rupture 6.2‰, hysterectomy 0.9‰, genitourinary injury 0.8‰, blood transfusion 1.8‰, umbilical artery pH < 7.00 1.5‰, and perinatal death 0.4‰ (97). Even maternal mortality can occur due to postoperative complications, initiated by severe bleeding. In the above review, one death was identified to be related to uterine rupture during TOL and described by Farmer et al (105).

1.4.4 Fetal risks

There are also fetal risks from caesarean section, even though the procedure is usually performed for the benefit of the foetus. Nowadays, the dangers to the neonate from general as well as from spinal anaesthesia are nowadays very limited. Datta et al. demonstrated that during general anaesthesia, induction-to-delivery intervals of more than 8 minutes and uterine incision-to-delivery intervals of more than 3 minutes were associated with only a minor change in umbilical artery pH (pH 7.22 versus pH 7.31). Also after receiving spinal anaesthesia, the prolongation of uterine incision-to-delivery interval by more than 3 minutes had only a slight influence on the umbilical artery pH (pH 7.18 versus 7.30). The time between the actual spinal injection and delivery of the baby was of no influence on the umbilical artery pH (106). The surgeon, however, seems to be more harmful to the neonate than is often thought, which is shown in a study by Smith et al.; fetal laceration injuries were recorded in 6% of caesarean sections when the presentation was breech or transverse; after vertex presentation and caesarean section, 1.4% of neonates were recorded to have laceration injuries. Only 6% of the injuries were documented by the surgeon in the operative report of the caesarean section; the other lacerations were noted by paediatric nurses or paediatricians (107). In a study by Hook et al., transient tachypnoea of the new-born, often only a "wet

lung", occurred in 6% of neonates after an elective caesarean section (108). Graziosi et al. claim a relative risk of 0.14 (CI $_{95\%}$ 0.03 - 0.64) for respiratory morbidity after delivery by elective caesarean section with a gestational age of 39-42 weeks, compared to 37-38 weeks (109). A retrospective study from 1988-1992 of 179,701 babies in the North of England showed that those born at 37-38 weeks were 120 times more likely to receive ventilatory support for surfactant deficiency, than those born at 39-41 weeks, especially if subjected to pre-labour caesarean delivery (110). Moreover, in a study comparing elective caesarean section (n=1,889) with vaginal delivery (n=21,017), neonates which were delivered by elective caesarean section were almost 5 times more likely to develop pulmonary hypertension than those which were delivered vaginally (0.37% vs 0.08%, OR 4.6; $CI_{95\%}$ 1.9 - 11) (111). Therefore, routine elective caesarean section should be performed from 39 weeks onwards. It is not clear whether this policy will also reduce the increased risk of pulmonary hypertension.

1.5 Caesarean section world wide

1.5.1 Caesarean section rates

Before 1965, caesarean birth rates in most Western countries remained stable between 1.5% and 5% of all births (112). In the 1970s, rates began to rise; gradually in the Netherlands and Ireland, more steeply in other Western countries (Figure 1.4). In the Netherlands, the caesarean section rate rose from 0.52% in 1938 to 6% in 1985 and 13.5% in 2001 (61;63;113-116). Figure 1.4 also shows that between 1970 and 2000, the rates of caesarean delivery in the USA of America and Canada rose from 5% to more than 15%, with a peak in 1988, followed by a short period of decrease. Recent data, however, show again an increasing trend, resulting in a caesarean section rate in the USA of 22.9% in 2000 (113;117;118). In England, the rate of caesarean delivery has climbed steadily since the second world war. During the 1990s, the rate has increased more rapidly, reaching 18% by 1997 and 22% in 2001 (119-121). The rise of caesarean section rates has not been limited to Europe and North-America. In the 1990s, Latin American countries were reported to have high national caesarean section rates, e.g. Cuba 23%, Mexico 31%, Argentina 25%, Brazil 32% and Chile 40% (122). Also from Asia, reports mention a rise in caesarean sections; from Mumbai, India, institutional caesarean section rates between 1957-98 increased from 1.9 to 16% (123); an urban population survey between 1997-99 in Madras City, India, identified a caesarean section rate of 32.6% and in the Indian private sector 47% of births were by caesarean section (124).

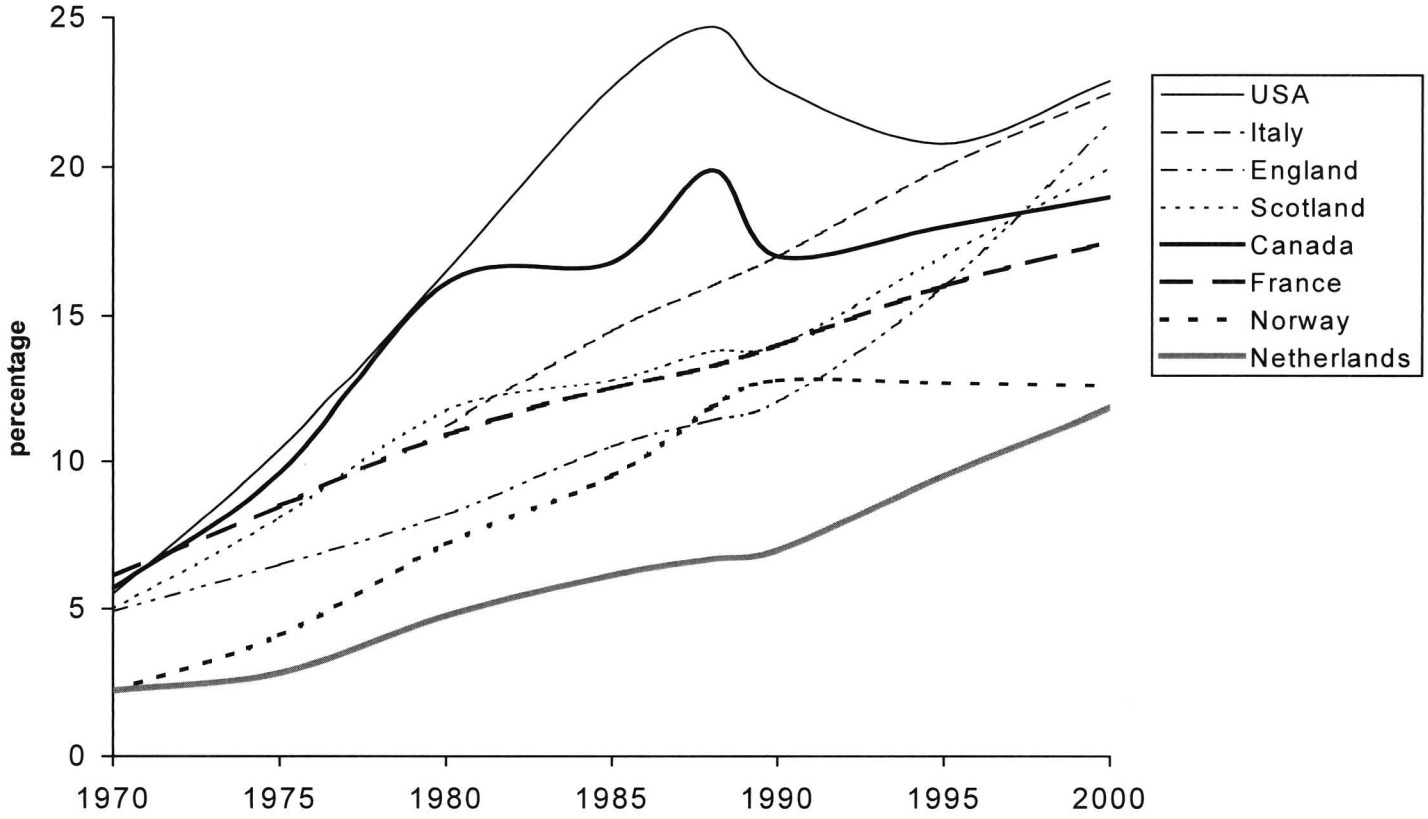

Figure 1.4 *International caesarean section rates (61;3;113-116;132;133)*

However, in 1997 in neighbouring Nepal, with very poor access to health care, the estimated population based rate of caesarean section was 2.3% in urban areas and 0.2% in rural areas (125). In Hong Kong from 1987-99, the overall annual caesarean section rate rose steadily from 16.6 to 27.4%. The private sector contributed most to this increase; 43.4% of births was by caesarean section (126). In Shantou, China, hospital based caesarean section rates increased from 11 to 30% between 1990-97 (127). In a district survey in the Minhang District of Shanghai, China, the caesarean section rates from 1960 to 1993 were calculated; the proportion of infants born by caesarean section increased from 4.7 % to 22.5% (128).
Caesarean section rates from sub-Saharan Africa are in shrill contrast with data from the Western world. Reviewing studies between 1970 and 2000, Dumont et al. observed a caesarean section rate of 1.3% in West-Africa (129). At two different time intervals 1991-93 and 1996-99, demographic data from eight countries were analysed by Buekens et al.; Burkina Faso, Madagascar, Niger and Zambia had caesarean section rates lower than 2%; Cameroon, Ghana and Tanzania had caesarean section rates between 2% and 5%; Kenya had a caesarean section rate of around 6%. Between the different time intervals, the number of caesarean sections even decreased in Ghana, Madagascar, Niger, Tanzania and Zambia (130). In 1999, the population caesarean section rate in Zimbabwe was 3.1% (131).

On the one hand, there has been public concern for over 30 years about the increasing caesarean section rates world wide; but on the other hand in low income countries the caesarean section rate is often still too low to guarantee safe obstetric care. The UNICEF, WHO, and UNFPA guidelines (1992) recommend that a minimum of 5% of deliveries are by caesarean section (134;135). Several studies confirmed that there is a lower bench-mark of a minimal number of needed caesarean sections in order to save lives of pregnant women; a minimal need was reported to be 5.4% (range 3.6 - 6.5%) by Dumont et al., 2.3% (range 1.3 - 4.7%) by Ronsmans et al. and 1 to 2% by De Brouwere et al. (129;136;137). However, it seems far more difficult to identify the cut-off point for the right upper number of caesarean sections (114;135;136). The WHO/UNFPA/UNICEF guidelines were agreed upon in a compromise between countries with probably too high caesarean section rates, and low income countries with far too low caesarean section rates, The upper bench-mark of needed caesarean sections has arbitrarily been set at 10-15%. This recommendation on maximum caesarean section rates originate from a conference in 1985 on appropriate technology for birth, held at Fortaleza, Brazil. This conference, organised by regional offices of the WHO from Europe and the Americas and the Pan American Health Organisation, was attended by over 50 participating groups representing midwifery, obstetrics, paediatrics, epidemiology,

sociology, psychology, economics, health administration, and mothers (138). According to the evidence at that moment, there were no additional perinatal or maternal health benefits to be expected from a caesarean section rate of more than 10 - 15%. It was stated that higher rates indicate over-utilisation of the procedure.

1.5.2 Determinants of increasing caesarean section rates

Perinatal mortality rates have continued to decline since the 1950s and it has been argued by Bottoms et al. that this was due to an increased caesarean section rate, improving the prognosis for the foetus (112). In Dublin's National Maternity Hospital, however, the caesarean section rate remained stable below 5% between 1965 and 1980, but the perinatal mortality made the same dramatic fall as in the Unites States from 42 to 16.8 per 1,000 infants born. The improvement of neonatal care has contributed to this reduced perinatal mortality, not the expansion of caesarean section rates (139).

The relative safety of caesarean section as discussed in section 1.4.1 makes physicians less hesitant to perform the procedure. The common belief, that most cases of cerebral palsy were the result of intrapartum asphyxia or vaginal delivery trauma, led to an increase in caesarean sections, out of fear for malpractice litigation (140). Nevertheless, critical assessment of long-term neonatal outcomes have shown that only a small minority of cases of cerebral palsy can be attributed to intrapartum events (141;142). Because of the perceived safety of the caesarean operation by doctors and the public, even factors like convenience of delivery time, socio-economic status and type of medical insurance influenced caesarean section rates (143-145). In addition, deliveries predominantly supervised by doctors have higher caesarean section rates (146). Deliveries with the same lay support person available during the entire labour reported lower intervention and caesarean section rates and higher satisfaction. Due to more and more supervision of birth by doctors, caesarean section rates are rising (147).

Have changes in population characteristics contributed to the observed increases in caesarean section rates? For example, women are delaying childbirth and have fewer children. In the Netherlands, the average age for a woman to have her first child has been postponed from 25 years in 1975 to 29 years in 2001. Nowadays, one in eight women is 35 years of age or older at the time of her first born (148). The same trend is seen in Northern-America and other European countries (112;114;140). Older women are more likely to have chronic medical conditions and pregnancy complications, tend to have longer labour and are more often diagnosed with "failure to progress". Practitioners' attitudes toward pregnancy in older

women may also contribute to the increase of caesarean sections (140). Shifts in the age of the population, however, have shown to account for only a small part of the increase in caesarean section rate. Age explained 1% and 17% of the caesarean increase in studies from Canada and the USA respectively (149;150).

An early and consistent observation has been that over 70% of caesarean sections can be attributed to the following four indications: dystocia (failure to progress during labour), fetal distress, breech presentation and repeat caesarean section (112;114;140;149;151;152).

Dystocia is the most frequent indication for caesarean section. It accounts for 33% of the increase in caesarean section rates (112). It includes cephalopelvic disproportion (CPD) and inefficient uterine contractions. Absolute cephalopelvic disproportion is these days quite rare. Dystocia has become a subjective diagnosis and depends more on the characteristics of the individual clinician than on the characteristics of the woman (153). Central to the management of presumed dystocia is augmentation of labour, when uterine contractions do not result in dilatation of the cervix. The guidelines of the partograph and the principles of the active management of labour have been brought up as tools to improve the diagnosis (154).

Fetal distress: electronic fetal monitoring was widely accepted in the USA in the late 1960s, well before evidence from randomised controlled trials (RCT) had demonstrated either efficacy or safety. A Cochrane review, including 9 RCTs, compared continuous electronic fetal heart rate monitoring (EFM) to intermittent auscultation. It identified no better neonatal outcome after EFM, but the rate of caesarean section (RR 1.41; $CI_{95\%}$ 1.23-1.61) and operative vaginal delivery increased (RR 1.20; $CI_{95\%}$ 1.11-1.30) (155). The introduction of continuous EFM during labour has resulted in a more frequent diagnosis of fetal distress, leading to more caesarean sections. Fetal scalp blood sampling reduces the false-positive rate of fetal distress associated with continuous EFM (156).

Breech presentation: approximately 3.5% of pregnancies present at term with a foetus in breech presentation. Changes in management of breech presentation have contributed to the increasing rates of caesarean section. Especially, after the publication of the term breech trial by Hannah et al. in 2000 the majority of women in high income countries with a breech presentation at term are delivered by caesarean section (157).

Repeat caesarean section is responsible for 23% of the increase in caesarean sections (112). The influence of previous caesarean sections on the overall caesarean section rate is most clearly illustrated by comparing women with a previous caesarean section with nulliparous women. The risk of caesarean section after a trial of labour is higher in women who have had a previous caesarean section compared to nulliparous women. Women who had had a

previous caesarean section for failure to progress were four times more likely to have a caesarean section as nulliparous women (OR 4.5; $CI_{95\%}$ 3.6-5.5). Women who had had a previous caesarean section for fetal distress were twice as likely to have a repeat caesarean section compared to nulliparous women (OR 2.2; $CI_{95\%}$ 1.6-2.9), but women with a previous caesarean section for breech presentation had a risk of caesarean section similar to that of nulliparous women (OR 0.95; $CI_{95\%}$ 0.7-1.3) (158). In a population, an increase in the number of women who have had a previous caesarean section will always result in a disproportionate increase in the overall caesarean section rate. The influence of previous caesarean section on the total caesarean section rate will be reinforced by a high elective repeat caesarean section rate. Especially, in the USA a policy adhering to Cragin's dictum of "once a caesarean, always a caesarean" resulted in low trial of labour rates and low vaginal birth after caesarean rates (159). Nowadays, in the USA and England about one third of caesarean sections are repeat procedures (114;140).

1.6 Vaginal birth after caesarean

1.6.1 Introduction

When Cragin addressed the medical community of New York in 1916, in an attempt to convince them that primary caesarean section should be avoided unless absolutely essential, he could not have predicted that his recommendation of "once a cesarean, always a cesarean" would be so universally accepted by American obstetricians in the decades thereafter. Cragin's plea to minimise primary caesarean section rates has been largely forgotten (159). Certainly, during Cragin's time his recommendation on repeat caesarean section was not unreasonable. The vast majority of caesarean sections were for major cephalopelvic disproportion, using a corporal uterine incision instead of the lower uterine segment, which is the standard today.

In the United Kingdom and continental Europe, Kehrer's transverse lower segment incision became popular and was modified by Munro Kerr (section 1.2) (21;27). Uterine rupture gradually became far less common with this incision than with the classic approach. In 1957, Dewhurst, reviewing the literature at that time, concluded that "an attempt at vaginal delivery after previous lower segment caesarean section can be made with a considerable degree of safety". During trial of labour, he reported uterine rupture rates after classical caesarean section between 4.7 - 8.9%, and after lower segment caesarean section between 0.8 - 1.2% (160). Among American obstetricians, the risk of uterine rupture received far greater

attention than the risk of repeat caesarean section. In addition, lower segment caesarean section was frequently performed by a vertical incision, which often entered the upper segment. In 1950, elective repeat caesarean section had become established practice in North America (161).

Because of the increasing caesarean section rate world wide and the parallel increase of repeat caesarean sections, the issue of vaginal birth after caesarean became more and more relevant (see Figure 1.4). Countries with high caesarean section rates also have a high proportion of repeat caesarean sections; e.g. in 1978, 98.9% of women with a previous caesarean section in the USA were delivered by repeat caesarean section (162). Traditionally, Europe had a more liberal policy on vaginal birth after caesarean section. In the 1980s, VBAC rates were 56% in Norway, 39% in Scotland, and 40% in Sweden (163). No national data for the Netherlands on VBAC were (and are still not) available on a routine basis. Several hospital based studies by Roumen, Jansen and van Vugt reported VBAC rates ranging from 57 to 62%, which suggests that also among Dutch obstetricians trial of labour after previous caesarean section has been the policy for many years (7;164;165).

With caesarean section rates of 20% or even 25%, it is more obvious than ever that a liberal policy on vaginal birth after caesarean section can contribute to a lower overall caesarean section rate. Nowadays, in the USA 37% and in England 29% of caesarean sections are repeat procedures (114;140). It is not surprising that most studies on vaginal birth after caesarean section stem from the USA. Elective repeat caesarean was the standard, and pioneer work on VBAC by Riva et al. and others in the seventies and eighties was often heavily criticised by "elective repeat believers" (Table 1.1) (166-173).

In this thesis, the definitions on "vaginal birth after caesarean" (VBAC) and "success rate" of trial of labour are used as formulated by the American College of Obstetricians and Gynecologists (ACOG) in 1996; to compare results of different studies, VBAC rates should contain all previous caesarean sections in the denominator, including even repeat caesarean sections for placenta praevia (174).

*VBAC Rate = (Number of VBACs/Number of **all** women with previous caesarean sections) x 100*

Success Rate = (Number of VBACs/Number of women who had a trial of labour after caesarean section) x 100

Table 1.1 *Vaginal birth after caesarean section and its outcome in Western and African countries*

Reference	Country + Study design	n	VBAC Rate[1] (%)	Success Rate[2] (%)	Uterine rupture (%)	PNM/1,000	MMR	Other remarks
Riva, 1961 (166)	USA, retrospective	214	74	78	0.9	0	0	
van Vugt, 1966 (7)	the Netherlands, retrospective	214	57	87	1.4	32	0	
Merrill, 1978 (167)	USA, retrospective	634	41	49	0.6	0	0	
Saldana, 1979 (168)	USA, retrospective	226	26	40	0	0	0	
Meier, 1982 (169)	USA, retrospective	226	?	85	0.4	0	0	
Gellman, 1983 (170)	USA, retrospective	220	35	63	0	0	0	
Martin, 1983 (171)	USA, retrospective	717	14	62	0.4	0	0	
Graham, 1984 (172)	USA, retrospective	1,551	11	69	0	0	0	
Boucher, 1984 (173)	USA, retrospective	852	32	80	2.6	0	0	
Lavin, 1982 (180)	Review	4,729	45	67	0.7	0.93, due to ruptured uterus in labour	0	Success rate after CPD 33%
De Jong, 1987 (230)	South-Africa, prospective cohort, non randomised	212	26	39	0.5	4.7 one intra uterine death before labour	0	
Flamm, 1988 (222)	USA, prospective non-randomised	4,929	27	74	0.2 one hysterectomy after uterine rupture	0	0	Success rate after: CPD 65%, Breech 88%, Fetal distress 71%
Jansen, 1989 (165)	the Netherlands, retrospective	462	62	83	0.2	6.5 in total study population, not related to labour	0	Success rate after CPD 65%
Roumen, 1989 (164)	the Netherlands, retrospective	249	61	79	0.4 after TOL with oxytocin	3.3 after VBAC not related to labour	0	after 2 x CS (n=15): VBAC 27%, Success rate 67% VBAC less: blood transfusion p<0.025, fever p<0.005

To be continued

Table 1.1 *continued*

Reference	Country + Study design	n	VBAC Rate[1] (%)	Success Rate[2] (%)	Uterine rupture (%)	PNM/1,000	MMR	Other remarks
Flamm, 1990 (175). Flamm 1988 included	USA, prospective non-randomised	15,098	28	75	0.17 after TOL overall 0.36 with oxytocin 0.1 without oxytocin Not significant	0.17 due to ruptured uterus in labour	21/100,000 2 maternal deaths after ERCS	Success rate after: CPD 65% Breech 89% Fetal distress 73%
Rosen, 1991 (98)	USA, meta-analysis	17,564	17 - 40	40 - 74	5.7 after failed TOL OR 2.8; $CI_{95\%}$ 1.4 - 5.4 0.7 after VBAC OR 0.7; $CI_{95\%}$ 0.4-1.2 0.5 after ERCS (OR 1.0)	1.2 after TOL OR 0.8; $CI_{95\%}$ 0.3-2.1 1.4 after ERCS excluding antenatal deaths, < 750 g, congenital anomalies	28/100,000 after TOL 24/100,000 after ERCS	risk of uterine rupture not related to: oxytocin use during trial of labour recurrent indication for previous caesarean section Failed TOL compared to ERCS: maternal fever, 22.5 vs 4.5% (OR 2.0; $CI_{95\%}$ 1.7-2.5)
Mock, 1991 (223)	Ghana, retrospective	220	50	66	0.5	64	454/100,000	
Van Roosmalen, 1991 (224)	Tanzania, retrospective	134	65	65	6.7	97	0	
Van der Wijden, 1993 (225)	Lesotho, retrospective	74	56	69	0	27	0	
Flamm, 1994 (226)	USA, prospective non-randomised	7,229	52	75	0.8 one hysterectomy after uterine rupture	0	0	TOL compared to ERCS (p=0.0001): hospital stay, 57 vs 87 hours postpartum transfusion, 0,72 vs 1.72% fever, 12.7 vs 16.4%
Miller, 1994 (177)	USA, Retrospective	17,322	60	82	0.6 after 1 x CS 1.7 after 2 or more CS OR 3.06; $CI_{95\%}$ 2.0-4.8	0.18 after 1 x CS 0.63 after 2 x CS due to ruptured uterus in labour	7.9/100,000 1 maternal death related to uterine rupture	success rate after: 1 x CS 83% 2 x CS 75%
van der Walt, 1994 (231)	South-Africa, retrospective, 1 x CS	189	45	57	2.1	10.6 two intra uterine death before labour	529/100,000 one maternal death after uterine rupture	

To be continued

Table 1.1 *continued*

Reference	Country + Study design	n	VBAC Rate[1] (%)	Success Rate[2] (%)	Uterine rupture (%)	PNM/1,000	MMR	Other remarks
McMahon, 1996 (189)	Canada, retrospective, 1 x CS,	6,138	32	60	major compl. (uterine rupture + hysterectomy + operative injury) 1.6 after TOL 0.8 after ERCS OR 1.8; $CI_{95\%}$ 1.1-3.0	9.0 after TOL 5.0 after ERCS p=0.09		Failed TOL compared to VBAC: Major complication 3.8 vs 0.2% (OR 5.1; $CI_{95\%}$ 2.8-9.4) Minor complications (fever, transfusion, wound infection) 9.3 vs 4.3% (OR 1.5; $CI_{95\%}$ 1.3-1.7)
Boulvain, 1997 (232)	meta-analysis, sub-Saharan Africa	3,288 based on 14 studies	47	71	2.1	58 nearly 50% due to lethal formations or prematurity	188/100,000	PNM and MMR based on 17 studies, 4,254 women
Spaans, 1997 (227)	Zimbabwe, retrospective	281	44	44	0.4	42.7	357/100,000	
Rageth, 1999 (176)	Switzerland, retrospective cohort	29,046	45	74	0.4 after TOL 0.19 after ERCS RR 2.07; $CI_{95\%}$ 1.3-3.3	1.9 after TOL 0.9 after ERCS RR 2.14; $CI_{95\%}$ 1.07 - 4.27 > 28 weeks excluding lethal anomalies	3/100,000 one maternal death, not specified	TOL compared to ERCS hysterectomy (RR 0.36; $CI_{95\%}$ 0.23-0.56) thrombo-embolic compl. (RR 0.52 $CI_{95\%}$ 0.34-0.78) Induction increased uterine rupture (RR 1.74; $CI_{95\%}$ 1.13-2.70)
Zelopp, 1999 (199)	USA, case-control, 1 x CS	2,774	na	na	0.7 after spontaneous labour 2.3 after induction p=0.001 number of ruptures: 29	0 only calculated for uterine rupture	0 6 hysterectomies after uterine rupture	2,214 women spontaneous labour 550 women induced with oxytocin/PGE_2 Induction with oxytocin increased uterine rupture (OR 4.6; $CI_{95\%}$ 1.5-14.1)
Mozurkewich, 2000 (99)	meta-analysis, review	47,682	44	72	0.4 after TOL 0.2 after ERCS OR 2.10; $CI_{95\%}$ 1.45-3.05	2.0 after TOL 1.0 after ERCS OR 2.05, $CI_{95\%}$ 1.17-3.57 excluding lethal anomalies and death before labour	10/100,000 3 in TOL group	TOL compared to ERCS: febrile morbidity (OR 0.70; $CI_{95\%}$ 0.64-0.77) blood transfusion (OR 0.57; $CI_{95\%}$ 0.42-0.76) hysterectomy (OR 0.39;$CI_{95\%}$ 0.27-0.57)

To be continued

Table 1.1 *continued*

Reference	Country + Study design	n	VBAC Rate[1] (%)	Success Rate[2] (%)	Uterine rupture (%)	PNM/1,000	MMR	Other remarks
Appleton, 2000 (228)	Australia, retrospective, all prev. CS included	21,452	25	?	0.34 (estimated for TOL group) number of ruptures: 26	0.5 only reported in relation to uterine rupture, no overall PNM	0	risk of hysterectomy due to uterine rupture 0.05%
Bais, 2001 (229)	the Netherlands, retrospective cohort	252	56	77	0.5 after TOL	12 after TOL, not related to labour	0	
Hibbard, 2001 (190)	USA, retrospective, 2 x CS allowed	2,450	37	69	0 after ERCS 0.2 after VBAC 1.8 after failed TOL OR 8,9; $CI_{95\%}$ 1.9-42	0.8 one perinatal death during uterine rupture	0	hysterectomy 0.5%. Failed TOL compared to VBAC: endometritis, 18.5 vs 3.4% (OR 6.4; $CI_{95\%}$ 4.1-9.8)
Lydon-Rochelle, 2001 (101)	USA retrospective cohort Para I, 1 x CS	20,095	?	?	0.16 after ERCS 0.52 spontaneous TOL[1] 0.77 ind. without PGE_2[2] 2.45 induc. with PGE_2[3]	?	?	[1] RR 3..3; $CI_{95\%}$ 1.8-6.0 [2] RR 4.9; $CI_{95\%}$ 2.4-9.7 [3] RR 15.6; $CI_{95\%}$ 8.1-30.0
Thistle, 2001 (233)	Zimbabwe, retrospective	177	66	75	0	0	0	
Yap, 2001(193)	USA, retrospective chart review of 21 ruptures	38,027	40	65	0.8 after prev. CS 0.01 without prev. CS	2 perinatal deaths: 1 potter syndrome 1 at 23 wks, no labour	no maternal deaths among women with ruptured uterus	3,319 women with previous caesarean 19 uterine ruptures among previous caesarean 2 hysterectomies: after classical and unknown scar
Smith, 2002 (192)	Scotland, retrospective cohort, singleton births 37 - 43 wks	313,238	47	75	?	1.29 after TOL 0.11 after ERCS OR 11.6; $CI_{95\%}$ 1.6-86.7 TOL, 1 in 775 Nullipara, 1 in 1016	0	1x CS with TOL 15,515 women 1x CS with ERCS 9,014 women Nulliparas 137,160 women Multiparas with no prev. CS 151,549 women

[1]VBAC Rate = (No. of VBACs/No. of women with previous caesarean sections) x 100

[2]Success Rate = (No. of VBACs/No. of women who had a trial of labour after caesarean section) x 100

1 x CS= one previous caesarean section

2 x CS= two previous caesarean sections

na= not applicable

1.6.2 VBAC, success rates and indicators for success

Many studies resulted in "evidence" or better named "obstetric consensus", that VBAC compared to elective repeat caesarean section has lower rates of postpartum fever, wound infection, blood transfusion, length of hospital stay and thrombo-embolic complications. The success rate after trial of labour (TOL) is high and varies between 45 and 80%. (Table 1.1, Flamm (175), Rageth (176), Mozurkewich (99), Miller (177), Rosen (98)). After previous caesarean for breech presentation and after previous vaginal delivery the success rate of TOL was almost 90% (178-180). In a meta-analysis of studies between 1982-1989, Rosen et al. calculated indicators for success and failure of trial of labour. He found lower VBAC rates after previous cephalopelvic disproportion and more than one previous caesarean section, and higher VBAC rates after previous breech presentation and previous vaginal delivery. Any previous indication, however, had a success rate of more than 50% (181). As long ago as 1991, after investigating morbidity and mortality of VBAC, Rosen et al. suggested to change Cragin's dictum into "Once a cesarean, a trial of labor should precede a second cesarean except in the most unusual circumstances" (98). Also, many studies have reported on high success rates of trial of labour after two or more previous caesarean sections. Success rates are comparable to success rates after one previous caesarean section (Table 1.2), but the overall VBAC rate among women with more than one previous caesarean section is lower, which means that many of those women deliver by elective repeat caesarean section.

Pelvimetry was suggested to predict the success rate of trial of labour after previous caesarean section (182-184). In Glasgow, Krishnamurthy et al. reviewed the case records including postpartum pelvimetries of 331 women delivered by caesarean section in their first pregnancy. The pelvis was considered to be inadequate in 248 (75%) of them and adequate in 83 (25%). Seventy-six women with a radiologically inadequate pelvis were allowed trial of labour and 67% (n=51) had a VBAC; among women considered to have an adequate pelvis, 73% (n=61) had a VBAC. These rates were not significantly different. In addition, three cases of uterine rupture occurred in women with a radiologically adequate pelvis (185). In Durban, South-Africa, Thubisi et al. randomly allocated 288 women to either X-ray pelvimetry at 36 weeks (n=144) or a trial of labour without ante-partum pelvimetry (n=144). All women in the control group underwent postnatal pelvimetry, which did not differ from the ante-partum group. The success rate after TOL of 84 women with adequate ante-partum pelvimetry was 28% (n=23, VBAC rate 16%). Women without ante-partum pelvimetry had a VBAC rate of 42% (OR 3.8; $CI_{95\%}$ 2.0-6.8) (186). In Singapore among women with one previous caesarean

Table 1.2 *Outcome of vaginal birth after two or more previous caesarean sections*

Reference	n	VBAC Rate[1] (%)	Success Rate[2] (%)	Uterine rupture (%)	PNM/1,000	MMR	Other remarks
Riva , 1961 (166)	76	?	66	0	0	0	
Saldana, 1979 (168)	38	?	58	0	0	0	
Martin, 1983 (171)	192	10	63	0 after TOL	0	0	
Porreco, 1983 (196)	21	?	81	0	0	0	
Wadhawan, 1983 (234)	96	23	71	6.5 2 during TOL	70	0	Study from Zambia, PNM due to low birth weight and asphyxia.
Farmakides, 1987 (195)	121	36	77	1.8 1 silent dehiscence	0	0	
Pruett, 1988 (235)	55	?	45	5.5	0	0	2 hysterectomies after uterine defect after VBAC.
Novas, 1989 (236)	69	42	81	1.4 1 after 2 x classic CS	43	0	PNM not related to TOL or CS.
Phelan, 1989 (237)	1,088	32	69	0 after TOL (1.8 dehiscence) 0.2 after ERCS (4.6 dehiscence)	24 after TOL 12 after ERCS	0	PNM not related to TOL.
Flamm, 1990 (175)	245	?	69	not specified after 2 x CS 0.17 after TOL (1 x CS included)	4.1 (ruptured uterus)	0	
Hansell, 1990 (238)	170	16	77	0.7 after ERCS 2.9 after TOL	0	0	
Granovsky-Grisaru, 1994 (239)	52	37	73	0	0	0	
Chattopadhay, 1994 (240)	1,136	9	90	0.8 after TOL 0.7 after ERCS	26 after TOL 10 after ERCS	one after ERCS because of atonic bleeding	PNM in TOL group occurred before labour.
Miller, 1994 (177)	3,728	37	75	1.7 after TOL	0.55 after 2 or more CS (ruptured uterus)	?	1 maternal death related to uterine rupture, not specified after 1, 2 or more prev. CS.
Asakura, 1995 (197)	435	45	64	2.0 after TOL 2.3 after ERCS	18 after failed TOL 46 after TOL 15 after ERCS	0	differences in PNM due to antepartum death, no rupture related PNM
Caughey, 1999 (198)	2 x CS=134 1 x CS=3,757	? ?	62 75	3.7 after 2 x CS 0.8 after 1 x CS OR 4.8; $CI_{95\%}$ 1.8-13.2	0 after 2 x CS 0.27 after 1 x CS	0	
Bretelle, 2000 (241)	180	35	66	3.1 after TOL (dehiscence)	0	0	
Spaans, 2003(242)	246	20	83	1.7 after TOL 1.1 after ERCS	4.1	0	

[1]VBAC Rate = (No. of VBACs/No. of women with previous caesarean sections) x 100

[2]Success Rate = (No. of VBACs/No. of women who had a trial of labour after caesarean section) x 100

1 x CS= one previous caesarean section

2 x CS= two previous caesarean sections

section, Wong et al. performed CT-pelvimetry in combination with ultrasound measurement of the fetal head and abdominal circumference (n=170). The calculated fetal-pelvic index had a positive predictive value of only 49% (187). The outcomes of these studies show that pelvimetry rather increases the repeat caesarean section rate and should no longer be used to decide on the mode of delivery after previous caesarean section (188).

1.6.3 VBAC and maternal and neonatal risks

In the USA, the VBAC rate increased from 1% in 1978, to a maximum of 28.6% in 1996, after which it decreased again (Figure 1.5) (113). VBAC is not without risk; the most serious complications are perinatal death and uterine rupture, which can be related or independent events. The risk of uterine rupture has been illustrated in several large studies (section 1.4.3.3). McMahon et al. (Table 1.1) found that major maternal complications were twice as common in women attempting trial of labour compared to those choosing elective repeat caesarean section (189). Major complications were five times as common in women with a failed trial of labour, compared to those who were successful and had a VBAC. In a meta-analysis of 15 studies, Mozurkewich et al. (Table 1.1) showed that women undergoing trial of labour were at significantly higher risk of uterine rupture compared to ERCS (0.4 vs 0.2%)

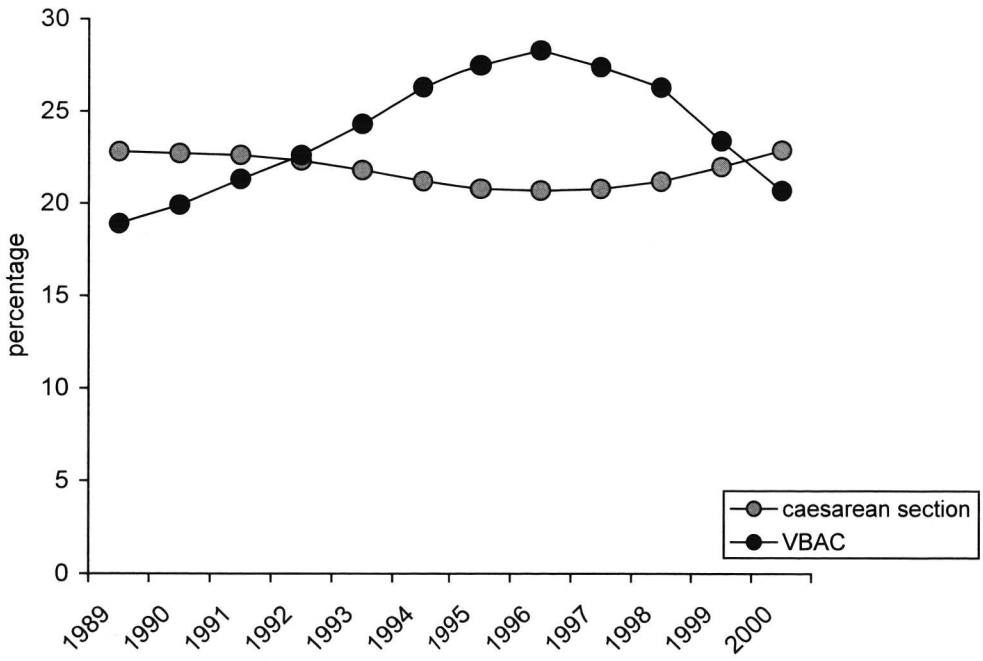

Figure 1.5 *Caesarean section rate and VBAC rate in the USA (113;194)*

(OR 2.10; $CI_{95\%}$ 1.5-3.1) (99). Also, perinatal mortality differed significantly between these two groups (2/1,000 vs 1/1,000) (OR 2.1; $CI_{95\%}$ 1.2-3.6). Rageth et al. (Table 1.1) reported from Switzerland that the risk of uterine rupture was twice as high in women attempting trial of labour, compared to women who elected repeat caesarean section (0.4 vs 0.19%) (RR 2.1; $CI_{95\%}$ 1.3-3.3) (176). In addition, perinatal mortality was twice as high in this study after trial of labour (1.9/1,000 vs 0.9/1,000) (RR 2.1; $CI_{95\%}$ 1.1-4.3). Hibbard et al. (Table 1.1) reported that women having a failed TOL had a higher risk of uterine rupture compared to VBAC (1.9% vs 0.2%) (OR 8.9; $CI_{95\%}$ 1.9-42) (190).

Perinatal mortality and morbidity are highest among foetuses who experience complete extrusion into the maternal abdomen. In this subgroup, Leung et al. reported 14% perinatal death and Bujold et al. reported a strong association with severe metabolic acidosis of the newborn ($pH < 7.0$). But also without this severe stage of uterine rupture, significant fetal morbidity can occur. In both studies, even emergency caesarean section, 15 to 17 minutes after the onset of fetal heart rate decelerations, which is a sign of early uterine rupture, could not prevent severe neonatal morbidity (104;191). The risk of perinatal death is higher in women who attempt VBAC than in women who undergo planned caesarean delivery. This was confirmed by Smith et al. (Table 1.1) in a Scottish retrospective cohort between 1992-97, linking morbidity register records to stillbirth and neonatal death enquiry records (192). Among women who had a trial of labour following previous caesarean section, delivery related perinatal death was approximately 11 times higher than the risk associated with planned repeat caesarean section (OR 11.6; $CI_{95\%}$ 1.6-86.7). The absolute risks, however, were small and the risk of perinatal death with a trial of labour was not significantly different from that of nulliparous women. In contrast to the above studies, Yap et al. reported that uterine rupture did not result in major morbidity. In San Francisco, between 1976 and 1998, he reviewed 21 uterine ruptures; 17 occurred after previous caesarean section (Table 1.1); two women with a history of previous caesarean section needed a hysterectomy; no maternal death occurred; at the time of discharge, there were no neonatal neurological abnormalities among neonates whose birth was complicated due to uterine rupture (193).

1.6.4 VBAC and risk of uterine rupture

Uterine rupture is one of the major complications of trial of labour after previous caesarean section. The risk of uterine rupture during labour is about 0.2 - 1.5% after a low transverse uterine incision (section 1.4.3.3). Several risk factors have been identified.

1.6.4.1 More than one previous caesarean section

The risk of uterine rupture increases with the number of previous caesarean sections. The first reports on selected patient groups with two or more previous caesarean sections were published by Riva et al., Saldana et al., Martin et al., Porreco et al., and Farmakides et al. (Table 1.2). The patient groups were small, hardly any complications were reported and the success rate after TOL was between 58% and 81% (166;168;195;196). Asakura et al. studied 435 women with more than one previous caesarean section. Uterine rupture or dehiscence occurred in 2.0% of women undergoing a TOL. After one previous caesarean section the uterine rupture rate was 1.1%, but the difference was not significant (Table 1.2) (197). Leung et al. conducted a case-control study of 70 patients with a uterine rupture. The risk of uterine rupture after two or three previous caesarean sections was increased to 2%, compared to 0.6% after one previous caesarean section (OR 2.6; $CI_{95\%}$ 1.1-6.4). Uterine rupture was also significantly increased by oxytocin use (OR 2.7; $CI_{95\%}$ 1.2-6.0) and dysfunctional labour (OR 7.2; $CI_{95\%}$ 2.7-20.0). Epidural anaesthesia, macrosomia, previous vaginal delivery or previous cephalopelvic disproportion were not associated with uterine rupture (96). Miller et al. (Table 1.1 and Table 1.2) reported 10 years of experience with VBAC (177). Among women undergoing a TOL, uterine rupture was significantly more common with two or more previous caesareans (1.7%) than with only one (0.6%) (OR 3.1; $CI_{95\%}$ 2.0-4.8) (177). Caughey et al. reported on women undergoing a trial of labour after one or two previous caesarean sections, in a 12 year period of (Table 2). The rate of uterine rupture was 0.8% and 3.7% respectively (OR 4.8; $CI_{95\%}$ 1.8-13.2) (198).

1.6.4.2 Oxytocin and prostaglandins

Large studies by Flamm et al. and Rosen et al. (Table 1.1) have found no significant increase in the rate of uterine rupture when oxytocin is utilised during a trial of labour (98;175). However, in a study by Zelop et al. (Table 1.1), induction of labour with oxytocin after one previous caesarean delivery and no other deliveries was associated with a 4.6-fold increased risk of uterine rupture ($CI_{95\%}$ 1.5 - 14.1). Increased risk of uterine rupture after PGE_2 use did not reach significance after controlling for oxytocin induction and augmentation (199). In an additional case control study by Goetzl et al. (n=24), an analysis was done to investigate doses or patterns of oxytocin which might influence the risk of uterine rupture during a trial of labour after caesarean. No induction protocols or oxytocin levels could be identified which were without increased risk of uterine rupture (200). A large study examining the association of PGE_2 gel (n=453) with risk of uterine rupture was conducted by Flamm et al.; uterine

rupture occurred in 1.3% (n=6), which was not significantly different from the 0.7% (n=33) uterine rupture rate in women who were not treated with PGE_2 (n=4,569) (201). Lyon-Rochelle (Table 1.1) analysed data of a retrospective cohort of primiparous women who gave birth to live singleton infants by caesarean section. In their next pregnancy, the rates of uterine rupture in women with ERCS, spontaneous labour, labour induced without prostaglandins, and prostaglandin-induced labour were 0.16%(n=15), 0.52% (n=56), 0.77% (n=15) and 2.45% (n=9) respectively (101). The study was criticised because International Classification of Disease codes (ICD-9) from hospital discharge data were used to identify cases of uterine rupture, but these data were not validated by a review of the women's charts (202;203). In additional studies, however, the risk of prostaglandins was again identified by Ravasia et al., who evaluated 2,119 trials of labour. The relative risk of uterine rupture with PGE_2 use versus spontaneous trial of labour was 6.41 ($CI_{95\%}$ 2.1 -20.0). The absolute risks of uterine rupture were 0.45% (7/1544) after spontaneous onset of labour, 0.74% (3/403) after induction of labour without prostaglandins and 2.9% (5/172) after induction with prostaglandins (204). Taylor et al. reported on 790 trials of labour with an overall uterine rupture rate of 1.8%. With PGE_2 use the uterine rupture rate was 10.3% (6/58); without PGE_2 the uterine rupture rate was 1.1% (8/732) ($p<0.05$) (205).

1.6.4.3 Influence of induction on success rates of TOL

A recent study by Delaney et al. on spontaneous labour (n=2,943) versus induced labour (n=803) after previous caesarean delivery reached no statistically significant levels for higher uterine rupture rates after induction (0.7% vs 0.3%;p=0.128). After induction, however, caesarean delivery was more frequent than after spontaneous onset of labour (38% versus 24%; OR 1.8; $CI_{95\%}$ 1.5 - 2.3) (206). Zelop et al. studied women before (n=1,504) and after (n=1,271) 40 weeks of gestation. Overall, rate of caesarean section was higher for women after 40 weeks (35.4% compared to 26.7%, $p<0.001$). Induction of labour after 40 weeks resulted in 43.0% caesarean sections (p=0.03). In this study, uterine rupture did not significantly change by induction (207). Sims et al. (n=236) found 51% repeat caesarean section after induction of labour, compared to 26% after spontaneous onset of labour, among women with no previous vaginal delivery, but also no increased rate of uterine rupture (208).

1.6.4.4 Interdelivery interval

In two studies, the risk of uterine rupture was related to the time-interval between caesarean section and subsequent trial of labour. Shipp et al. reported a three fold increase with an

interval of less than 18 months (OR 3.0; $CI_{95\%}$ 1.2-7.2) and Bujold et al. calculated a two to three fold increase after an interval of less than 24 months (OR 2.65; $CI_{95\%}$ 1.08-5.46) (209;210). Huang et al. found no influence of interdelivery intervals on the rate of symptomatic uterine rupture (211).

1.6.4.5 Previous postpartum fever

Shipp et al. conducted a case-control study to investigate whether fever after previous caesarean section was associated with the risk of uterine rupture. Fever was defined as a temperature above 38°C. Postpartum fever was more frequent in patients with uterine rupture (8/21;38%) than in the controls (13/84;15%). Multiple logistic regression associated fever with a four-fold increase in the risk of uterine rupture during subsequent trial of labour (OR 4.0; $CI_{95\%}$ 1.0-15.5) (212).

1.6.4.6 Single-layer closure

Single or double-layer closure of the uterus and its influence on subsequent uterine rupture has already been discussed in section 1.3.1 "surgical technique".

1.6.4.7 Maternal age

In a study by Shipp et al., among women with only one previous caesarean section (no vaginal deliveries), the risk of uterine rupture increased in women older than 30 years (1.4%) After excluding confounding factors like birth weight, induction, augmentation and interval delivery, the odds ratio was 3.2 ($CI_{95\%}$ 1.2 - 8.4) compared to women younger than 30 years of age (0.5%) (213).

1.6.4.8 Previous vaginal deliveries

In the earlier mentioned case-control study by Leung et al., somewhat fewer patients with a uterine rupture than those in the control group had previously delivered vaginally (16% vs 23%, not significant) (96). In a study by Zelop et al., among pregnant women at term with one previous caesarean section, previous vaginal delivery was associated with one fifth the risk of uterine rupture, in comparison to pregnant women with no previous vaginal delivery (0.2% vs 1.1%, OR 0.2; $CI_{95\%}$ 0.04-08) (214).

1.6.4.9 Thickness of the lower uterine segment

Antenatal measurement by abdominal ultrasound of the lower uterine segment has been proposed to assess the risk of uterine rupture during trial of labour. Rozenberg et al.

conducted a study of 642 pregnant women with uterine scars to determine whether the thickness of the lower uterine segment late in pregnancy (36-38wks) was a predictor of uterine rupture and dehiscence during labour. The risk was 0% (0/278) with a lower uterine segment > 4.5 mm, 0.6% with a lower uterine segment 3.6-4.5 mm, 6.6% with a lower uterine segment 2.6-3.5 mm, and 9.8% with a lower uterine segment of 2.5 mm or less. In the population of Rozenberg et al., the uterine rupture rate was relatively high (2.3% and 1.7% dehiscence). His proposed cut-off thickness of 3.5 mm or less identified 29% of the population as being at high-risk for rupture, but only 7.4% of those identified actually had a rupture. At the moment, clinical value of this technique seems to be limited (215;216).

1.7 VBAC and guidelines

Studies published in the international literature have lead to several practice guidelines on vaginal birth after caesarean section. The guidelines of the Society of Obstetricians and Gynaecologists of Canada (SOGC), the American College of Obstetricians and Gynecologists (ACOG) and the Deutschen Gesellschaft für Gynäkologie und Geburtshilfe are summarised in Table 1.3. In the late 1980s and early 1990s, VBAC rates were rising steeply in the USA and obstetricians extended the trial of labour to women with more than one previous caesarean section, multiple pregnancy and suspected fetal macrosomia. Reports on the complications of trial of labour, however, raised concern about neonatal and maternal morbidity and liability claims (117). Until 1998, ACOG guidelines indicated that a physician capable of performing a caesarean section should be "readily" available when a VBAC patient is in labour (217). In July 1999, the ACOG changed the criteria to "immediately" available (32). Even though "immediately" was not defined, many obstetricians understood this as meaning a quicker response than "readily". Especially within the USA, the 1999 guideline on VBAC has been interpreted as requiring obstetricians and anaesthetists to be in-house for 24 hours a day. Hospitals without 24 hour coverage are afraid of facing liability claims if complications after trial of labour might arise. As a result, the optimism about VBAC in the USA was tempered and the VBAC rate is decreasing. In 2000 the VBAC rate was back at the 1989 level. The new ACOG guidelines have already been blamed for the observed decrease in VBACs (Figure 1.5) (218;219). In 2000, the ACOG Task Force on Evaluation of Cesarean Delivery restricted trial of labour to one previous low transverse caesarean delivery. Prostaglandins after a previous caesarean section are "out" since the report by Lydon-Rochelle (101). Based on this study, the ACOG published a committee opinion in 2002 on induction of labour for VBAC and discourages prostaglandins for cervical ripening or induction. Breech presentation after

previous caesarean section and trial of labour will most likely fade out, due to the publication of the term breech trial by Hannah et al. (157). Articles criticising this study will most likely not be able to stop the trend of repeat caesarean section for breech presentation in subsequent pregnancy (220;221).

After having reviewed the literature and international guidelines, it seems clear that there is world wide consensus on the success rates of trial of labour at least: in the majority of patients more than 50% of TOLs will be successful, irrespective of the indication for the previous caesarean section. However, research from the USA and the ACOG guidelines are trend setting. It might be high time for a European answer to the American way of risk perception of previous caesarean section.

Table 1.3 *Practice Guidelines for VBAC (32;140;243;244)*

	SOGC[1] 1997	ACOG[2] 1999/ Task force on Caesarean / Committee opinion 2002	DGGG[3] 2000
Contra-indications to VBAC	Previous: classical cs, inverted T or unknown scar, myomectomy, uterine rupture. Placenta praevia, transverse lie. Other contra-indications to labour (obstetric/medical).	Previous: classical cs, T-shaped or transfundal surgery, uterine rupture or contracted pelvis. Obstetric or medical complication precluding vaginal delivery.	Previous: classical cs, uterine rupture, or contracted pelvis. Obstetric or medical complication precluding vaginal delivery.
Candidates for trial of labour	Women with one or more than one previous CS, breech or twin pregnancies.	Women with one previous CS, singleton and vertex.	Women with one or more than one previous CS, breech or twin pregnancies.
Medication	Oxytocin allowed. Prostaglandins, safety not established.	Oxytocin allowed. Prostaglandins discouraged.	Oxytocin allowed. Prostaglandins, safety not established.
Fetal monitoring during trial of labour	In cases of induction or augmentation continuous electronic fetal heart rate monitoring necessary	Continuous fetal heart rate monitoring recommended.	Not mentioned.
Analgesia	Not mentioned.	Epidural allowed	Epidural allowed.
External version of breech presentation after previous CS	Not mentioned.	Limited data suggest it can be successful	not contra-indicated.
Place of trial of labour after previous CS	Hospital equipped for obstetrical care	Institution equipped to emergencies, with physicians immediately available to provide emergency care.	In institution which can perform emergency caesarean section within a short span of time.

[1]SOGC= Society of Obstetricians and Gynaecologists of Canada

[2]ACOG=American College of Obstetricians and Gynecologists

[3]DGGG=Deutsche Gesellschaft für Gynäkologie und Geburtshilfe

1.8 Aim of the thesis

The aim of this thesis is to address the following questions:

1. Why have caesarean section rates increased?
2. What is the use and effectiveness of African maternity waiting homes, especially with respect to previous caesarean section?
3. Is a trial of labour after previous caesarean section safe for mother and child in rural Africa?
4. What are the risk factors at caesarean section which predict failure of a trial of labour in subsequent pregnancy?
5. Is a trial of labour after two or three previous caesarean sections safe for mother and child?

1.9 Outline of the thesis

Chapter 1 describes history, development, technique and safety of caesarean section. The caesarean section rates world wide are outlined and discussed. Background information on VBAC with an overview of relevant literature is given and international guidelines on VBAC are compared.

Chapter 2 outlines the history, geography and demography of Zimbabwe and Mberengwa District. The concept of maternity waiting homes is introduced and reviewed. It describes two studies from Zimbabwe. One is on the use of maternity waiting homes in Mberengwa District in Zimbabwe; the number of home and hospital births, district caesarean section rate and district VBAC rate are assessed. The other study contains information on trial of labour after previous caesarean section in hospital births; maternal and neonatal outcome, indication for the primary caesarean section, success rate and VBAC rate are described; predicting factors for VBAC are investigated.

Chapter 3 gives background information on obstetric care in the Netherlands, together with an overview of Dutch dissertations which have caesarean section as their major subject. It describes two studies on trial of labour in the Netherlands. The first study investigates at the Academic Medical Centre of Amsterdam women with one previous caesarean section; the indications for the first caesarean section, the number of trial of labours, and the number of successful trial of labours are described; factors in the previous labour experience and factors in the next labour experience that may predict failure of a trial of labour are studied. The second study focuses on trial of labour after two or three previous caesarean sections at the Academic hospitals of Leiden and Amsterdam; the success rate, induction rate, neonatal outcome and maternal outcome are described.

Chapter 4 discusses the aims of this thesis in relation to the literature and the studies presented in chapter one, two and three.

Finally, a summary and guidelines for vaginal birth after caesarean section are given.

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Chapter 2

Caesarean Section and Trial of Labour in Zimbabwe

2.1 Introduction on Zimbabwe

Zimbabwe is a tropical land-locked country, situated in south-central Africa, enclosed by Mozambique, Zambia, Botswana and South-Africa, with a size of 390,590 km^2. Dotted around the country of Zimbabwe are paintings on rocks and cave walls, some of which date back thirty thousand years. These paintings, which are still visible today, depict mythical creatures, wild animals, hunting men and families in their camps. The artists who made these, were known as the San; a late stone age hunter-gatherer people and in Western countries more often referred to as "Bushmen". They relied on the plentiful wildgame, were nomadic and when necessary lived in caves (1). The first iron age people, the Bantu, are thought to have crossed the Zambezi river from the north about two thousand years ago. The Bantu people are linked by a basic similarity of language, and it is thought that they originated in the Western Sudanic areas of Africa, before moving to the other regions of Central, Eastern and Southern Africa. From 400 AD the Shona, one of the Bantu people, settled in what is nowadays called Zimbabwe. The Nguni, Tsonga, Sotho and Tswana moved further south into what is called today South-Africa and Botswana (2). The San were gradually expelled from their hunting areas and driven back to the deserts of the Kalahari in Botswana.

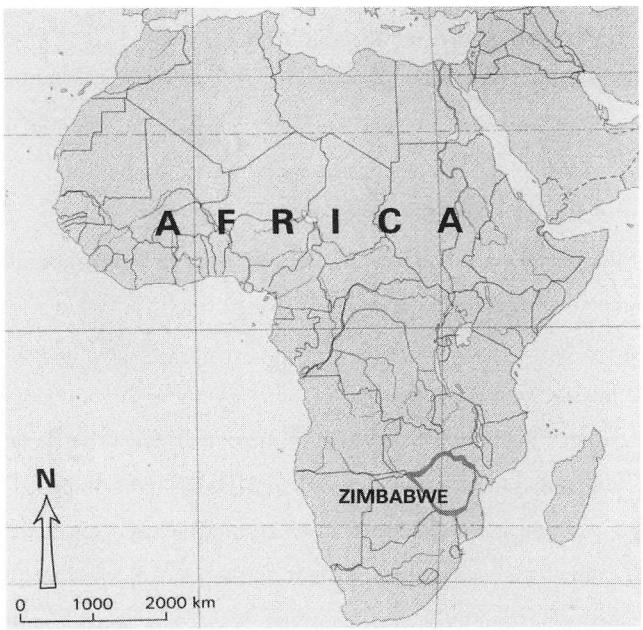

Figure 2.1 *Zimbabwe and its geographical position in Africa*

The Shona brought the technology of the iron age. They organised agriculture, made larger settlements, and metals like gold and copper were used for trading. These metals, together with ivory, were exchanged for cloth and beads from India and Persia and even porcelain from China. Around 1200 AD, trade flourished to such an extend that centres like "Great Zimbabwe" were erected. The ruins of Great Zimbabwe (Zimba=large house, -bwe=stone) are near the city of Masvingo. Great Zimbabwe, together with one of the dug up bird sculptures, has become a national symbol. From 1500 onwards, the city of Great Zimbabwe fell into decay. A new invasion came from the South at the beginning of the nineteenth century. In what is now called Natal, King Shaka Zulu built his imperium. Many tribes tried to escape from his power, and this is why, around 1830, the Ndebele people settled in the South-western part of Zimbabwe, Matabele land. The Ndebele were a people of herdsmen with a martial spirit; they subdued the Shona chiefs, living in Mashona land, and made them pay taxes (1).

In 1890, the whites moved in from South Africa under the leadership of Cecil Rhodes. Resistance by the Ndebele king Lobengula was beaten down by superior fire-power of the British invaders, and both the Shona and the Ndebele were subjected. After a second uprising in 1896, the Shona and Ndebele were again defeated, resulting in the death penalty of many Shona leaders, while many Ndebele's managed to negotiate amnesty. Later, this uprising was referred to as the first liberation war (the first chimurenga).

The initial motive of the first European settlers was competition for land and natural resources. Much of the fertile land was allocated to large-scale commercial farms and the peasant population was displaced to less fertile lands. In 1930, the Land Apportionment Act allocated 50% of the land to 50,000 whites (3-5). In 1953, Zambia (North-Rhodesia), Zimbabwe (South-Rhodesia) and Malawi (Nyasaland) formed a federation. In 1964, Zambia and Malawi became independent under black majority rule. The whites in South-Rhodesia refused a government based on "one-man-one-vote". After a referendum among whites, Ian Smith declared Rhodesia independent on the 11th of November 1965, under a white minority regime. This so called Unilateral Declaration of Independence (UDI) placed Rhodesia in isolation and international sanctions of the United Nations were imposed upon Rhodesia. Gradually, black opposition intensified and, after a guerrilla war (second chimurenga) with 35,000 casualties, Zimbabwe became independent on the 18th of April 1980. Robert Mugabe became the first prime minister and, at the beginning of the new republic, tried to reconciliate the whites, Shona and Ndebele. In 1983 and 1984, however, the Fifth Brigade of the national army killed and tortured many Ndebele people in Matabele land. In 1988, the political wings

of Ndebele and Shona, the PF-ZAPU and ZANU-PF, were amalgamated to the United ZANU-PF (Zimbabwe African National Union-Patriotic Front) (6). After 10 years of independence, the transition of Rhodesia's white minority regime into a multiracial Zimbabwe seemed to be a success. The land distribution between whites and blacks, however, had not been solved at independence. The new government of Zimbabwe bound herself to a constitutional agreement in which expropriation or nationalisation of land, other than under-utilised land, for purposes of land reform was prohibited for a period of 10 years.

Until the early 1990s, in a population of 10 million people, approximately 4,500 white farmers owned 40% of the agricultural land, about 12 million hectares. Over six million other Zimbabweans were still crowded in poverty on "communal areas" of poor soil and little rainfall. Zimbabwe's struggle for Independence had promised the return of land to Zimbabweans. Demographic indicators and percentages of the ethnic groups in Zimbabwe are presented in Table 2.1 and Table 2.2 respectively. The redistribution of land and the resettlement of black farmers to the more fertile regions were far behind schedule. At independence, it was agreed that land purchase could only take place according to a "willing-buyer willing-seller" condition in foreign currency. Even the "land acquisition act" of 1985, which made expropriation much easier, did not speed up land redistribution. In July 2000, Mugabe launched the "fast-track land reform programme". The target was to resettle 162,000 families on five million hectares, owned by the white commercial farmers. Later, he increased his target to 8.3 million hectares. Since then, the situation in Zimbabwe has become increasingly unstable. Land seizures, intimidation and violence have been the result, seriously disrupting agriculture on commercial farms. Inflation rose to 500% with unemployment above 60%, while foreign exchange reserves and exports were disappearing. In 2001, over 700,000 Zimbabweans faced severe food shortages in a country that was once called the granary of Africa! There was hope that the presidential elections of March 2002 might bring a change of leadership. International observers declared the elections unfair, because of intimidation campaigns with brutal violence by Mugabe's ZANU-PF. Morgan Tsvangirai, the leader of the opposition party Movement for Democratic Change (MDC), was defeated (7). He was taken into custody for some time and charged with high treason. He was arrested again for organising national strikes and demonstrations, and after two weeks released on bail. By 2003, Mugabe's "land reform programme" had already resulted in a 90% decrease of food production by commercial farms. Nowadays, about half the population of Zimbabwe is dependent on food-aid (8).

Table 2.1 *Zimbabwe, demographic indicators (4;9-12)*

Indicators	1980-85	1988	1999	2002
Population size (millions)		9.1		11.3 - 13.1
Population growth rate %		3.1		0.05 - 1.7
Female life expectancy, years	58			37 - 42
Male life expectancy, years	54			38 - 43
Crude birth rate/1,000	47	42		25
Crude death rate/1,000	12	10		24
Total fertility rate per woman				5
HIV/AIDS prevalence rate %, (female/male)			25	40/15*
Maternal mortality ratio per 100,000	140	137		610
Child mortality < 5 per 1,000, female/male				119/129

*15-24 years

Table 2.2 *Ethnic groups in Zimbabwe (11)*

Ethnic group	%
Shona	82
Nbebele	14
Other African	2
mixed and Asian	1
White	1

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2.2 Mberengwa District

2.2.1 Geography

Mberengwa District is an area in the most Southern part of the Midlands Province (Figure 2.2). It is a mountainous region with small plots of land pressed in between stone-covered hills. Rainfall is unreliable with a mean annual fall of 400 - 600 mm per year. Approximately 75% of the district land area is communal land, 9% is resettlement area and the remaining 16% is privately owned farmland. The altitude of the land ranges from 600 to1200 metres, the middle veld of Zimbabwe. The hot rainy season is from November to March, followed by a transitional period till mid-May with lower temperatures; the cool dry season lasts till mid-August, followed by a hot dry season till November. The people of Mberengwa are among the poorest of Zimbabwe despite the fact that their region is rich in minerals. Transnational companies have been making profits on Mberengwa's minerals: zinc, iron ore, gold, asbestos, nickel and emeralds. Only few of the local population are involved in these mining activities, which need a minimal labour force. The raw minerals are exported to other areas of the country or abroad (1).

2.2.2 Demography

The majority of the 183,000 inhabitants live on the 3,753 km^2 of communal land, with a population density of 46 per km^2. Many of them belong to the Karanga, a Shona population group, who speak the ChiKaranga dialect, which is spoken by 27% of all Shona people in Zimbabwe. Few of the inhabitants of Mberengwa, especially in the South-western part of the district, belong to the Ndebele people (2). The population of the communal area of Mberengwa consists of many children under five years of age, many female-headed households and an under representation of male adults (Table 2.3).

2.2.3 Health Infrastructure

From the early 1900s, the Evangelical Lutheran Church, formerly the Church of Sweden Mission, colonised Mberengwa District and established several mission centres and sub-centres. In 1915, the first Swedish Sister came to Mnene; the first Swedish doctor came in 1925; the training of nurses started in 1941. Later, missionaries built clinics and hospitals at Musume and Masase, and the Zimbabwe government developed hospitals at Mberengwa and

Table 2.3 *Population breakdown in Mberengwa District (n=183,000) (1;3)*

Subgroup	
Children under 1 year %	3.8
Children under 5 years %	18
Women 15-49 %	21
Households headed by women %	45
Household size in persons	5.6
male / female ratio adults	1/2

Figure 2.2 *Zimbabwe and Mberengwa District*

Jeka, which were serviced by the district medical officer stationed at Mberengwa (Figure 2.3) (4). In the first instance, most nurses and midwives were recruited in Sweden, but gradually local trained Zimbabweans replaced them. In 1994, Zimbabwean doctors succeeded the expatriate medical staff. The running cost of the Mberengwa healthcare system, however, is still partly dependant on donations from Sweden through the Evangelical Lutheran Church of Zimbabwe (ELCZ). At the moment, there are five hospitals in Mberengwa District; three hospitals at Mnene, Musume and Masase are run by the ELCZ; two at Mberengwa and Jeka, are directly under the Ministry of Health. In addition, there are 10 rural health centres and 10 clinics. Of the operating commercial mines, three have privately run clinics for their personnel.

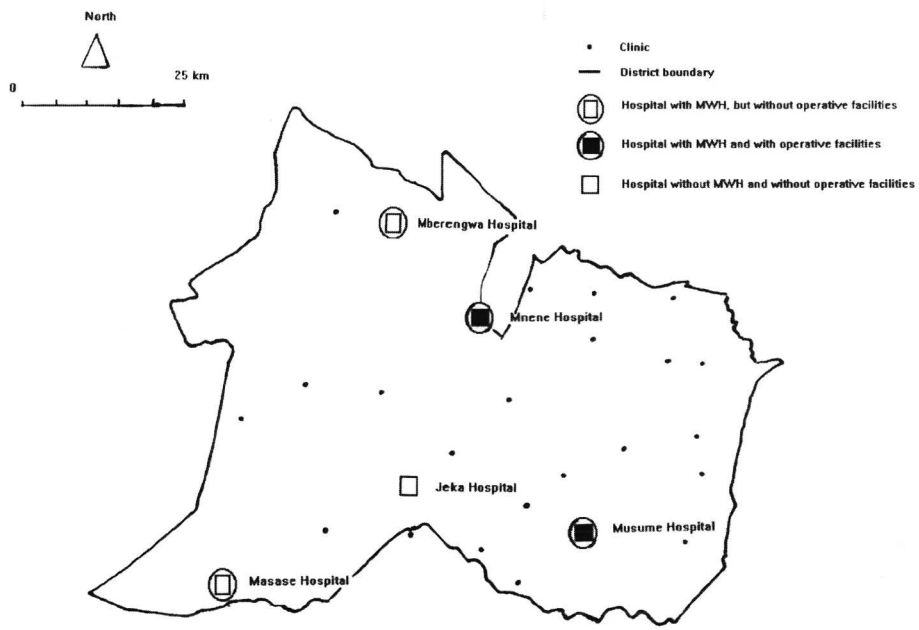

Figure 2.3 *Mberengwa District Health facilities*

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2.3 Maternity waiting homes; still a corner-stone of safe motherhood?

The most striking fact about maternal health in the world today is the extraordinary difference in maternal death ratios between industrialised and developing countries. Of the estimated 515,000 maternal deaths world-wide each year, 273,000 take place in Africa, 217,000 in Asia, 22,000 in Latin America and the Caribbean, and less than 3,000 take place in the more developed regions. In terms of the maternal mortality ratio (MMR), the world figure is estimated to be 400 per 100,000 live births. By region the MMR was highest in Africa (1,000), followed by Asia (280), Oceania (260), Western Europe (14) and Northern America (11 per 100,000 live births) (1;2). The main causes of maternal deaths in low income countries are summarised in Table 2.4. The tragedy is that most maternal deaths are avoidable, if women could have access to life saving care.

Table 2.4 *Causes of maternal deaths in low income countries (3)*

Severe haemorrhage	25%
Indirect causes including anaemia, malaria, heart disease	20%
Puerperal sepsis	15%
Unsafe abortion	13%
Eclampsia	12%
Obstructed labour	8%
Other direct causes including ectopic pregnancy, embolism, or complications of anaesthesia	8%

In 1987, a call to action to reduce the appallingly high maternal mortality ratios was launched at the Safe Motherhood Conference of the World Health Organisation (WHO) in Nairobi (4). The major goal was to reduce maternal mortality by half in one decade. The use of maternity waiting homes (MWHs) was suggested to be an adequate answer to one of the major causes of maternal and perinatal death: poor access to hospitals, which results in a delay of treating emergency childbirth complications. The purpose of MWHs is to provide a shelter, near a hospital with essential obstetric facilities, where women can be accommodated during the final weeks of their pregnancy. At first, maternity waiting homes were intended for high risk pregnant women (5). Several studies suggested that risk assessment should play a central role in reducing maternal mortality (6-8). Based on the paradigm of risk assessment,

the WHO identified four elements which are essential for a well functioning Maternity Waiting Home (9):

1. *Definition of antenatal risk factors and selection of women staying at a MWH.*
2. *The availability of a viable community health service for identifying women in need of referral and community awareness in compliance with the referral indication.*
3. *Skilled obstetric services, including emergency care.*
4. *Community and cultural support.*

In the above concept of a MWH, which presupposes that it is possible to identify pregnancies that are likely to develop complications ("high risk pregnancies"), selection of women for referral to a MWH is important. Examples of high risk pregnancies, suggested to benefit from admission to a MWH, are the following (10):

1. *Malpresentation, e.g. breech and transverse lie.*
2. *Poor obstetric history, e.g. previous stillbirth, previous early neonatal death, previous postpartum haemorrhage, prolonged labour with vesico-vaginal fistula.*
3. *Previous caesarean section or symphysiotomy.*
4. *Multiple pregnancy.*
5. *High pregnancy order.*
6. *Age, adolescent or women beyond 35 years of age.*
7. *Short stature.*
8. *Malnutrition, anaemia.*
9. *Hypertension/pre-eclampsia.*

It should be noted that on the one hand, high risk pregnancies often do not lead to complications, and on the other hand, in initially low risk pregnancies unexpected complications may arise. Even in a low risk population, it is estimated that 20% of pregnancies will result in complications which will need treatment at a facility providing essential obstetric care (11). The essential treatments of obstetric care, as identified by the WHO, are summarised in table 2.5.

Table 2.5 *Components of essential obstetric care (3;12)*

Parenteral antibiotics, oxytocin and anti-convulsants
Facilities for manual removal of the placenta
Facilities for removal of retained products of conception
Assisted vaginal delivery: vacuum extraction
Facilities for blood transfusion
Facilities for caesarean section

Selection of women with high risk pregnancies, who should be transferred to MWHs, has never been very successful. In Tanzania for example, a study by Jahn et al. showed very poor risk selection by health care workers; only risk factors like previous caesarean section and first pregnancy lead to a marked selection towards health facilities with essential obstetric care (13). Due to the fact that identifying "low" and "high" risk pregnancies is difficult, the safe motherhood initiative changed its priority towards "access to quality emergency obstetric care". Training of traditional birth attendants and training of health care workers in risk assessment should go hand in hand with improving the accessibility of obstetric care. This policy should increase the quality of supervision of birth; international organisations aim at 85% skilled attendance of births by 2015 (14).

It is difficult to evaluate safe motherhood programmes. Often, maternal mortality ratios are not very useful to monitor the effects of these programmes, because these ratios summarise maternal health care over a 10 year period and are very unreliable. In order to assess the success of safe motherhood programmes, other indicators than mortality ratios have been proposed by Unicef and the World Health Organisation. Suggested indicators of maternal health care are: the number of facilities offering emergency obstetric care, the proportion of deliveries attended by qualified personnel, the proportion of obstetric complications seen by obstetric emergency services, and the proportion of caesarean sections performed among all births (15). In addition, De Brouwere introduced the "unmet obstetric need" in order to assess maternal health care programmes. The difference, between the number of women in a population with an indication for a major obstetric intervention and the number of women who received that intervention, is the unmet need (16).

It is not easy to prove that maternity waiting homes "work". Nevertheless, they improve the accessibility of maternal health care in a certain area. In developing countries, Bulatao et al. showed that access to maternity health services is a key indicator for maternal mortality. Maternal health services in 49 countries were rated by experts in each country,

using an 81-item questionnaire. Links between these ratings and the maternal mortality ratios were analysed. The ratings in this questionnaire measuring access to maternal health services, had a consistent effect on reducing maternal mortality. Stepwise logistic regression analysis indicated only two important predictors of maternal mortality ratios: per capita gross national product and adequacy of access to maternal health services (17). This study supports the growing opinion that reaching a health facility which can provide essential obstetric care is the best tool in reducing maternal mortality.

Relatively few data are known on the functioning of maternity waiting homes. The African studies on MWHs stem from Ethiopia, Zimbabwe and Zambia and show better pregnancy outcomes among women making use of these homes. From Ghana, there is a reported failure of a MWH. The MWH was built far from a hospital, and emergency transport was needed to travel to the main hospital where obstetric facilities were available. During twelve months, only one woman stayed for one night at the MWH! This project lacked community support and clearly did not improve the accessibility of health care, and therefore was doomed to fail (18). The successful studies are summarised in Table 2.6 (19-24). In all studies perinatal and maternal mortality were lower among MWH users. Two studies, Poovan et al. and van Lonkhuizen et al., reported that the majority of users consisted of high risk pregnant women. Still, in the study by Poovan et al., the stillbirth rate was ten times higher in the non-MWH users than in MWH users; many women in the non-MWH group were emergency admissions with severe complications. Results of these studies (Table 2.6) indicate that selection of high risk women, one of the criteria by the WHO at the start of the safe motherhood initiative in 1987, cannot be met by MWHs. However, maternity waiting homes should not go out of favour, because they can still play a key role in improving the accessibility of emergency obstetric care for all pregnant women.

Table 2.6 *Summary of studies on Maternity Waiting Homes (19-24)*

Reference	Country	women using MWH[1]/Non-MWH[2]	Para 0 (%) MWH/Non-MWH	Para > 6 (%) MWH/Non-MWH	PMR[†] MWH/Non-MWH	MMR[*] MWH/Non-MWH
Poovan, 1990	Ethiopia	151 / 635	7 / ?	11 / ?	28 / 254	0 / 2047
Miljard, 1991	Zimbabwe	486 / 336	25 / 24	7 / 9	35 / 71	? / ?
Chandramohan, 1994	Zimbabwe	1573 / 2915	42 / 38	7 / 5	19 / 32	64 / 69
Tumwine, 1996	Zimbabwe	280 / 773	32 / 28	25 / 25[b]	25 / 30	357 / 388
Spaans, 1998[a]	Zimbabwe	813 / 228	31 / 15	18 / 27[b]	22 / 39	123 / 877
Van Lonkhuijzen, 2003	Zambia	218 / 292	54 / 31	12 / 8	53 / 54	0 / 342

[†]Perinatal mortality rate per 1,000 live births

[*]Maternal mortality ratio per 100,000 live births

[1] Women staying in a Maternity Waiting Home

[2] Women not staying in Maternity Waiting Home, but travelling to a hospital

[a] District survey: women giving birth at a maternity waiting home/hospital setting (MWH) compared to women giving birth at home (non-MWH)

[b] Parity 5 or above

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2.4 The safe motherhood initiative: a maternity waiting home experience in Zimbabwe

W.A. Spaans[1], J. van Roosmalen[2], C.M.A.G. van Wiechen[3]

[1] Resident in Obstetrics and Gynecology, Academic Medical Centre, Amsterdam, the Netherlands.

[2] Consultant Obstetrician from the department of obstetrics of Leiden University Hospital, Leiden, the Netherlands.

[3] Research Fellow, National Institute of Public Health and the Environment, Bilthoven, the Netherlands.

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2.4.1 Abstract

Objective

To investigate the use and effectiveness of maternity waiting homes (MWHs) in rural Zimbabwe.

Method

During a two months period in 1994, data were collected from 1,092 home and hospital births through structured questionnaires. Statistical significance was tested with a Mantel-Haenszel equation for odds ratio's (OR) or a Fisher exact 2-tailed test.

Results

From 1,041 births which could be analysed, 228 (22%) occurred at home and 813 (78%) in hospital. MWHs were used by 616 (59%) of all women. Women with a previous caesarean section (OR 13.9; $CI_{95\%}$ 2.3-566) and primi parous women (OR 2.4; $CI_{95\%}$ 1.6-3.7) gave more often birth in hospital and women with a parity of five or above (OR 0.6; $CI_{95\%}$ 0.4-0.9) gave more often birth at home.

Conclusion

The use of MWHs in Mberengwa district was instrumental to the high percentage of hospital births. The MWHs were effective in improving the accessibility to obstetric care for primi parous women and for women with a previous caesarean section.

2.4.2 Introduction

In 1987, a call to action to reduce the appallingly high maternal mortality ratios was launched at the Safe Motherhood Conference of the World Health Organisation in Nairobi (1). The use of maternity waiting homes (MWHs) was suggested to be an adequate answer to one of the major causes of maternal and perinatal death: poor access to hospitals resulting in a delay of treating emergency childbirth complications. The purpose of MWHs is to provide a setting where high-risk women can be accommodated during the final weeks of their pregnancy near a hospital with essential obstetric facilities (2). The few African studies on MWHs stem from Ethiopia and Zimbabwe and show better pregnancy outcomes among women making use of these homes (3-5). Those reports, however, are all based on hospital births, excluding women giving birth at home.

In rural Zimbabwe, the Evangelical Lutheran Church owns and runs three of the five hospitals in the Mberengwa district. The service of MWHs had been part of their community program for many years. Together with the foundation of hospitals in the district from 1915 onwards, simple huts (machacha) were erected as waiting homes for out-patients and pregnant women coming from remote areas. After independence of Zimbabwe in 1980, the existing MWHs were easily integrated in the primary health care programs and one additional waiting home was opened at a government hospital. Despite the long tradition of MWHs in Mberengwa district, no information on the effectiveness of MWHs was available. In order to assess the functioning of MWHs within the district health system, a prospective study was performed on maternal and perinatal outcome, covering all home and hospital births in the entire district of Mberengwa during a two months period. Through the survey we tried to answer two main questions: (1) How many pregnant women make use of the MWHs?; (2) Are MWHs effective in providing a shelter for women with high risk pregnancies?

2.4.3 Materials and methods

Mberengwa district in the Southern part of the Midlands Province of Zimbabwe had 185,000 inhabitants (6). In this district of 5,500 km^2, 5 hospitals and 22 clinics were delivering maternity services (Figure 2.3). In only two hospitals instrumental vaginal and caesarean births were performed. Four hospitals have been running maternity waiting homes since long. Antenatal care was delivered at all health institutions. Haemoglobin levels were hardly checked, but the majority of patients was screened for syphilis. Ultrasound was not available. Transport in the district was poor, and referral possibilities from clinics to hospitals were limited. At all hospitals

with MWHs ambulances were available. Women with high risk pregnancies were encouraged to stay at one of the maternity waiting homes from a pregnancy duration of 36 weeks onwards. Anyone wishing to stay at the maternity waiting home, however, was permitted to do so. The women brought bedding, pots and food, and cooked for themselves in a special kitchen. There was no charge for services. After approval and technical support by the Medical Research Council of Zimbabwe, data were collected from all women who gave birth in Mberengwa district, during a two months period in 1994. Information was obtained through structured questionnaires. At every clinic and hospital an education session explaining the study and its questionnaire was organised. Women who gave birth at home were traced up to 3 months after delivery and interviewed by clinic nurses, outreach vaccination teams, village community workers or environmental health technicians. Women who gave birth in hospitals were identified through the birth registers in these centres and interviewed up to a few days after birth by nurses or midwives on duty. The estimated birth rate was 38 per 1,000 and therefore 1,172 births could be expected to occur during the study period (6). The data were tested for statistical significance with a Mantel-Haenszel equation for odds ratio's (OR). The Fisher exact 2-tailed test was used in case of small or zero cell counts. Statistical analysis was performed using the Epi-Info package.

2.4.4 Results

In the survey 1,092 births could be traced. Because of missing data, 51 births were excluded from further analysis. From the remaining 1,041 births, 228 (21.9%) occurred at home, 795 (76.4%) in hospital and 18 (1.7%) at a health centre. Hospital and health centre births were analysed together as hospital births. Maternity waiting homes were used by 616 (59.2%) of all women, 170 (16.3%) women travelled to hospital during labour and 27 (2.6%) women were admitted in one of the hospitals before the onset of labour. From 283 primiparous women, 35 (12.3%) gave birth at home and 248 (87.7%) gave birth in hospital (Table 2.7).

Table 2.7 *Antenatal stay and place of delivery for primiparous and all women*

Place of antenatal stay	Place of giving birth	Primi para n=283	%	Total group n=1,041	%
Home	Home	35	12.3	228	21.9
Maternity waiting home	Hospital	195	68.9	616	59.2
Home	Hospital	46	16.3	170	16.3
Admitted in hospital	Hospital	7	2.5	27	2.6

The average stay at the maternity waiting home was 16 days (SD = 12.5). A mean of 2.4 Z$ (SD = 7.7) was spent per day on items like food, drinks, soap or baby clothing (1 Z$= 0.1 US$). Women at a MWH were interviewed about their motivation to stay there (Table 2.8). Good access to medical care was the main stimulus to use a MWH for 529 women (85.9%). Also women who gave birth at home were asked about their motivation to do so (Table 2.9). Lack of money was the main reason to deliver at home for 80 women (35.1%), followed by unsure gestational age for 59 women (25.9%).

Within the district, 963 pregnant women (92%) had at least one antenatal visit by a trained nurse or midwife. The majority of antenatal clinic (ANC) visits started from 21 weeks gestation onwards. All women who stayed at a MWH received antenatal care. Women who gave birth at home were more often unbooked for antenatal care (OR 0.2; $CI_{95\%}$ 0.1-0.4) than women who gave birth in hospital (Table 2.10 and 2.12). Maternal mortality occurred in two

Table 2.8 *Main reason for choosing a Maternity Waiting Home*

Main reason for mother	**n=616**	**%**
Good access to medical care	529	85.9
High risk pregnancy	33	5.3
Time to rest	29	4.7
Referred by nurses, doctors or relatives	19	3.0
Saving money for car hire	2	0.3
Missing	5	0.8

Table 2.9 *Main reason for giving birth at home*

Main reason	**n=228**	**%**
No money to stay at or travel to a MWH	80	35.1
Not sure about gestational age	59	25.9
Occupied by family, children, harvest or funeral	32	14.0
Delivered preterm	17	7.5
Traditional or religious belief	14	6.1
Had planned to travel to hospital during labour	13	5.7
Other reasons	11	4.8
Missing	2	0.9

Table 2.10 *Antenatal care enrolment*

First ANC* visit	Home birth, n = 228	%	Hospital birth, n = 813	%
< 21 weeks	35	15.4	188	23.1
21 - 30 weeks	102	44.7	408	50.2
30 - 40 weeks	50	21.9	180	22.1
Unbooked	41	18.0	37	4.6

*Antenatal clinic

Table 2.11 *Perinatal mortality by weight and place of delivery*

Birth weight in grams	Home birth, n=228	Hospital birth, n=813
< 1,500	5	4
1,500 - 1,999	2	4
2,000 - 2,500	-	1
>= 2,500	1	8
Missing	1	1
Total	9	18

term primi-gravid women who delivered at home due to postpartum haemorrhage, and in one grand multiparous woman who died in hospital from cerebral malaria. No severe maternal morbidity like uterine rupture was reported. In the district 27 perinatal deaths were identified. Perinatal mortality did not differ significantly (OR 0.6; $CI_{95\%}$ 0.2-1.4) between hospital (22/1,000) and home (39/1,000) births. It seemed, however, that perinatal mortality at home was more often caused by severe low birth weight (Table 2.11).

Caesarean section rate for the district was 2.5% (26/1,041) and symphysiotomy was performed in 0.6% (6/1,041) of all births. The vaginal birth after caesarean section rate (VBAC) was 64% (25/39). Women with a previous caesarean section (OR 13.9; $CI_{95\%}$ 2.3-566) and primiparous women (OR 2.4; $CI_{95\%}$ 1.6-3.7) gave significantly more often birth in hospital than at home (Table 2.12). Women with at least four previous births (OR 0.6; $CI_{95\%}$ 0.4-0.9) gave significantly more often birth at home (Table 2.12). Women with a previous postpartum haemorrhage delivered more often at home, but the difference was not statistically significant (OR 0.5; $CI_{95\%}$ 0.2-1.0). The number of women with a previous perinatal death did not differ significantly between home and hospital births. All breeches were born in hospital and twins were born more often at home, but no significant difference was reached (Table 2.12).

Table 2.12 *Obstetric risk factors among home births, hospital births and users of maternity waiting homes*

Risk factor	Home birth n = 228	%	Hospital birth n = 813	%	MWH n = 616	%	Odds ratio* $CI_{95\%}$
Primi para	*n = 35*		*n = 248*		*n = 195*		
Height < 155 cm	$3^{m=1}$	8.8	$45^{m=6}$	18.6	$33^{m=3}$	17.2	2.4 (0.7-12.6)
Multipara	*n = 193*		*n = 565*		*n = 421*		
Previous caesarean section	1	0.5	$38^{m=2}$	6.7	$22^{m=1}$	5.2	13.9 (2.3-566)†
Previous perinatal mortality	11	5.7	49	8.7	31	7.4	0.6 (0.3-1.3)
Previous postpartum haemorrhage	$13^{m=1}$	6.8	$18^{m=2}$	3.2	$12^{m=1}$	2.9	0.5 (0.2-1.0)
All women included	*n = 228*		*n = 813*		*n = 616*		
Parity five or above	61	26.8	150	18.4	111	18.0	0.6 (0.4-0.9)†
Breech presentation	0	0	12	1.5	7	1.1	p = 0.08‡
Twins	7	3.1	13	1.6	11	1.8	0.5 (0.2-1.5)
Unbooked for ANC	41	18.0	37	4.6	0	0	0.2 (0.1-0.4)†
Primi para	35	15.4	248	30.5	195	31.7	2.4 (1.6-3.7)†

* Odds ratio's calculated between home and hospital births

† Difference is statistically significant

[m] Missing values

‡ Fisher exact test

2.4.5 Discussion

With regard to the number of women making use of MWHs in Mberengwa district, our survey showed that the concept of MWHs was a success. We observed a relatively high hospital birth rate of 78%, with approximately 60% of all women making use of a MWH. Surveys in other rural areas of Zimbabwe, without the long tradition of maternity waiting homes, report institutional deliveries of 40 - 49% (7). In rural Transkei without MWHs, two-third of women had delivered at home (8). It is likely that the use of MWHs in Mberengwa district was instrumental to the high percentage of hospital births. It is difficult to assess the effectiveness and influence of the MWHs on good obstetric outcome.

On the one hand, district health parameters like perinatal mortality, maternal mortality, the number of uterine ruptures and caesarean section rate give an indication about the level of obstetric care when compared to other areas in Zimbabwe and Africa. These parameters, all related to the accessibility of care, are promising for Mberengwa district. The district perinatal mortality of 26/1,000 was low compared to a perinatal mortality ranging from 56 to 72/1,000 at the provincial hospital and was about the same as the perinatal mortality of 30.6/1,000 in a district close to the provincial hospital with good transport facilities (9;10). Perinatal mortality was higher at home than in hospital and seemed more often to be related to low birth weight and preterm birth. In rural Tanzania, a similar observation was described by Walraven et al. (11). In Mberengwa, out of 9 home perinatal deaths, 7 weighed less than 2,000 gram. These deaths could not have been prevented by a stay in a MWH from 36 weeks onwards. Two term primi-gravid women who gave birth at home died of postpartum haemorrhage and one woman died of cerebral malaria in hospital. At the time of the survey, primiparae were not considered as high risk pregnancies. Uterine rupture, a frequent complication in areas with poor transport without MWHs, did not occur (2). The caesarean section rate (2.5%) together with the symphysiotomy rate (0.6%) were low and around the estimated need of 5% caesarean sections in rural Africa (12;13). A lower abdominal delivery and symphysiotomy rate would have indicated that women had insufficient access to maternity care. It is likely that the MWHs in Mberengwa district played an important role in preventing complications due to transport problems.

On the other hand, effectiveness of a MWH can be measured by its integration in the community and its ability to select high risk pregnancies. Women identified the purpose of MWHs very clearly, because 86% stayed at a MWH in order to have good access to medical care. Lack of money was the main reason to give birth at home for 35% of women. Only 6%

gave birth at home out of traditional belief, indicating that MWHs were widely accepted by the community. The MWHs functioned well in selecting high risk pregnancies for giving birth in hospital. Only one woman with a previous caesarean section (OR 13.9; CI $_{95\%}$ 2.3-566) gave birth at home. Although primiparae were not officially labelled as high risk pregnancies, through self referral they gave significantly more often birth in hospital (OR 2.4; $CI_{95\%}$ 1.6-3.7). Obviously the risk selection failed for women with a parity of five or more (OR 0.6; $CI_{95\%}$ 0.4-0.9) and for women without antenatal care (OR 0.2; $CI_{95\%}$ 0.1-0.4). Selection by maternal height, breech presentation, twin pregnancy, previous perinatal mortality or previous postpartum haemorrhage did not reach statistical significance.

The MWHs are a success in Mberengwa district not only because many pregnant women (59%) use them, but they are as well effective in improving the accessibility to obstetric care especially for women with high risk pregnancies. Further advancement in selecting high risk pregnancies could be obtained through more health education. Obviously a previous caesarean section is widely accepted as an obstetric risk factor in a future pregnancy. The antenatal visit seems the right time to review the previous birth experience and to explain its implications for the coming birth. Primiparae and women with a bad obstetric history, like a previous perinatal death or postpartum haemorrhage, should be stimulated to stay at a MWH. Under the present circumstances, without ultrasound scans, it is not likely that better detection of twin pregnancies and breech presentations can be achieved. Improving the survival of low birth weight and premature babies would need major social, educational and economic changes (14). When geographical access is a problem, however, MWHs should be built in a realistic attempt to improve obstetric outcome.

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2.5 Trial of labour after previous caesarean section in rural Zimbabwe

Wilbert A. Spaans [1], Frans H. van der Velde [2], Jos van Roosmalen [3].

[1] Resident in Obstetrics and Gynaecology, University Hospital, Amsterdam, the Netherlands

[2] Resident in Family Health and Community Medicine, University of Maastricht, the Netherlands

[3] Consultant Obstetrician, Leiden University Hospital, the Netherlands

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2.5.1 Abstract

Objective

Vaginal delivery after previous caesarean section is widely accepted in Western countries. Is a trial of labour in rural Africa also safe for mother and child ?

Study Design

In a case control study in rural Zimbabwe the outcome of labour of 281 women who had one or more previous caesarean sections was compared to 4,501 women who had no previous caesarean section. Maternal and perinatal mortality, the percentage of vaginal birth and factors related to the achievement of vaginal delivery were studied. Data were tested for statistical significance with a Mantel-Haenszel equation for odds ratio's.

Results

No elective caesarean sections were performed. 124 Women (44%) out of 281 had a vaginal birth after previous caesarean section. One scar rupture occurred in a woman with thyrotoxicosis. Perinatal and maternal outcome did not differ significantly between cases and controls. A history of more than one previous caesarean section (OR 10.0; $CI_{95\%}$ 4.4-23.8) or a previous caesarean section for cephalopelvic disproportion (OR 6.2; $CI_{95\%}$ 3.2-12.0) increased the risk for a repeat caesarean section significantly.

Conclusion

A policy of allowing all women a trial of labour after a previous caesarean section did not increase adverse pregnancy outcome. It seems rational, also in rural Africa, to encourage a trial of labour after one or more previous caesarean sections.

2.5.2 Introduction

Caesarean section rates have increased dramatically world wide since the 1970s (1). Extremes are found in the USA where nowadays about one quarter of all births is by caesarean section. Few data exist on less developed countries. It is estimated that in rural Africa approximately one percent of births end in caesarean section and that only one in five women who need a caesarean section are actually operated upon (1-3). On the other, hand a caesarean birth rate of 16.6% in a provincial hospital in Zimbabwe could safely be reduced to 8% after introducing new labour ward protocols (4). This suggests that some areas in Africa show a trend in caesarean section rates similar to the Western world.

In the USA, maternal mortality rates after caesarean section range from 0.02% to 0.07%. This relative safety of caesarean birth contributed much to the increase in abdominal deliveries (5).

In contrast to the Western world, caesarean section in Africa is relatively unsafe. In Sub-Saharan Africa maternal mortality rates after abdominal birth vary from 0.6% - 5% (6). From Zimbabwe De Muylder reported 15% major and 27% minor complications among women who underwent caesarean section (7). These data illustrate that the decision to perform caesarean section should not be taken too lightly.

How should women with a history of previous caesarean section be managed? In the Western world, the safety of a trial of labour is widely accepted (8;9). In rural Africa, labour is monitored by clinical assessment only. A trial of labour should be balanced against the risk of uterine scar rupture. In this study we report the evaluation of a policy to allow women a trial of labour after previous caesarean section in rural Zimbabwe with regard to maternal and perinatal mortality, the percentage of vaginal birth and factors related to its achievement.

2.5.3 Material and Methods

Mnene Hospital in the Southern part of the Midlands Province of Zimbabwe is the district hospital caring for 185,000 inhabitants of Mberengwa district. In this area of 5,500 km^2, five hospitals provide delivery care. Only in Mnene hospital and one other hospital instrumental vaginal and caesarean births take place. The other three hospitals refer their complicated cases to Mnene hospital. Antenatal care is provided in all health institutions, which include 22 rural clinics. Two third of women deliver in one of the health institutions in the district and about one third deliver at home with help from a traditional birth attendant. Haemoglobin levels are hardly checked, but the majority of patients is screened for syphilis. Ultrasound is not available. Transport in the district is poor, and referral possibilities from clinics and hospitals to Mnene

are limited. Women with high risk pregnancies are encouraged to stay at the Mnene maternity waiting home from a pregnancy duration of 36 weeks onwards. In a survey by the Ministry of Health in 1994 80% of women who had had a previous caesarean section, were estimated to use maternity waiting homes.

All women with a previous caesarean section who delivered between the 1st of January 1991 and the 31st of December 1993 at Mnene Hospital, were included in the study. Data on mode of delivery, indication for the previous caesarean section, obstetric history, maternal complications and perinatal outcome were obtained from medical records, delivery and theatre books. All women with a history of previous caesarean section were allowed a trial of labour. Data from all women who had never had caesarean section and who delivered during the same period at Mnene hospital were used as controls. Pregnancy outcome in the control group was ascertained in the same way as in the cases. A trial of labour was defined as regular uterine contractions with cervical changes taking place or premature rupture of membranes without contractions within 24 hours. Oxytocin was not used to induce or augment labour. Monitoring of labour was done by clinical assessment only together with a partograph (10). Deliveries were conducted by nurses or midwives under supervision of medical officers on duty. None of these was a specialist obstetrician, but all of them were experienced in both obstetrics and surgery. Nurses with a training in anaesthesia were available. Caesarean sections were mostly performed under spinal anaesthesia, set by a medical officer or nurse. As medication bupivacaine, 0.5% solution in 5% dextrose, or lignocaine, 5% solution in 5% dextrose, was used. The data were tested for statistical significance with a Mantel-Haenszel equation for odds ratio's (OR). The Fisher exact 2-tailed test was used in case of low cell numbers. Statistical analysis was performed using Epi-Info package (11).

2.5.4 Results

During the study period 281 women (5.9%) out of 4,782 births had a history of one or more previous caesarean sections. Of these, 209 (75%) had one, 57 (20%) had two and 15 (5%) had three previous caesarean births. The number of caesarean sections in the total group was 465 (9.7%), of which 157 (34%) were repeat abdominal births. Within the district, with a birth rate of 3.8% (census 1992) about 7,000 deliveries were expected per year, of which two third delivered at one of the health institutions. At Mnene hospital there were about 1,500 deliveries each year. The estimation of the district caesarean section rate was calculated from the district annual reports. From the other hospital in the district performing caesarean sections, 238 abdominal deliveries were reported during the study period. Therefore the caesarean section rate

Table 2.13 *Pregnancy outcome of women who had a previous caesarean section compared to women who had no previous caesarean section*

Outcome	Previous caesarean section		No previous caesarean section		OR/Fisher exact	
	n	%	n	%		$CI_{95\%}$
Vaginal birth	124/281	44.2	4,193/4,501	93.2	0.06*	(0.04-0.08)
Caesarean section	157/281	55.8	308/4,501	6.8	17.2*	(13.2-22.6)
Uterine rupture	1/281	0.4	3/4,501	0.07	5.4	(0.6-51.2)
Maternal death	1/281	0.4	2/4,501	0.04	8.0	(0.7-88.1)
Stillbirth	8/281	2.8	68/4,501	1.5	1.9	(0.8-4.1)
Early neonatal death	4/281	1.4	64/4,501	1.4	1.0	(0.3-2.9)
Perinatal death	12/281	4.3	132/4,501	2.9	1.5	(0.8-2.8)
Apgar < 7	7/281	2.5	58/4,501	1.3	2.0	(0.8-4.5)

* Statistically significant

for the district was estimated around 3%. The majority of caesarean sections was performed because of cephalopelvic disproportion or failure to progress.

The outcome of pregnancy for those who had and those who had no previous caesarean section is summarised in Table 2.13. After a trial of labour 124 (44%) women delivered vaginally. For women with a history of previous abdominal birth the chance to deliver again by caesarean section was 17 times higher than for women who had not experienced caesarean birth before. When looking at the group of women with only one previous caesarean section, 116 (56%) delivered vaginally (Table 2.14). Maternal death, low apgar score (< 7), and perinatal death did not differ significantly between the two groups (Table 2.13). One woman in the previous caesarean section group died of uterine rupture: she had two vaginal births after a previous caesarean section. She was admitted with thyrotoxicosis and in an attempt to avoid anaesthesia, labour was augmented with oxytocin. Suddenly she developed signs of uterine rupture, and died during surgery.

The relation between the obstetric history of women with a previous caesarean section and the outcome of a trial of labour is illustrated in Table 2.14. Out of 72 women with more than one previous caesarean section 64 (89%) and out of 91 women with a previous caesarean section for cephalopelvic disproportion (CPD)/failure to progress (FTP) 75 (82%) delivered by repeat caesarean birth. These caesarean birth rates were significantly higher than for women with only one previous caesarean section (OR 10.0; $CI_{95\%}$ 4.4-23.8) or women with no

Table 2.14 *Obstetric history of women who had a previous caesarean section in relation to the outcome of a trial of labour*

Obstetric history	Outcome trial of labour is repeat caesarean section			
	n	%	OR	$CI_{95\%}$
All previous caesarean sections (n = 281)				
Previous caesarean section > 1 (n = 72)	64/72	89		
Previous caesarean section = 1 (n = 209)	93/209	44	10.0	4.4-23.8
Previous caesarean section for CPD/FTP (n = 91)	75/91	82		
Previous caesarean section for other reasons (n = 190)	82/190	43	6.2	3.2-12.0
Previous SVD (n = 109)	34/109	31		
No previous SVD (n = 172)	123/172	72	0.2	0.1-0.3
Only para I (n = 113)				
Previous caesarean section for unknown reason (n = 38)	14/38	37		
Previous caesarean section reason known (n = 75)	57/75	76	0.2	0.1-0.5
Only para I[a] (n = 75)				
Previous caesarean section non recurrent[b] (n = 20)	10/20	50		
Previous caesarean section for CPD/FTP (n = 55)	47/55	85	0.2	0.1-0.6

[a] Thirty-eight women with an unknown reason for the previous caesarean section were excluded

[b] Non recurrent: e.g. prolapsed cord, fetal distress or breech.

history of CPD/FTP (OR 6.2; CI $_{95\%}$ 3.2-12.0). Repeat caesarean birth was significantly decreased (OR 0.2; CI $_{95\%}$ 0.1-0.3) after a prior vaginal delivery (34/109, 31%) versus no prior vaginal delivery (123/172, 72%) and after previous caesarean section for a non recurrent cause (10/20, 50%) versus CPD/FTP (47/55, 85%) (OR 0.2; CI $_{95\%}$ 0.1-0.6). Also women with an unknown indication for the previous caesarean section (14/38, 37%) had significantly less chance to deliver by repeat caesarean section (OR 0.2; CI $_{95\%}$ 0.1-0.5) than women with a known indication (57/75, 76%). Eight women (2.8%) with previous caesarean section delivered a child in breech presentation. Two stillborn breeches were delivered vaginally. Six breeches were delivered alive, five abdominally, and one vaginally (3,550 gram). Four women with previous caesarean section were expecting twins. Three of them delivered by caesarean section, one delivered vaginally.

Table 2.15 *Details on perinatal deaths among 281 women who had a previous caesarean section*

Information on mother and child	Mode of delivery	NND	SB
Infarction placenta, postterm, 2,460 gram, P1	CS	*	
Apgar > 7, sudden death, 2,320 gram, > P1	CS	*	
Premature, 1,320 gram, > P1	VD	*	
Premature, 1,020 gram, > P1	CS	*	
Breech, 1,700 gram, P1	VD		*
Breech, 1,185 gram, > P1	VD		*
Rupture of uterus, 2,660 gram, > P1	CS		*
Cord prolaps, 3,500 gram, > P1	VD		*
Abruptio placentae, 2,120 gram, > P1	CS		*
Macerated SB, 1,530 gram, > P1	VD		*
Fresh SB, 3,920 gram, > P1	VD		*
Fresh SB, 3,980 gram, > P1	VD		*

P1 = one previous delivery which was a caesarean section; > P1 = multipara

Perinatal mortality of children from women with previous caesarean section is shown in Table 2.15. Case 7 is the new-born of the woman described above with thyrotoxicosis. This adverse outcome of both mother and child was the only one, directly related to the policy of a trial of labour.

2.5.5 Discussion

In our hospital one in 17 women presented with a history of previous caesarean birth, which illustrates the need for a protocol of labour following caesarean section. A study in Gweru, Zimbabwe, indicated that women who experienced a caesarean section have reduced compliance to health care in subsequent pregnancies; more frequently they failed to attend antenatal clinic or even opted for unsupervised home delivery (12). In order to promote hospital delivery, women with a previous caesarean section generally were allowed a trial of labour. Our results suggest that this policy did not result in significantly higher maternal or perinatal mortality rates. The only death of a woman with a previous caesarean section occurred in a woman with thyrotoxicosis. This woman sustained the only scar rupture in our series. Perinatal mortality in births to women with a previous caesarean section (43/1,000) was not significantly different from that to women without a previous caesarean section (29/1,000). Of the 12 women with a perinatal death, 3 cases (1, 11 and 12) might have gained from elective caesarean section.

It is not likely, however, that allowing all women a trial of scar had a negative influence on perinatal outcome.

The issue whether a uterine scar can bear the constraints of subsequent labour has arisen in many rural African hospitals, resulting in several reports. Our results are in agreement with most studies from Sub-Saharan Africa (Table 2.16). The overall maternal mortality of 3 per 3,005 (0.1 %) seems surprisingly low in relation to reported mortality figures of 0.6 - 5% after caesarean section (6). This may be put forward as evidence of the relative safety of a trial of labour. There can be, however, a publication bias of studies with the best outcomes, which may account for a lower maternal mortality in this overview than in reality occurred. The criteria to perform elective caesarean section differed from study to study. Studies with more elective caesarean sections (13-15) did not have better maternal or perinatal outcome than studies with few elective operations (16-18). In studies with more elective operations a trial of labour is often more successful ((vaginal delivery/trial of labour) x 100). After combining all studies of Table 2.16, the median vaginal delivery rate following previous caesarean section is 45% (range 26% to 75%).

Our results indicate that, even under the conditions of a rural African hospital, a trial of labour in women who had a previous caesarean section is relatively safe when compared to the outcome of pregnancy in women who had no previous caesarean section. At Mnene hospital the necessary early observations during labour were possible due to the existence of a maternity waiting home. Women with a history of more than one previous caesarean section or a history of CPD were significantly more at risk of repeat abdominal delivery. Less than 20% of them delivered vaginally. However a study from Chicago supports allowing a trial of labour for women with more than one previous caesarean section, even when the indication for the primary operation was dystocia (19). Performing elective pre-labour caesarean section in all these women might sometimes result in iatrogenic preterm birth, because often gestational age is not really known. Even with gestation at term the incidence of respiratory morbidity was reported to be significantly higher for babies born before the onset of labour (20). Therefore, it seems rational to encourage a trial of labour following one or even more than one previous caesarean section.

Acknowledgements

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Table 2.16 *Overview of Sub-Saharan studies describing labour following caesarean section*

Reference	Country	n	Elective caesarean section (repeat) (%)	Emergency caesarean section (%)	Vaginal delivery (VD) (%)	Trial of labour (TOL) (%)	(VD/TOL) x 100 (%)	Uterine rupture	Maternal mortality	Perinatal mortality
Mock, 1991(21)	Ghana	220	23	27	50	77	66	1	1	14
Walton, 1978 (13)	Kenya	382	52	12	36	48	75	12	0	27
Van der Wijden, 1993 (22)	Lesotho	74	20	24	56	80	69	0	0	2
Granja, 1991 (23)	Mozambique	211	15	40	45	85	53	2	0	6
Egwuatu, 1990 (14)	Nigeria	274	63	10	27	37	72	5	0	9
Ojo, 1989 (16)	Nigeria	142	8	17	75	92	82	0	0	8
De Jong, 1987 (15)	South-Africa	212	33	41	26	67	39	1	0	1
Van der Walt, 1994 (24)	South-Africa	189	21	34	45	79	57	4	1	2
Van Roosmalen, 1991 (17)	Tanzania	134	_	35	65	100	65	9	0	13
Nyirjesy, 1992 (18)	Zaire	34	3	32	65	97	67	3	0	2
Wadhawan, 1983 (25)	Zambia	451	29	26	45	71	63	1	0	22
De Muylder, 1988 (26)	Zimbabwe	401	28	13	59	72	82	2	0	20
Mnene Hospital	Zimbabwe	281	_	56	44	100	44	1	1	12
Median and totals		3,005	21	27	45	79	66	41	3	138

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Chapter 3

Caesarean Section and Trial of Labour in the Netherlands

3.1 Obstetric care, caesarean section and VBAC in the Netherlands

Obstetric care in the Netherlands differs from other industrialised countries. The organisation of obstetric care is divided into two levels: primary care by independent midwives or general practitioners for low-risk women and secondary care for medium- and high-risk women by obstetricians, who have access to all modern technology. In contrast to other Western countries, home birth is still popular throughout the Netherlands, despite the fact that the overall percentage of home births decreased from 68% in 1965 to 35% in 1980, stabilising around 30% in the 1990s. In 1993, the central registration of home births in the Netherlands was terminated, but a recent study by TNO, covering the period 1995-2000, showed no further decrease in the amount of home births. Every year about 62,000 women give birth at home in the Netherlands (1). Of all home deliveries, 95% are under the responsibility of independent midwives and 5% are under responsibility of general practitioners. In addition to home deliveries, about 10% of women give birth in hospital as an out-patient, under supervision of their own midwife or general practitioner. Some Dutch demographic indicators are outlined in Table 3.1 and, for reasons of comparison, Zimbabwean indicators are added.

Table 3.1 *The Netherlands and Zimbabwe demographic and obstetric indicators in 2002 (1-4)*

Indicators	the Netherlands	Zimbabwe
Population size (millions)	16	11 - 13
Population growth rate %	0.3	0.05 – 1.7
Female life expectancy, years	80.7	37 - 42
Male life expectancy, years	75.8	38 - 43
Crude birth rate/1,000	12.6	25
Crude death rate/1,000	8.7	24
Total fertility rate per woman	1.7	5
Total number of deliveries (2000)	205,123	400,000
Home deliveries	62,000	?
HIV/AIDS prevalence rate %, (female/male)	0.1/0.2*	40/15*
Maternal mortality ratio per 100,000	12	610
Perinatal mortality per 1,000	7.9	50 - 70
Child mortality < 5 per 1,000, female/male	5/6	119/129

*15-24 years

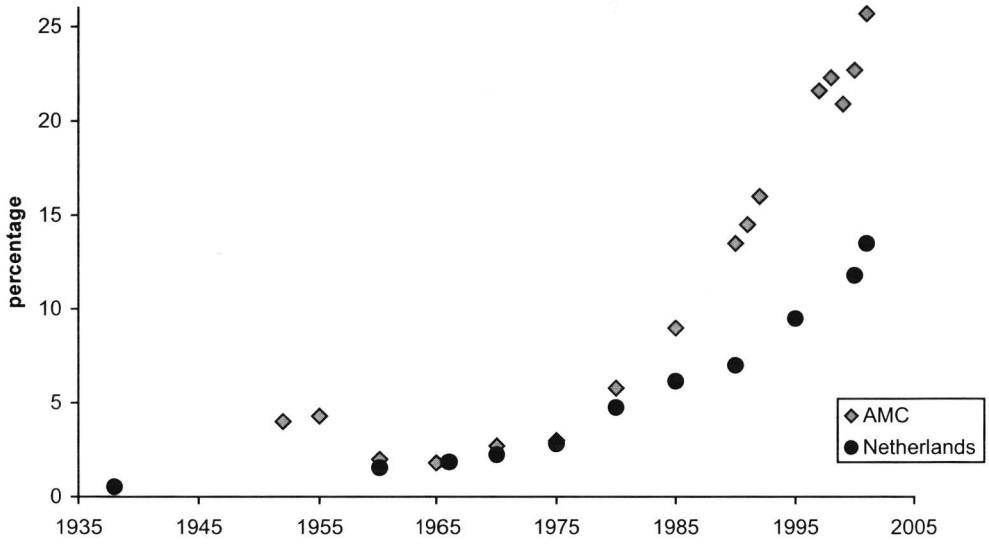

Figure 3.1 *Caesarean section rates in the Netherlands and the Wilhelmina Gasthuis / Academic Medical Centre (AMC)*

As in most Western countries, the caesarean section rate in the Netherlands started to increase gradually in the 1970s (Figure 1.4, section 1.5.1). However in 2001, it is still low compared to other Western countries. The infrastructure of Dutch obstetric care, with independent primary care attendants (midwives and general practitioners) responsible for the previously mentioned 30% home births, was mentioned as an explanation for the lower caesarean section rates by Treffers and Pel in 1993 (5). But the Dutch national rates could just be lagging behind and might approach the higher foreign rates in future. Figure 3.1 shows that the national caesarean section rates reached a level of more than 13% in 2001. The institutional caesarean section rates, especially at tertiary level, have increased even more rapidly than the national rates; the Wilhelmina Gasthuis/Academic Medical Centre in Amsterdam started at about 5% in 1952, decreased to a level of below 2% during the sixties and the seventies, after which it continued to rise sharply, reaching 10% in 1984, 20% in 1997, 22.7% in 2000 and 25.7% in 2001 (Figure 3.1) (6;7). Apart from the reasons for a rising caesarean section rate, discussed in chapter one, the development of high risk neonatal care units and that of third line obstetric care have contributed to this rapid increase. The

catchment area of the present Academic Medical Centre (AMC), on the outskirts of Amsterdam, differs much from its precursor, the Wilhelmina Gasthuis which was situated in the inner city of Amsterdam. Nowadays, antenatal intra-uterine transfers of high risk pregnant women from all over the country are among the patient population.

The development and safety of caesarean section and its changing indications are described in chapter one. In the AMC, mortality due to caesarean section decreased rapidly from 12.4% (Treub, 1898 - 1920), 6.5% (v. Rooy, 1920- 1929), 5.8% (v. Rooy, 1929 - 1939) 1.8% (v. Bouwdijk Bastiaanse, 1939 - 1950) to 0% in a 16 year period (v. Bouwdijk Bastiaanse-Kloosterman, 1950 -1966) (8), and since the 1960s it has become an extremely rare event.

Parallel to the international literature, several Dutch theses on caesarean section have been published. An overview is given in Table 3.2. These theses summarise the national and international development of the caesarean operation. Before 1945, the mortality and morbidity of both mother and child were high, but decreased gradually as described by Ynzonides (9), Adriani (10), Van Leeuwen (11), Houtman (12), Ketel (13) and Bouwer (14). The first major improvement was suturing of the uterine wound. In an effort to improve maternal outcome, hysterectomy immediately after caesarean delivery was promoted by Adriani, but this mutilating procedure became obsolete with the development of the lower segment caesarean technique and asepsis. Noteworthy is that, from 1945 onwards, Dhont (15) Stokhuyzen (16) and van Vugt (17) advocated vaginal birth after caesarean section, opposing elective repeat caesarean section with the only indication "previous caesarean". Dhont identified lower segment caesarean section, having a lower risk of uterine rupture during subsequent labour. Spinal anaesthesia and antibiotic prophylaxis were the last major improvements which reduced maternal mortality and morbidity. In 1950, spinal anaesthesia was even then preferred to general anaesthesia in Amsterdam (Stokhuyzen), while up to 1967 all caesarean sections in Leiden were performed under general anaesthesia (Bessem) (16;18). Antibiotic prophylaxis during caesarean section (elective and emergency) was still not widely used in 1983, despite the available evidence that it reduces postoperative infections (Roex) (19). The liberal approach in Dutch theses towards trial of labour after previous caesarean section contrasted the dogmatic "once a caesarean, always a caesarean" policy practised in the USA (20).

Table 3.2 *Theses on Caesarean Section in the Netherlands*

	Title	Method	Major conclusions
G. Ynzonides, 1874 Utrecht (9)	Bijdrage tot de geschiedenis der Sectio Caesarea	Description of the first 95 known caesarean sections in the Netherlands up to 1873.	Maternal mortality 68%, perinatal mortality 32%.
D.H.N. Adriani, 1890 Groningen (10)	Beknopte geschiedenis der keizersnede van 1869 tot 1890	Literature review of caesarean techniques since 1869.	Mortality by the Porro operation (supra-vaginal hysterectomy with caesarean section) and the classical Sänger operation was around 15%. Adriani was a strong supporter of the Porro caesarean section and believed it would replace the classical caesarean after some time.
Th. M. Van Leeuwen, 1904 Utrecht (11)	Herhaalde sectio caesarea	Description of morbidity after one or more (classical) caesarean sections. n=59 between 1899 – 1904 (Treub, Veit, Nijhoff, Kouwer) and literature study. Animal study on 12 rabbits.	Morbidity due to postoperative fever 90%. Suturing essential: regeneration of muscle fibres without leaving scar tissue in the uterus was believed to occur if properly sutured. Less infection in puerperium after repeat caesarean section. No information on VBAC or uterine rupture or maternal mortality. Animal study confirmed the importance of suturing of the uterus.
Houtman, 1919 Amsterdam UVA (12)	Sectio caesarea bij eclampsie	Description of 64 caesarean sections between 1875 and 1918 indicated because of eclampsia (reported by all gynaecologists in the Netherlands).	Maternal mortality 33% before 1908 and 16% after 1908. Perinatal mortality about 20% with caesarean delivery compared to 40% during conservative management.
A.P. Ketel, 1922 Utrecht (13)	Keizersnede	Description of classical (n=91) and cervical (n=26) caesarean sections between 1907 – 1920. Rotterdam (de Snoo), number of women 89, 31 repeat caesarean sections.	Caesarean section rate ?, Maternal mortality 3.4%, perinatal mortality 8.5% Postoperative fever (about 80%), did not differ between cervical or classical operations. In puerperium after repeat caesarean less infection. Suturing material: catgut.
S. Bouwer, 1923 Groningen (14)	Keizersnede bij placenta praevia	Description of 34 women with placenta praevia delivered by caesarean section between 1907 - 1923, Groningen.	Maternal mortality 6%, perinatal mortality 18%. Classical caesarean section. Placenta praevia without caesarean section (n=176): maternal mortality 6 - 11% and perinatal mortality 29 - 78%.

To be continued

Table 3.2 *continued*

	Title	Method	Major conclusions
C.M. Dhont, 1945 Amsterdam, UVA (15)	Over de sectio caesarea en hare betekenis als verloskundige methode	Description of (lower segment) caesarean sections between 1929 – 1939. Vrouwenkliniek Amsterdam (van Rooy) n=520 (460 women).	Caesarean section rate 3%, maternal mortality 5.8%, perinatal mortality 12.7%. Puerperium after CS: 31% less than 3 weeks admitted. 69% complicated, mainly due to postoperative infection. VBAC rate 23% (46/202), VBAC rate after pelvic disproportion 13% (17/128). Uterine rupture: 3, all after previous classical or lower midline cervical CS. Lower segment caesarean section preferred approach. Suturing material: catgut.
A.W. Stokhuyzen, 1952 Amsterdam UVA (16)	De Keizersnede Methode en Analgesie	Description of caesarean sections (n=670) between 1939 – 1950. Vrouwenkliniek Amsterdam, (Bouwdijk Bastiaanse).	Caesarean section rate 3.8%, maternal mortality 1.8%, perinatal mortality 5.4%. VBAC rate 35% (68/193), no uterine ruptures. Lower segment caesarean section preferred approach. Spinal anaesthesia preferred to general anaesthesia. The dogma "Once a caesarean, always a caesarean" is not adhered to by Bouwdijk Bastiaanse.
Van Vugt, 1966 Utrecht (17)	De latere gevolgen van de keizersnede	Description of 214 women with at least one previous caesarean section (1946-1952). H. Johannes de Deo Hospital, The Hague.	VBAC rate 57% (122/214). Success rate 87% (122/141). Uterine rupture 1.4%, perinatal mortality (corrected) 3.2%, maternal mortality 0%. Trial of labour is advisable after a previous lower segment caesarean, but after other incisions of the uterus a repeat caesarean should be the treatment of choice.
Bessem, 1969 Leiden (18)	Keizersnede	Description of caesarean sections (n=657) between 1946 - 1967. Universiteits-Vrouwenkliniek Leiden (Holmer, Sikkel).	Caesarean section rate 2.5%, maternal mortality 2.5% (1946), 0,6% (1956) 0% (1961 - 1967), perinatal mortality 5.7%. No information on VBAC. Lower segment caesarean section 88.5%. Only general anaesthesia (up to 1967).
Roex, 1986 Amsterdam VU (19)	Sectio caesarea en antbiotica profylaxe	Nation wide questionnaire on antibiotic prophylaxis and caesarean section. Randomised clinical trial on the effect of antibiotics (n=129) on the occurrence of infections following caesarean section (1983).	Antibiotic prophylaxis in all caesarean sections was used by 25% of hospitals. Antibiotic prophylaxis reduced postoperative infection compared to placebo: febrile morbidity 23% vs 45%, endometritis 3% vs 14%, wound infection 2% vs 11%, urinary tract infection 0% vs 16%.

VBAC rates have been reported in several Dutch studies (Table 3.3), reaching more than 50% in recent years. In a study by Elferink-Stinkens et al., trends for caesarean section in women with a previous caesarean section were calculated. In 1983, out of 762 women 33% had a repeat caesarean section and in 1992 out of 3,028 women 41% had a repeat caesarean, thus showing a rising trend in repeat caesarean sections (24). In the Netherlands, however, no information is available on VBAC rates on a yearly basis, due to the fact that the perinatal database of the Netherlands (LVR) has no code for vaginal birth after caesarean section. Therefore, maternal and neonatal complications after trial of labour, as discussed in section 1.6, are difficult to monitor. On the other hand, the "Dutch Obstetric Peer Review" project (Verloskundige Onderlinge Kwaliteitsspiegeling, VOKS) is a powerful tool in comparing obstetric intervention rates from different hospitals. Data used in the VOKS are obtained from the national perinatal database. Statistical models based on the distribution of risk factors, were developed, adjusting for population differences between obstetric departments. Differences between the expected number of interventions (labour inductions, caesarean sections and vaginal operative deliveries) and the actual numbers are calculated and presented. Each year, the obstetricians in the Netherlands are receiving a report on the expected and observed intervention rates, as well as their relative position with respect to other departments (Figure 3.2) (25). The academic centres of both Amsterdam and Leiden have less frequent intervention rates than the average Dutch hospital. Including VBAC rates into the "Obstetric Peer Review" reports might improve the quality of care concerning trial of labour after previous caesarean section.

Table 3.3 Vaginal birth after caesarean section in the Netherlands

Reference	n	VBAC Rate %
Dhont, 1945, (15)	202	23
Stokhuyzen, 1952 (16)	193	35
Van Vugt, 1966 (17)	214	57
Jansen, 1989 (21)	462	62
Roumen, 1989 (22)	249	61
Bais, 2001 (23)	252	56

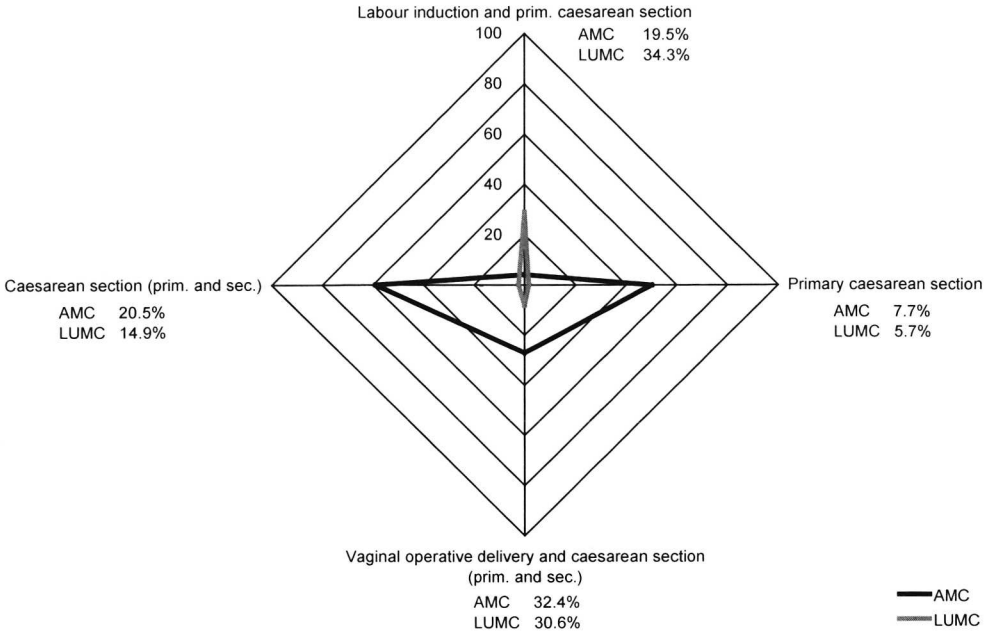

Figure 3.2 *Ranking of AMC and LUMC for average obstetric intervention rates in the period 1998 - 2002, compared to all other Dutch hospitals. The actual percentages of AMC and LUMC are shown for each obstetric intervention.*
E.g. a ranking of 30% of LUMC for labour induction and prim. cs, indicates that 70% of hospitals has a higher and 30% a lower intervention rate than 34.3%.

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3.2 Risk factors at caesarean section and failure of subsequent trial of labour

Wilbert A. Spaans[1], Myrthe B. Sluijs[2], Jos van Roosmalen[3] and Otto P. Bleker[4].

1. Consultant in Obstetrics and Gynaecology, Ziekenhuiscentrum Apeldoorn, the Netherlands.
2. Medical Student, University of Amsterdam, the Netherlands
3. Consultant Obstetrician, Department of Obstetrics, Leiden University Medical Centre, Leiden, the Netherlands.
4. Professor in Obstetrics and Gynaecology, Academic Medical Centre, Amsterdam, the Netherlands.

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3.2.1 Abstract

Objective

To identify risk factors at caesarean section, related to failure of a trial of labour (TOL) in subsequent pregnancy.

Study Design

Hospital records (1988 - 1999) of the index pregnancy were reviewed at caesarean delivery for oxytocin use, indication for caesarean, dilatation of cervix, speed of dilatation, duration of contractions and birth weight. The records of the subsequent pregnancy were reviewed for successful vaginal birth after caesarean (VBAC), maternal and neonatal outcome. Data were tested for statistical significance with a Mantel-Haenszel equation for odds ratio's (OR, with 95% confidence intervals, $CI_{95\%}$), a Fisher exact test or a student 't' test.

Results

From 214 women with a previous caesarean section, 68.7% underwent a TOL, which was successful in 71.4%. A labour pattern during the index pregnancy characterised by oxytocin use (OR 3.1; $CI_{95\%}$ 1.4-7.1), contractions for more than 12 hours (OR 3.0; $CI_{95\%}$ 1.3-7.0) and cervical dilatation less than 1 cm per hour (OR 5.6; $CI_{95\%}$ 1.1-39.4) increased the risk of a failed TOL at subsequent labour significantly.

Conclusion

Women who attempt VBAC may be informed that a labour pattern of their index pregnancy characterised by oxytocin use, contractions for more than 12 hours and slow dilatation is associated with a reduced chance of success. A partograph obtained during first labour can be a managerial tool for subsequent labour.

3.2.2 Introduction

Caesarean section rates have increased dramatically world wide since the 1970s. In the USA about one fifth of all births is by caesarean section (1). The dictum "once a caesarean, always a caesarean" dominated obstetric practice in the USA for nearly 70 years (2). This concept began changing gradually about 30 years ago and a number of reports have documented the relative safety of a trial of labour (3-7). However, patients who fail a trial of labour are at increased risk of infection and morbidity (8). Infants born by repeat caesarean delivery after a failed trial of labour also have increased rates of infection (9). The success rate of a trial of labour (TOL) has a minimum of around 50%, and increases up to 90% after a preceding vaginal birth (10-12).

However after caesarean delivery at full dilatation the success of a TOL was 13% in subsequent pregnancy in one study (13), while another reported 75% a success of a TOL after previous failed ventouse or forceps delivery (14). Therefore we asked ourselves whether the course of labour before the first caesarean section is related to failure of a trial of labour in subsequent pregnancy.

3.2.3 Methods

A retrospective review of charts and operative reports was performed at the Academic Medical Centre in Amsterdam, which is a university teaching hospital. The study period extended from January 1, 1988 through December 31, 1998. During this period 14,619 women delivered vaginally, and 3,120 women by caesarean section. All women were included whose first term pregnancy was terminated through a low transverse caesarean section and who gave birth at the Academic Medical Centre a second time during the study period. The first pregnancy was labelled the "index" pregnancy. The subsequent pregnancy in the same woman, in which she attempted a trial of labour or in which she underwent an elective caesarean section, was labelled the "next" pregnancy. We excluded those women who had a twin pregnancy in the index or next pregnancy. Breech and transverse presentations were included and analysed together. Files were identified from a computerised archive and hand searched. Records of the index pregnancy were reviewed for oxytocin use, dilatation of cervix, speed of dilatation, duration of contractions, indication for caesarean and birth weight. The records of the next pregnancy were reviewed for successful vaginal birth after caesarean (VBAC), maternal and neonatal outcome. Data were analysed with the statistical package of

Epi-Info and tested for statistical significance with a Mantel-Haenszel equation for odds ratio's, a Fisher exact test or a student 't' test.

3.2.4 Results

There were 6,322 term primi parous deliveries in the study period; 1,044 (16.5%) by caesarean section and 254 of these women met the inclusion criteria of our study. Complete information on index and next pregnancies was available in 214 cases. From 40 women files were missing, but crude information on pregnancy outcome was available from a computerised database.

From the first caesarean sections, 30 (14%) were elective procedures and 184 (86%) were emergency ones (Table 3.4). The main indication for elective caesarean delivery was fetal distress in 33.3% (n=10). For emergency caesarean section the main indications were failure to progress (FTP) or suspected cephalic pelvic disproportion (CPD) in 44.6% (n=82), followed by fetal distress in 40.8% (n=75) (Table 3.5). A total 55 women (25.7%) had reached the second stage of labour before the first caesarean section was performed.

In the next pregnancy, 31.3% (n=67) had an elective repeat caesarean section (ERCS) and 68.7% (n=147) a trial of labour (TOL). Trial of labour was successful in 71.4% (n=105). Approximately 95% of patients in the next pregnancy gave birth after 37 weeks. ERCS, emergency caesarean section and vaginal birth after caesarean were equally distributed among the study population and the missing cases (Table 3.4). Through analysis of the records and operative reports of the next pregnancies, it was found that patient's request in 52.2% (n=35) was the main indication for ERCS. The leading indication for emergency (repeat) caesarean section was failure to progress (FTP) or suspected disproportion (52.4%, n=22) (Table 3.5).

We studied the labour records of the index pregnancy. The decision by the obstetrician to offer a trial of labour in subsequent pregnancy was found to be significantly related to the cervical dilatation at the moment of the first caesarean section. With more than 7 cm of cervical dilatation at the index caesarean section, the TOL rate was 37.1% (n=49) versus an ERCS rate of 56.9% (n=29) in the next pregnancy (OR 2.2; $CI_{95\%}$ 1.1-4.5). Previous birth weight did not differ between the patients who underwent an ERCS or a TOL.

The use of oxytocin (OR 3.4; $CI_{95\%}$ 1.4-8.4) or a history of failure to progress or suspected CPD (OR 2.9; $CI_{95\%}$ 1.3-6.8) in the index labour increased the chance of a failed TOL in next labour significantly. A trial of labour following an index labour with contractions lasting more than 12 hours (OR 3.0; $CI_{95\%}$ 1.3-7.0) or a cervical dilatation of less than 1 cm/h (OR 5.3; $CI_{95\%}$ 1.1-51.6) had significantly more chance of failing (Table 3.6).

Birth weight after vaginal birth (next labour) was significantly less than after failed TOL (p=0.001). The strongest indicator for a failure of TOL was a child weighing more than 4,000 grams (OR 6.6; $CI_{95\%}$ 2.4-18.4) (Table 3.7). With a birth weight of 4,000 g or less the success rate of a TOL was 78.7% (n=96), but above 4,000 g the success rate was 36% (n=9). Also slow progress of less than 0.5 cm/h during a TOL increased the chance of a failed TOL (p=0.01). However, induction or augmentation of next labour as well as gestational age of more than 40 weeks, did not influence the mode of delivery (Table 3.7).

In the study population, there were no maternal deaths. In index and next pregnancies, no uterine ruptures occurred. One scar dehiscence was noted at an elective repeat caesarean section in a next pregnancy. One child died in an index pregnancy of a placental abruption and one child in a following pregnancy of congenital malformations after an emergency caesarean section for fetal distress. Two children in the next pregnancy had an Apgar score lower than 7 at 5 minutes, one after vaginal birth and one after a failed TOL; both had an uneventful recovery.

3.2.5 Discussion

Women with a previous caesarean section who attempt a trial of labour have a high chance of success, regardless of clinical parameters. The overall success rates range from 60% to 80% (4;7;15). Our success rate of 71.4% is comparable to these reports. However, these figures are based on selected research populations. Many candidates for a trial of labour are often excluded and delivered by elective repeat caesarean section. In our study the overall vaginal birth rate after caesarean section was 49.1%. Women with a cervical dilatation of more than 7cm at the moment of the first caesarean were less likely to be offered a trial of labour in a subsequent pregnancy. The labour pattern at the time of the first caesarean section influenced the decision to offer a trial of labour. This might explain that in our study the reported association by Hoskins and Gomez of full previous cervical dilatation with a reduced chance of a subsequent successful VBAC was not found (13). However, other studies did not find a relation between previous reached cervical dilatation and success of a TOL (16;17).

Indicators for a relative cephalic pelvic disproportion during index labour, like oxytocin use, failure to progress, contractions for more than 12 hours and dilatation of less than 1 cm/h increased the chance of a failed TOL during next pregnancy. This is in accordance with several studies (18-20). In our study still 31 out 54 women (57%) in the next pregnancy group, with previous CS for FTP or suspected CPD, delivered vaginally.

Babies born vaginally following a successful TOL weighed less than babies born after a failed TOL. One may wonder if women with a previous caesarean who experience a failed trial of labour form a subgroup. A combination of relative disproportion between birth route and foetus and a dysfunctional uterus may lead to dysfunctional labour. In our study this relative disproportion was partly reflected by a cervical dilatation of less than 1 cm/h during the index labour and a cervical dilation of less than 0.5 cm/h during next labour, but most clearly the relative disproportion was expressed by the low success rate of a TOL (36%) with babies weighing more than 4,000 grams. A failure to progress during a TOL after a previous caesarean is most likely a sign of dysfunctional labour. Augmentation with oxytocin should be used with extreme caution in this subgroup of women, especially if the expected birth weight is more than 4,000 grams.

The partograph has been recommended as a tool for monitoring women with a previous caesarean section (21). The partograph has also been used for the assessment of those at risk of uterine rupture after a previous caesarean section (22).

Our study confirmed the speed of cervical dilatation as a tool in monitoring women with a previous caesarean section. The use of a partograph should be stimulated especially during a woman's first labour. If she gives birth by a caesarean section, this partograph can be helpful again during a subsequent trial of labour (23).

Table 3.4 *Characteristics of study population and missing cases*

	First Caesarean Section				**Second Caesarean Section**			
	Index				**Next**			
	Study population		Missing cases		Study population		Missing cases	
	n=214	%	n=40	%	n=214	%	n=40	%
Elective (repeat) CS	30	14.0	7	17.5	67	31.3	14	35.0
Emergency CS	184	86.0	33	83.5	42	19.6	8	20.0
Mean age (years)	28.7	sd 5.0	28.1	sd 5.1	31.7	sd 4.9	31.0	sd 4.9

Table 3.5 *Indications for the first and next caesarean section in the study population*

Indication CS	First Caesarean Section				Second Caesarean Section			
	Index, n=214				Next, n=109			
	Elective CS		Emergency CS		ERCS		Emergency CS	
	n=30	%	n=184	%	n=67	%	n=42	%
Fetal distress	10	33.3	75	40.8	10	14.9	16	38.1
FTP or suspected CPD[‡]	4	13.3	82	44.6	9	13.5	22	52.4
Breech presentation	5	16.7	25	13.6	4	6.0	3	7.1
Placenta praevia	3	10.0	0	0	0	0	0	0
Prolapsed cord	0	0	1	0.5	0	0	0	0
Patient's request	2	6.7	0	0	35	52.2	0	0
Anomaly of uterus	0	0	1	0.5	1	1.5	0	0
Other indications[§]	6	20.0	0	0	8	11.9	1	2.4

[‡] FTP/CPD=failure to progress or suspected cephalic pelvic disproportion

[§] Previous classical scar, arthritis of hip joints, ovarian cyst, condylomata acuminata, congenital myotonia, previous myomectomy

Table 3.6 *Risk factors at index labour related to failure of next trial of labour*

Risk factors at index labour	Outcome of next trial of labour (n=147)				
	Vaginal Birth After Caesarean		Failed TOL		
	n=94	%	n=39	%	OR and CI 95%
oxytocin use	40	42.6	28	71.8	3.4 (1.4 - 8.4)
FTP or suspected CPD[‡]	31	33.0	23	59.0	2.9 (1.3 - 6.8)
Contractions index >= 12 h	38	40.4	26	66.7	3.0 (1.3 - 7.0)
2nd stage index labour reached	22	23.4	10	25.6	1.1 (0.4 - 3.0)
Dilatation index labour < 1.0 cm/h	32[*]	62.7	18[**]	90.0	5.3 (1.1 - 51.6)

[‡] FTP/CPD=failure to progress or suspected cephalic pelvic disproportion

[*]43 missing, [**]19 missing

Table 3.7 *Risk factors at next labour related to failed trial of labour*

Risk factors at next labour	**Outcome of next trial of labour n=147**				
	Vaginal Birth After Caesarean		Failed TOL		
	n=105	%	n=42	%	OR and CI 95%
Dilatation during labour < 0.5 cm/h	1*	1.1	4**	17.4	p=0.01, Fisher exact
Induction of labour	7	6.7	4	9.5	1.5 (0.3 - 6.1)
Augmentation of labour[a]	18	18.0	8	21.0	1.2 (0.4 - 3.3)
Gestational age > 40 wks	50	47.6	25	59.5	1.6 (0.7 - 3.6)
Birth weight (mean, in grams)	3342	sd 530	3759	sd 691	p = 0.001, student 't'
Birth weight > 4,000 grams	9	8.6	16	38.1	6.6 (2.4 - 18.4)

*17 missing, **19 missing

[a]induction of labour excluded

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3.3 Trial of labour after two or three previous caesarean sections

Wilbert A. Spaans[1], Laura M.E. van der Vliet[2], Elisabeth A.M. Röell-Schorer[3], Otto P. Bleker[4] and Jos van Roosmalen[5].

1. Consultant in Obstetrics and Gynaecology, Gelre Ziekenhuis, Apeldoorn, the Netherlands.
2. Medical Student, University of Amsterdam, the Netherlands.
3. Medical Student, Leiden University Medical Centre, the Netherlands.
4. Professor in Obstetrics and Gynaecology, Academic Medical Centre, University of Amsterdam, the Netherlands.
5. Consultant Obstetrician, Department of Obstetrics, Leiden University Medical Centre, Leiden, the Netherlands.

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3.3.1 Abstract

Objective

To investigate the safety of a trial of labour after two or three previous caesarean sections.

Study Design

Retrospective analysis of medical records of women with a history of more than one previous caesarean section who gave birth during a 10 year period (1988-1997) in two large university hospitals in the Netherlands.

Results

A number of 30,132 women gave birth with a hospital caesarean birth rate of 14.8%. There were 246 women with a history of more than one previous caesarean section: 187 (76 %) delivered by elective repeat caesarean section; 59 (24%) had a trial of labour, of whom 49 (83%) had a vaginal birth. Three uterine ruptures occurred after previous lower segment caesarean sections without maternal or perinatal mortality related to the uterine rupture; only one rupture was during a trial of labour. In the study group was no maternal mortality. Maternal morbidity did not differ between women with an elective repeat caesarean or a failed trial of labour. Perinatal mortality was not related to the mode of delivery.

Conclusion

Elective repeat caesarean section is not the only answer to a woman with two or three previous caesarean sections. A trial of labour can be a safe option for a selected group of women.

3.3.2 Introduction

Caesarean section rates have increased dramatically world-wide since the 1970s. In the USA more than one fifth of all births is by caesarean section and about one third of all caesareans is an elective repeat operation (1). The dictum "once a caesarean, always a caesarean" dominated obstetric practice in the USA for nearly 70 years (2). This concept began changing gradually about 30 years ago and a number of reports have documented the relative safety of a trial of labour (TOL) (3-7).

How safe is a trial of labour after two or even more previous caesarean sections? After two previous caesarean sections the reported risk of scar rupture varies between 2% and 3.7% and the calculated odds ratio compared to the risk of uterine rupture after one caesarean section varies between 2.6 and 4.8 (8-10). Patients who experienced a failed trial of labour were at increased risk of infection and morbidity in a large study in Canada (11).

We report on a trial of labour after two or three previous caesarean sections in 59 women in the Netherlands.

3.3.3 Methods

A retrospective review of charts and operative reports was performed at two Dutch university hospitals, Academic Medical Centre in Amsterdam and Leiden University Medical Centre, Leiden. The study period extended from 1 January 1988 through 31 December 1997. During this period 25,674 women delivered vaginally and 4,458 by caesarean section; the hospital caesarean section rate was 14.8%. Singleton pregnancy, breech and transverse presentations were included, but twin pregnancies were excluded. Files were identified from a computerised archive and hand searched. Neonatal morbidity was defined as Apgar score < 7 at 5 minutes and admission to a neonatal intensive care unit. Maternal morbidity was defined as postpartum infection (fever or endometritis requiring antibiotic treatment), cystitis, thrombosis, and the need for blood transfusion. Data were analysed with the statistical package of Epi-Info and tested for statistical significance with a Mantel-Haenszel equation for odds ratios, a Fisher's exact test or a Student's 't' -test.

3.3.4 Results

Trial of labour

Two hundred and forty-nine women gave birth after more than one previous caesarean section. Three files were missing, and therefore 246 women were in the study population.

After two previous caesarean sections 156 (74%) women were delivered by elective repeat caesarean section, 45 (21 %) had a successful trial of labour and 10 (5%) had a failed trial. There was no trial of labour after four or five previous caesarean sections. The overall success of a trial of labour was 49/59 (83%) (Table 3.8).

A history of previous vaginal delivery did not increase the chance of a vaginal birth significantly (OR 1.7; $CI_{95\%}$ 0.8-3.4). However, a history of failure to progress did decrease the chance of a successful trial of labour (OR 0.4; $CI_{95\%}$ 0.3-0.8) (Table 3.9).

The number of inductions of labour was 14/59 (24%), with a failure rate of 4/14 (29%) (Table 3.10). The only uterine rupture during labour occurred in this group.

Perinatal mortality and morbidity

There were 15 perinatal deaths: six related to chromosomal or congenital malformations, five related to prematurity or immaturity, three related to placental insufficiency with hypertension and one case of abruptio placentae. A trial of labour or vaginal birth was never identified as a cause for perinatal mortality. In Table 3.11, the neonatal outcome after elective repeat caesarean section (ERCS) or trial of labour (TOL) is shown. In order to study the influence of a TOL on the perinatal outcome, women who experienced one of the above mentioned perinatal deaths or women who experienced fetal distress before the onset of labour for example because of intra uterine growth retardation were excluded from this subgroup analysis. Apgar score below 7 at 5 minutes and admission to a neonatal intensive care unit were less frequent in the elective repeat caesarean section group than in the trial of labour group, but the differences did not reach statistical significance (Table 3.11).

Maternal mortality and morbidity

In the study group no maternal deaths occurred. Seven scar dehiscences were noted; six at elective repeat caesarean section and one after a failed trial of labour. In addition three uterine ruptures occurred:

(1) *A gravida 3 para 2 developed acute pain at 30 $^{2/7}$ weeks. An emergency caesarean section was performed and a child of 1,585 g, partly expelled from the uterus in breech presentation, was born. Apgar score 10 after 5 minutes. Both mother and child recovered uneventfully.*

(2) *A gravida 4 para 3, one vaginal delivery and twice a caesarean section because of prolapsed cord, was induced with prostaglandins and oxytocin at 42 $^{6/7}$ weeks. Because of fetal bradycardia the second stage was precipitated by a ventouse, and a child of 4,015 g was*

born in good condition. Postpartum the mother developed abdominal swelling and signs of shock. At emergency laparotomy a severely torn uterine scar was found and hysterectomy was unavoidable. Both mother and child recovered without further complications.

(3) *A gravida 5 para 2, twice a caesarean section because of fetal distress, was known with a bicornuate uterus. An elective repeat caesarean section was planned, however she got into spontaneous labour at 31 weeks. At emergency caesarean section uterine rupture was noted, which could be repaired. A son of 1,780 g was born, Apgar three at five minutes, arterial pH 7.05. He died after 5 weeks because of complications due to transposition of the great arteries.*

No minor complications were noted after a failed trial of labour (Table 3.12). After elective repeat caesarean as well as after vaginal birth the maternal infection rate was around 8%. The need for blood transfusion was 10% after elective repeat caesarean and 8% after vaginal birth.

Table 3.8 *Pregnancy outcome after more than one previous caesarean section*

Pregnancy outcome	**Number of previous caesarean sections**									
	Two		Three		Four		Five		Total	
	n=211	%	n=29	%	n=4	%	n=2	%	n=246	%
ERCS	156	74	25	86	4	100	2	100	187	76
VBAC	45	21	4	14	0	0	0	0	49	20
Failed TOL	10	5	0	0	0	0	0	0	10	4

Table 3.9 *Obstetric history and pregnancy outcome*

Obstetric history	**Caesarean section**		**Vaginal birth after caesarean**		
	n=197	%	n=49	%	OR and CI 95%
Previous vaginal birth	51*	26	18	37	1.7 (0.8 - 3.4)
Failure to progress	116**	65	17***	40	0.4 (0.3 - 0.8)

* 1 missing, ** 19 missing , *** 6 missing

Table 3.10 *Induction of labour*

Type of induction	VBAC		Failed TOL	
	n=49	%	n=10	%
Oxytocin	6	12	1	10
Prostaglandin	3	6	1	10
Prostaglandin with oxytocin	1	4	2*	20

* One vaginal birth complicated with uterine rupture and hysterectomy booked as failed TOL

Table 3.11 *Neonatal outcome after elective repeat CS or trial of labour (TOL)**

Neonatal outcome	ERCS		TOL		Fisher exact /
	n=171	%	n=43	%	OR and CI 95%
Apgar < 7 at 5 min	6	3.5	3	7.0	p=0.39
Neonatal ICU	39	22.8	15	34.9	1.8 (0.8 - 4.0)

* Fifteen perinatal deaths and ante partum fetal distress because of placental insufficiency excluded (n=32)

Table 3.12 *Minor complications postpartum*

Complication	ERCS		VBAC		Failed TOL	
	n=187	%	n=49	%	n=10	%
Infection	14	8	4	8	0	0
Endometritis	3	2	1	2	0	0
Cystitis	2	1	0	0	0	0
Thrombosis	2	1	1	2	0	0
Blood transfusion	19	10	4	8	0	0

3.3.5 Discussion

In our study, less than 1% of all hospital births occurred after more than one previous caesarean section. Even if all these women had delivered vaginally, a reduction in the overall caesarean section rate would be hardly noticed. However, for the individual woman the difference between abdominal delivery and vaginal birth may be very significant. In our study a trial of labour was allowed in 24% of all women with more than one previous caesarean section, with a success rate of 83%. Complications were rare, but the numbers of trial of labour were small. One uterine rupture followed by hysterectomy could have been avoided if labour had not been induced with prostaglandins. The other two ruptures occurred preterm without signs of labour in one case and in a congenital malformed uterus in the other case; obviously these ruptures were unavoidable. Concern persists that a trial of labour may increase the risk of uterine rupture. According to the American College of Obstetricians and Gynaecologists (ACOG), women who have had two previous low-transverse caesarean deliveries may be considered for a trial of labour. They should be informed, however, that the risk of uterine rupture slightly increases with the number of caesarean deliveries. In the case of the use of oxytocin or prostaglandins, close monitoring is suggested (12). A retrospective cohort analysis in Washington State among women with one previous caesarean section showed that uterine rupture occurred at a rate of 24.5 per 1,000 after induction with prostaglandins compared to 5.2 per 1,000 among women with spontaneous onset of labour and 7.7 per 1,000 among women whose labour was induced without prostaglandins (13). Our study was too small to confirm these data, but according to our opinion, awaiting the spontaneous onset and progress of labour seems the right choice for management. After thorough counselling of a pregnant woman, a trial of labour following two or three previous caesarean sections seems a safe option under optimal hospital conditions.

References section 3.3

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Chapter 4

General Discussion

Why have caesarean section rates increased?

Since the 1970s, caesarean section rates have increased world wide (Figure 1.4). The major contributors to this increase, as mentioned in chapter one, are the safety of the operation, fear for litigation, increasing age of women at the time of their first born, introduction of electronic fetal monitoring, more often diagnosing failure to progress, change in management of breech deliveries and last but not least repeat caesarean section without trial of labour (1-8). It is felt that the rising caesarean section rates are a cause for concern. As described in section 1.4.1, there is an increased maternal mortality of three to seven times compared to vaginal delivery (9;10). But also short-term and long-term morbidity of the mother like haemorrhage, thrombo-embolic disorders, placenta praevia and accreta are increased after caesarean section, compared to vaginal delivery (11-15). Neonatal morbidity has been reported to be higher after (elective) caesarean section than after vaginal delivery (16-18).

It is likely that a caesarean section rate of 3.6 to 6.5% (median 5.4%) is needed to address obstetric complications, and that a rate of 2% is an absolute minimum (19;20). In our survey in Mberengwa (section 2.4), we observed a caesarean section rate of 2.4% together with a symphysiotomy rate of 0.6% (21). Nowadays, caesarean section rates around the lower benchmark of 5% are found in developing countries only, where often rates are even much lower than 5%, which may indicate an unmet need for obstetric interventions for maternal indication (19;20). The lack of access to adequate emergency obstetric services leads to high maternal mortality and morbidity. In west Africa one woman in twelve dies from maternal causes, compared to 1 in 4,000 in Northern Europe (22). Many suffer from obstetric morbidity like vesicovaginal fistulae and infertility after complicated childbirth. Of course, higher caesarean section rates do not guarantee that all women who are in need of a caesarean section have access to this intervention. In fact, many caesarean sections may be performed unnecessarily. Latin America, with caesarean section rates up to 40%, is an extreme example (23). But also in Zimbabwe, the institutional caesarean section rates in private hospitals in Gweru and Zvishavane were 34.5% and 27.1% respectively in 1999 (24).

The debate on the increase of caesarean sections found its way in the editorials and formed the impetus for "An Evaluation of Cesarean Delivery" in the USA and the "National Sentinel Caesarean Section Audit Report" in the United Kingdom (3;8;25-29). In 1985, the World Health Organisation concluded that there were no additional health benefits associated with a caesarean section rate above 10 to 15% (30-32). Even these rather high targets, being a compromise between countries with low and high caesarean section rates, have been

challenged by Sachs et al. in 1999 when he wrote "setting a target rate is an authoritarian approach to health care delivery" (33). Recently, Matthews et al. stated that hospitals with high caesarean section rates have a different attitude towards obstetric intervention, resulting in lower perinatal mortality for all women giving birth in these institutions. He also opposes "desirable targets" like 10 -15 % as a maximum for caesarean section rates, but prefers a discussion on caesarean section rates based on "facts" (34). From the "National Sentinel Caesarean Section Audit Report" by Thomas et al. we know that about one fifth of the obstetricians in the United Kingdom were not bothered by the caesarean section rate in their institute, even if it was above 20% (8).

How do doctors cope with "facts" obtained from randomised controlled trials (RCTs)? Parer wrote a paper on "what determines clinical acceptance or rejection of results of RCTs by doctors?". Technologies which are simple to apply and have a single endpoint, show concordance between trial results and clinical use, e.g. the use of administering antenatal corticosteroids to the mother during preterm labour in order to minimise respiratory distress postpartum. Results of RCTs on this subject have been accepted and implemented by almost all obstetricians. But a more complex intervention, like fetal blood sampling in addition to a non-reassuring fetal heart rate, was poorly implemented. This technique is inconvenient to doctors and technically more difficult to apply (35). Thus, even "facts" originating from RCTs are not easily put into action. What will happen when doctors face the complexity of an continuously increasing caesarean section rate? Nowadays, in leading peer reviewed journals, research is published on elective primary caesarean section, on the right of prevention of pelvic floor damage and on prevention of urinary incontinence (36-39). These publications pave the way for accepting caesarean section as a better alternative to vaginal delivery. Caesarean section, being a clear endpoint, will be more easily accepted by doctors each time when "new evidence" against vaginal delivery arises. An example of inconsistent decision-making by many obstetricians is the immediate acceptance of caesarean section as the golden standard after the "term breech trial". The evidence of this trial was not unchallenged, but the clear end point did suit doctors (7;40;41).

In the USA, trial of labour and VBAC increased up to 28.6% by the year 1996 (42). Encouraging VBAC has been considered a key method of reducing the caesarean rate universally, and in the USA in particular (43). However, concern for maternal and neonatal morbidity, especially among patients who have a failed TOL, reversed the upward VBAC trend in the USA (Figure 1.5). Of course, the reported increased maternal morbidity and neonatal mortality after (failed) TOL is statistically significant, but how clinically relevant is a

uterine rupture rate of 0.4% compared to 0.2%, or a perinatal mortality of 1.3 per 1,000 compared to 0.11 per 1,000 (44-47)? From daily practice and common sense we know that expectant mothers want to have a birth that is "safest for her baby", which was confirmed by the National Sentinel Caesarean Section report (8). Surprisingly however, in the same report 50% of obstetricians thought an elective caesarean section was the safest option for a baby to be born! In an editorial, convinced by "the evidence" about the reported dangers of VBAC, Green supported elective repeated caesarean section instead of trial of labour, because "a woman wants the safest thing for her baby"; a policy that may suit many doctors (48). In many countries, the remuneration of (repeat) caesarean section is higher than of vaginal birth, and elective repeat caesarean section will decrease the disutility of working hours.

What is the use and effectiveness of African maternity waiting homes, especially with respect to previous caesarean section?

The economic situation in sub-Saharan Africa is deteriorating and, as a result, access to healthcare is decreasing. Buekens et al. mentioned caesarean section rates in Africa ranging from 1 to 6% (section 1.5.1). In 1999, the caesarean section rate in Zimbabwe was 3.1%. The percentage of births delivered in health institutions varied from 54% in Cameroon to 18% in Niger (19;24). These observations are far from the aim to have 85% of all births attended by skilled attendants by 2015 (49). Our study on maternity waiting homes in Mberengwa district, Zimbabwe, showed an institutional delivery rate of 78% (section 2.4) (21). A survey among women in Gutu district, a comparable area with maternity waiting homes in Zimbabwe's Masvingo province, reported 85% institutional deliveries (50). Thus, when accessibility to health care is poor, the alternative of a maternity waiting home seems a reasonable option. Risk perception and selection, once being the corner stone of the safe motherhood initiative, played a minor role for pregnant women in Mberengwa. Women with risk factors like previous perinatal death and previous postpartum haemorrhage were not using MWHs more frequently. Maternity waiting homes were accepted by the community as an answer to poor transport facilities. Fifty-nine of all women who delivered during the survey in Mberengwa stayed at one of the MWHs (Table 2.7). Previous caesarean section and primi parity were identified as risk factors and strongly associated with the use of maternity waiting homes and hospital birth (Table 2.12). One of the main reasons mentioned by women for giving birth at home was lack of money (Table 2.9). Only one woman with a previous caesarean section gave birth at home (Table 2.12). The VBAC rate in the MWH survey was 25/39 (64%). The

willingness of women with a previous caesarean section to use maternity waiting homes is in contradiction with an earlier report from the provincial hospital of the Midlands in Gweru (Zimbabwe, Figure 2.2). This report describes that women with a previous caesarean section were reluctant to attend the antenatal clinic. They came to the hospital in a more advanced stage of labour than women with no previous caesarean section and did not turn up for an elective caesarean section, often opting for an unsupervised home delivery (51). In Mberengwa district, trial of labour after previous caesarean section has been the policy for many years, which can explain the difference with Gweru hospital. Namely, an advantage of having a more liberal approach to a trial of labour after previous caesarean section is that women may be more likely to return to hospital for supervision of subsequent labour. The approach of promoting vaginal birth after caesarean section, with low elective repeat caesarean section rates, can only be achieved in a health care setting where maternity waiting homes are integrated into the regional maternal health care system.

Nevertheless, the resources of a community determine the use of maternity waiting homes (52). It can be expected that the use of maternity waiting homes will decrease during economic and social hardship; in Mberengwa, one third of the women who gave birth at home indicated "lack of money" as the main reason (Table 2.9). At the moment, unemployment in Zimbabwe is estimated at 60%, 25% of Zimbabwe's inhabitants are HIV positive and the political situation is unstable (53). Surviving has become priority number one, and gold panning along the rivers in Mberengwa will again be one of the main strategies in surviving the economic constraints, carried out by both men and women (54). Consequently, rural women, living under poor hygienic conditions, will have no time for antenatal care and no time to spend at maternity waiting homes. Women in a low income country like Zimbabwe are very well aware of which road leads to safe motherhood. This road, however, is often blocked by poverty.

Is a trial of labour after previous caesarean section safe for mother and child in rural Africa?

How should women with a previous caesarean section be managed in a developing country? Our study in Mberengwa (section 2.5) reported a VBAC rate of 56% after one previous caesarean section (55). Women with more than one previous caesarean section and women with a previous caesarean section for dystocia had VBAC rates of 11% and 18% respectively. After a previous caesarean section labour was not induced or augmented. We observed a

perinatal mortality of 43‰ and one maternal death. From our district survey on maternity waiting homes in Mberengwa, we calculated a caesarean section rate of 2.6% and a symphysiotomy rate of 0.6% (21). Data from our study are comparable to other studies from Zimbabwe. De Muylder and Thistle et al. reported VBAC rates of 59% and 66% respectively (56;57). In a meta-analysis by Boulvain et al., reporting on 4,500 women with a previous caesarean section in sub-Saharan Africa, the VBAC rate was 48%, with a success rate after TOL of 71%; perinatal mortality was 58‰; maternal mortality was 190 per 100,000 (58). The reported maternal mortality by Boulvain et al. is less than the estimated maternal mortality of 110 – 180 per 100,000 due to caesarean section in Africa, and also less than the reported maternal mortality of 360 - 610 per 100,000 live births in the general obstetric population of this region (59-63). Our study together with data from Boulvain, De Muylder and Thistle support the relative safety of (a trial of) vaginal birth after caesarean section in rural Africa.

In our survey in Mnene, we offered a trial of labour to all women with one or more previous caesarean sections (55). Clinical judgement, however, was very strict. Due to contracted pelves, cephalopelvic disproportion is often more outspoken in Africa, which will influence the decisions of doctors during a trial of labour. After a known previous caesarean section for CPD or after more than one previous caesarean section, a TOL will be more easily converted to a repeat caesarean section. This might explain the lower VBAC rates after previous CPD (18%) and after more than one previous caesarean section (11%) compared to Western studies (Table 1.1 and 1.2).

The risk of uterine rupture in sub-Saharan Africa was 2.1% in the largest available meta-analysis (58). Why not offer elective repeat caesarean section to women with a high probability of a failed trial of labour instead of offering all women a trial of labour? In high income countries, morbidity after failed trial of labour is higher than after elective caesarean section. For example in Nova Scotia, Canada, the need for hysterectomy, uterine rupture, laceration of one or both uterine arteries, laceration of the bladder, ureter or bowel were reported to be 0.8% after elective repeat caesarean section (n=2,889) and 3.8% after failed trial of labour (n=1,287) (64). In Africa the situation is different; an elective caesarean section risks preterm delivery if estimates of gestational age are wrong, and without the technology of ultrasound this will be a common problem. The risk of dying due to caesarean section is 11 - 18‰ (range 6‰ to 50‰) in Africa, compared to 0,06‰ (range 0,01‰ to 0.22‰) in the USA (60;63;65;66). Major complications like life-threatening anaesthetic problems, surgical injury to the bladder or to the bowel, severe lacerations of the uterus, inverted T incision of the

uterus, postoperative shock, re-laparotomy for bleeding or abscess, burst abdomen or peritonitis were reported to be 11% by De Muylder in Gweru hospital among 230 elective repeat caesarean sections (67). In sub-Saharan Africa, caesarean section remains a major operation with substantial morbidity and mortality. In addition, a potential late risk of recurrent caesarean section is an increased incidence of placenta praevia and placenta accreta with complications such as hysterectomy and even maternal death. These risks may be more important in low income countries, where the total fertility rate (TFR) per woman is higher than in Western countries (68). For example, the TFR for a woman in Zimbabwe is 5 compared to 1.7 for a woman in the Netherlands (Table 3.1) .

A policy of elective repeat caesarean section should be discouraged. The risk of uterine rupture and the risks after a failed trial of labour do not counterbalance the increased risks of elective repeat caesarean section. A liberal approach to a trial of labour should be supported, but its safety depends on the quality of supervision. In order to prevent the catastrophe of uterine rupture, intermittent fetal auscultation and the use of a partograph should be used to monitor labour. Women who wish to have a vaginal birth after caesarean section should be advised against home delivery or delivery at a health centre without facilities to perform an emergency caesarean section. The use of maternity waiting homes should be promoted. Nevertheless, it is obvious that, when a pregnant woman in Africa has previously had severe cephalopelvic disproportion with bladder damage, ruptured uterus or a classical scar, or when she has a malpresentation in the present pregnancy, caesarean section in early labour should be performed.

What are the risk factors at caesarean section which predict failure of a trial of labour in subsequent pregnancy?

In countries were morbidity and mortality due to caesarean section are low, the risk of trial of labour should be balanced against the risk of elective repeat caesarean section (section 1.6.3-4). Apart from the risk of uterine rupture, which occurs in the range of 0.4% to 2%, the patient is at increased risk of infection and other major complications, especially when a trial of labour fails (44;69). McMahon et al. found that, compared to an elective caesarean delivery, a trial of labour was associated with an almost two-fold increased risk of rupture of the uterus, hysterectomy and operative injury. These complications almost exclusively occurred in those women in whom the trial of labour was not successful (64). Also, in a study by Hook et al., sepsis of the neonate was increased after failed trial of labour (18). This emphasises the

importance of being able to predict the success rate of a trial of labour for a particular patient. An attempt has been made to develop scoring systems in order to predict a successful trial of labour. Rosen et al., as described in section 1.6.2, found a success rate of TOL greater than 50%, irrespective of the previous indication for caesarean section (70). In a scoring model by Troyer et al. only a non-reassuring fetal heart tracing on admission, a variable which cannot be discussed with a woman before labour starts, reduced the chance of success of a trial of labour below 50%. Otherwise success rates were high, and even after previous dystocia 63% delivered vaginally (71). Pickhardt et al. tried to formulate a prognostic model using stepwise logistic regression in order to predict the success rate of a trial of labour in 336 women. Their model used estimated fetal weight, number of previous caesarean sections, cervical dilatation and estimated gestational age as factors to predict the success rate of trial of labour. The positive predictive value was 63% to 72%, equal to the a priori expected success rate of trial of labour of 50% to 80% (72). Weinstein et al. performed stepwise logistic regression in a study on 471 women with one previous caesarean section. Bishop score of 4 or higher at trial of labour (OR 6.0; $CI_{95\%}$ 3.5-10.4), previous vaginal delivery (OR 1.8; $CI_{95\%}$ 1.1-3.1), previous breech (OR 1.9;$CI_{95\%}$ 1.0-3.7), and previous hypertension (OR 2.3; $CI_{95\%}$ 1.0-5.8) were related to higher success. Previous cephalopelvic disproportion showed no significant value in predicting the success rate of a trial of labour. In their proposed scoring model, all women had an expected success rate of trial of labour of more than 50% (73). Flamm et al. developed a predicting scoring model using data of 2,502 women with one previous caesarean section. The model was tested on a control group of 2,501 women. Previous vaginal birth was a major contributor to success in this scoring model. Other factors in the model were: age under 40, previous caesarean section not because of failure to progress, cervical effacement and dilatation. Even with the lowest score (no previous vaginal delivery and previous failure to progress), the success rate of trial of labour was 49% (74). For that reason, scoring models are of limited value in discriminating between women who will have a successful trial of labour and women who will need a emergency caesarean section.

In our study on risk factors at caesarean section and failure of subsequent trial of labour (section 3.2), we included only women who gave birth twice, to eliminate the influence of previous vaginal delivery (75). The VBAC rate was 49%, with a success rate of 71% after TOL. We showed that women who had had a previous caesarean section at more than 7 cm of cervical dilatation were more often offered an ERCS during a next pregnancy (OR 2.2; $CI_{95\%}$ 1.1-4.5). The labour pattern at the time of the first caesarean section (< 1.0 cm/h) is important for the prediction of VBAC. Women with risk factors at index labour like the use of oxytocin,

a history of failure to progress/suspected CPD, cervical dilatation < 1 cm/h or contractions lasting more than 12 hours had significantly more chance of a failed trial of labour in subsequent pregnancy (Table 3.6). In our study, we outlined the importance of the partograph for future pregnancies, providing a proper diagnosis of failure to progress/CPD during a woman's first labour. We also identified birth weight of the new-born in subsequent pregnancy of more than 4,000 g to be strongly associated with failure of TOL (OR 6.6; $CI_{95\%}$ 2.4-18.4) (75).

Active management during the active phase of a woman's first labour, documented by an obtained partograph, will help to standardise and compare labour patterns (76-78). Labour pattern and previous dilatation have been studied before as predictor of VBAC. Hoskins et al. reported a success rate of only 13% in 245 women who had a caesarean section at full dilatation in their previous pregnancy (79). Other studies reported success rates of TOL ranging from 65% to 80% in women with previous dystocia in the second stage of labour (80-83). In a study by Jongen et al., even 55 women with a failed previous instrumental delivery had a TOL with a success rate of 75% (84). The above mentioned studies on trial of labour after previous caesarean section for dystocia in the second stage of labour had all TOL rates between 50 to 75%. Also in our study, caesarean section at the second stage of labour did not increase the risk of a failed TOL in subsequent pregnancy (Table 3.6). There are two reports which describe outcome of TOL in relation to birth weight and uterine rupture among women with one previous caesarean section and no other deliveries. In a study by Zelop et al. (n=2,749), the success rate of TOL associated with birth weights of 4,000 g or less was 71% versus 60% for those with birth weights > 4,000 g ($p=0.001$, RR 1.7; $CI_{95\%}$ 1.3 - 2.2). The rate of uterine rupture did not significantly differ between the two groups, 1% versus 1.6% respectively (85). Elkousy et al. studied a larger group of women (n=6,348) and identified a significant trend ($p<0.001$) in decreasing success rates of TOL with increasing birth weights (68% with < 4,000 g, 52% with 4,000 - 4,249 g, 45% with 4,250 - 4,500 g and 38% with > 4,500 g). The success rates of TOL were further decreased when the indication of the previous caesarean delivery was cephalopelvic disproportion or failure to progress (39% with 4,250 - 4,500 g and 29% with > 4,500 g). The uterine rupture rate in this subgroup was 3.6% for women with a neonatal weight of 4,000 g or more and 1.2% with a neonatal weight of < 4,000 g (RR 2.3; $p<0.001$) (86). Elkousy's study emphasises the need of information on the labour pattern at the time of the first caesarean section. Failure to progress/CPD, diagnosed at the first caesarean section in combination with an expected birth weight > 4,500 g in subsequent pregnancy, can help to identify women who have lower success rates of TOL and higher risks

of uterine rupture. The increased risk of uterine rupture and the lower success rates of TOL should be discussed with these women. Also a pre-pregnancy weight of the expectant mother of more than 135 kg (BMI 57 +/- 9kg/m^2) reduced the success rate for TOL (n=30) to 13% (4/30; $CI_{95\%}$ 3.7% - 30.7%) in studies by Carroll et al. and Chauhan et al. (87;88). Infectious complications after TOL were higher among these morbidly obese patients (53%), and lower after elective repeat caesarean section (28%). These results are incongruent with those of Edwards et al., who reported a 63% (5/8; $CI_{95\%}$ 24% - 91%) success rate in a small group of 8 women who had a BMI of 50 or greater (89).

In addition, our study confirmed the speed of cervical dilatation as a tool in monitoring subsequent labour in women with previous caesarean section. Dilatation < 0.5 cm/h during subsequent labour was a risk factor for failed TOL (p=0.01, Table 3.7). Hamilton et al. studied dystocia and the course of labour in relation to uterine rupture (n=19) in a case-control study. When cervical dilatation was lower than the 10th percentile and was arrested for two or more hours, caesarean delivery would have prevented 42 % (n=8) of uterine ruptures (90). This study of Hamilton confirms the use of a partograph as a tool for assessing those at risk of uterine rupture. These results confirm an earlier case control study by Leung et al. (n_{cases}=70); dysfunctional labour, mainly based on arrested dilatation for 2 hours or more, had a 7 times increased risk of uterine rupture (OR 7.2; $CI_{95\%}$ 2.7-20.0) (91). Khan et al., in a retrospective cohort study (n=236), found an 8 times increased risk of uterine rupture (n=7) after an arrested dilatation for 2 hours or more (OR 8.0; $CI_{95\%}$ 1.6-40) (76). A case-control study by Phelan et al. did not find a relation between a protracted active phase and uterine rupture (n=18) (92). The studies of Hamilton, Leung, Khan and our own study support the use of a partograph at a woman's first labour, and at a subsequent TOL after previous caesarean section.

Is a trial of labour after two or three previous caesarean sections safe for mother and child?

Despite the fact that the absolute numbers of women with more than one previous caesarean section are small, in a general obstetric practice, the issue of how to manage their labour will arise several times a year. The major concern is the strength of the uterine scar and the chance of uterine rupture. The danger of uterine rupture to mother and child was described in sections 1.4.3.3 and 1.6.4.1 The risk of uterine rupture increases with the number of previous caesarean sections. Leung et al., Miller et al. and Caughey et al. reported a scar rupture rate

between 1.7 and 3.7% (Table 1.1 and 1.2) (91;93). Studies on more than one previous caesarean section show success rates of a TOL between 60 - 90% (Table 1.2).

In our study, after two or three previous caesarean sections the VBAC rate was low (20%). The TOL rate was 24%, with a high success rate (83%) (94). The uterine rupture rate was 1.7% after TOL and 1.1% at elective repeat caesarean section. There should be awareness of the fact that uterine rupture can also occur before the onset of labour, as happened with one woman in our study. Previous failure to progress did decrease the chance of a successful trial of labour (OR 0.4; $CI_{95\%}$ 0.3-0.8). On the other hand, previous vaginal delivery is not a "conditio sine qua non" for a safe trial of labour after more than one previous caesarean section. In our study, 31 women had a VBAC without a previous vaginal delivery. One uterine rupture followed by hysterectomy could have been avoided if labour had not been induced with prostaglandins.

Induction and augmentation should not be started lightly. Even after only one previous caesarean section, induction of labour with oxytocin and prostaglandins significantly increases the risk of uterine rupture, compared to spontaneous onset of labour (section 1.6.4.2) (46). Without any intervention, women with more than one previous caesarean section already have a risk of uterine rupture during labour, which is higher compared to women with one previous caesarean section. Therefore it should be questioned if induction of labour is the safest strategy for such women. If there is an indication for terminating pregnancy and the spontaneous onset of labour can no longer be awaited, an elective repeat caesarean section is a slightly safer option than induction. Arrest of the progress of labour should not be followed by augmentation with oxytocin, but interpreted as dysfunctional labour with increased risk of uterine rupture (91). "After twice a caesarean section, prevent complications of trial of labour" should replace the dictum "twice a caesarean section, always a caesarean section".

There is little support for the concept of trial of labour in women with two or more previous caesarean sections. A study investigating the practices of consultants in the United Kingdom found that only 5% would support a trial of labour in women with more than one previous caesarean section, despite 97% of respondents supporting a trial of labour after one previous caesarean section (95). The recent "National Sentinel Caesarean Section Audit Report" confirmed the practices of supporting trial of labour after one caesarean section. However, no questions were asked about more than one previous caesarean section; it does not seem to be "an issue", unfortunately (8). Clinicians should support a woman's request for a trial of labour, regardless of the number of previous caesarean sections, provided she has been counselled with accurate information on outcome and risk.

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Summary and Guidelines

for Vaginal Birth after Caesarean Section

Summary

The aim of this thesis is to address the following questions:

1. Why have caesarean section rates increased?
2. What is the use and effectiveness of African maternity waiting homes, especially with respect to previous caesarean section?
3. Is a trial of labour after previous caesarean section safe for mother and child in rural Africa?
4. What are the risk factors at caesarean section which predict failure of a trial of labour in subsequent pregnancy?
5. Is a trial of labour after two or three previous caesarean sections safe for mother and child?

Until the second half of the 19th century, the chances of surviving a caesarean section were poor due to the fact that the uterus was not sutured. Closing of the uterine wound made caesarean birth less hazardous and the outcome further improved after the introduction of asepsis, the development of the lower segment caesarean section technique, advances in anaesthesia, introduction of intravenous fluid and blood replacement and the use of antibiotics. In Western countries, maternal mortality rates due to caesarean section decreased from about 70 per 100 to 1-13 per 100,000; in low-income countries, maternal mortality rate is still around 1 per 100. It is a matter of concern that caesarean section rates in the Western world and Latin America have reached rates ranging from 13% to 40%, while in sub-Saharan Africa rates are often far below 5%, which is too low to guarantee safe obstetric care. The success rate of vaginal birth after previous caesarean section (VBAC) varies between 45 and 80%. The risk of uterine rupture during VBAC is 0.2 -1.5%. This risk increases after more than one previous caesarean section (2 - 4%) and induction with prostaglandins (2.5%). In several studies, perinatal mortality was significantly higher after trial of labour than after elective repeat caesarean section, but not different from that of nulliparous women. The major contributors to the increase of caesarean section rates are the safety of the operation, fear for litigation, increasing age of women at the time of their first born, more often diagnosing dystocia and fetal distress, change in management of breech presentation and repeat caesarean section without trial of labour. However, concern for maternal and neonatal morbidity, especially among patients who have a failed TOL, is maybe overdrawn. Doctors easily accept

"evidence" against VBAC, because elective repeat caesarean section is a clear end point that satisfies both patient and doctor.

Mberengwa district, Zimbabwe, where two studies of this thesis were carried out, is a communal area of 3,753 km^2 with 183,000 inhabitants. Within the district there were five hospitals; four of them had maternity waiting homes (MWHs). To investigate the use and effectiveness of maternity waiting homes, data from home and hospital births were collected, during a two months period in 1994. From 1,041 births, 22% (n=228) occurred at home and 78% (813) in hospital. MWHs were used by 59% (n=616) of all women. Due to maternity waiting homes all women (n=39) with a previous caesarean section, except one, gave birth in hospital. MWHs improved the accessibility of obstetric care and were instrumental to the high percentage of hospital births. Lack of money to stay at a MWH was the main reason to give birth at home.

In Mberengwa district, outcome of labour was studied retrospectively in 281 women with a history of previous caesarean section, between 1991-93. After one previous caesarean section the VBAC rate was 55%; after more than one previous caesarean section or after previous dystocia, the VBAC rates were 11% and 18% respectively. During trial of labour, one woman with thyrotoxicosis died of haemorrhage due to uterine rupture. Her child died as well; this was the only perinatal death attributable to a trial of labour after previous caesarean section. Trial of labour after previous caesarean section was safe in our study in Mberengwa. Also other studies from Africa support this view.

Under the responsibility of independent midwives or general practitioners, around 30% of women in the Netherlands give birth at home. Maybe as a result, the caesarean section rate in the Netherlands of 13% is still low compared to that of other Western countries. Since 1945 several Dutch studies and theses have been advocating vaginal birth after caesarean section. Due to the fact that the perinatal database of the Netherlands (LVR) has no code for VBAC, there are no national VBAC rates available. In the Academic Medical Centre, hospital records of 214 women, whose first term pregnancy was terminated through a low transverse caesarean section between 1988 and 1999, were reviewed, in order to identify risk factors at caesarean section which are related to failure of a trial of labour in subsequent pregnancy. The TOL rate was 69%, with a success rate of 71%; the overall VBAC rate was 49%. A labour pattern during the index pregnancy, characterised by oxytocin use, contractions for more than 12 hours or cervical dilatation less than 1 cm/h, increased the risk of a failed TOL in subsequent labour. Dilatation less than 0.5 cm/h during subsequent labour or birth weight of the new-born in subsequent pregnancy of more than 4,000 gram were associated with failure

of TOL. At subsequent TOL a partograph can be a managerial tool for labour management, as is a partograph obtained at a woman's first labour.

Women with two or more previous caesarean sections, who gave birth during a 10 year period (1988-1997) at the Leiden University Medical Centre or at the Academic Medical Centre, were studied. There were 246 women included; 187 (76%) delivered by elective repeat caesarean section; 59 (24%) had a trial of labour, of whom 49 (83%) had a vaginal birth. Three uterine ruptures occurred; one was during a TOL, induced with prostaglandins and complicated by hysterectomy. There was no maternal mortality, and perinatal mortality was not related to the mode of delivery. A trial of labour following two or three previous caesarean sections seems a safe option, provided that spontaneous onset of labour is awaited.

Guidelines for vaginal birth after caesarean section

Rates of postpartum fever, wound infection, blood transfusion, hysterectomy, maternal discomfort and length of hospital stay are all lower with VBAC than with repeat caesarean section. In addition, infants born to women who deliver vaginally experience a lower rate of respiratory problems. Complications like uterine rupture, however, can occur during VBAC. The risk of uterine rupture increases with the number of previous caesarean sections. The following items are essential to the management of vaginal birth after caesarean section:

- Women with a previous uterine rupture, classical scar, placenta praevia or other obvious contra-indications to trial of labour, should be delivered by repeat caesarean section;
- From all women the previous operative report should be obtained as well as notes of the previous labour if applicable;
- A woman is counselled on the chances of success of a trial of labour. Depending on the indication of the previous caesarean section the success rate is between 50 - 80%. Previous CPD in combination with an expected birth weight of more than 4,500 gram or extreme obesity may decrease the success rate well below 50%;
- If medically indicated or requested by the woman, an elective repeat caesarean section should be performed after 39 weeks of pregnancy;
- Spontaneous onset of labour is preferred; induction with oxytocin increases the risk of uterine rupture up to slightly less than 1%, but after induction with prostaglandins, this

risk increases up to 2.5%. Therefore, there should be reluctance to induct with prostaglandins;

- Trial of labour should take place in an institution which can handle obstetric emergencies 24 hours a day;
- A partograph during trial of labour is mandatory; failure of progress can be a sign of disproportion, but otherwise augmentation of labour with oxytocin is allowed;
- Fetal monitoring can be done by intermittent auscultation or by electronic cardiotocography. Fetal distress can be a sign of uterine dehiscence or uterine rupture; an emergency repeat caesarean section should be considered instead of obtaining a fetal scalp blood sample;
- A repeat caesarean section should be considered if, despite adequate uterine contractions, there is no progress for more than two hours during the active phase of the first stage of a trial of labour;
- There are no set time limits when to terminate the second stage during a trial of labour, but fetal distress can be an early sign of uterine rupture;
- Instrumental delivery in itself does not increase the risk of uterine rupture.

In low income countries, trial of labour should be offered in preference to elective repeat caesarean section. The use of maternity waiting homes should be promoted if what is lacking is accessibility to health care institutions which can handle obstetric emergencies.

Samenvatting

en Richtlijnen

voor Vaginale Baring na Keizersnede

Samenvatting

Het is het doel van dit proefschrift om de volgende vragen te behandelen:

1. Waarom is het aantal keizersnedes toegenomen?
2. Wat is het gebruik en de effectiviteit van Afrikaanse wachthutten voor zwangeren, in het bijzonder met betrekking tot vrouwen met een eerder doorgemaakte keizersnede?
3. Is op het platteland in Afrika een proefbaring na een eerdere keizersnede veilig voor moeder en kind?
4. Wat zijn de risicofactoren ten tijde van een keizersnede die het mislukken van een proefbaring in een volgende zwangerschap voorspellen?
5. Is een proefbaring na twee of drie keizersnedes veilig voor moeder en kind?

Tot de tweede helft van de 19^{e} eeuw waren de kansen op het overleven van een keizersnede slecht omdat de baarmoeder niet werd gehecht. Het sluiten van de baarmoederwond maakte geboorte via een keizersnede minder gevaarlijk en vervolgens verbeterde de uitkomst door de invoering van asepsis, de ontwikkeling van de keizersnede via het onderste uterussegment, de vooruitgang in de anesthesie, de invoering van het toedienen van intraveneus vocht en bloed en door het gebruik van antibiotica. In Westerse landen daalde de moederlijke sterfte ten gevolge van een keizersnede van ongeveer 70 per 100 tot 1-13 per 100.000; in arme landen is de moederlijke sterfte nog steeds rond de 1 per 100. Het is zorgwekkend dat het aantal keizersnedes in Westerse landen en Latijns Amerika varieert van 13 tot 40%, terwijl in Afrika beneden de Sahara de aantallen vaak ver onder de 5% liggen, wat te laag is om veilige verloskundige zorg te waarborgen. Het succescijfer van een vaginale baring na een keizersnede (VBNK) wisselt tussen de 45 en 80%. Het risico van een uterus ruptuur ten tijde van een VBNK is 0,2 - 1,5%. Dit risico neemt toe na meer dan één keizersnede (2 - 4%) en na inleiding met prostaglandines (2,5%). In verscheidene studies was de perinatale sterfte significant hoger na een proefbaring dan na een electief herhaalde keizersnede, maar niet verschillend van dat van nulliparae. De belangrijkste factoren die bijdragen aan het stijgend aantal keizersnedes zijn de veiligheid van de operatie, angst voor rechtszaken, toename van de leeftijd van de vrouw ten tijde van de eerst geborene, verandering in het beleid van de stuitligging en herhaalde keizersnede zonder proefbaring. Echter, de bezorgdheid voor maternale en neonatale morbiditeit, vooral onder patiënten die een mislukte proefbaring hebben, is misschien overtrokken. Dokters nemen gemakkelijk

"bewijs" aan tegen VBNK, omdat een electief herhaalde keizersnede een helder eindpunt is dat zowel de dokter als de patiënt tevreden stelt.

Mberengwa district in Zimbabwe, waar twee van de onderzoeken van dit proefschrift plaatsvonden, is een communaal gebied van 3.753 km^2 met 183.000 inwoners. In het district waren vijf ziekenhuizen; vier daarvan hadden wachthutten voor zwangeren. Om het gebruik en de effectiviteit van de wachthutten voor zwangeren te onderzoeken werden in 1994, gedurende een periode van twee maanden, gegevens verzameld van thuis- en ziekenhuisbevallingen. Op een totaal van 1.041 geboortes vond 22% (n=228) thuis plaats en 78% (n=813) in het ziekenhuis. De wachthutten werden door 59% (n=616) van alle vrouwen gebruikt. Dankzij de wachthutten voor zwangeren bevielen op één na alle vrouwen met een eerdere keizersnede in het ziekenhuis. Wachthutten voor zwangeren verbeterden de bereikbaarheid van obstetrische zorg en droegen bij tot het hoge percentage ziekenhuisbevallingen. Gebrek aan geld was de belangrijkste reden om thuis te bevallen.

In Mberengwa district werd retrospectief, tussen 1991 en 1993, de uitkomst van de bevalling bestudeerd onder 281 vrouwen met een eerdere keizersnede in de voorgeschiedenis. Na één eerdere keizersnede was het aantal vaginale baringen na keizersnede (VBNKs) 55%; na meer dan één eerdere keizersnede of na eerdere dystocie was het aantal VBNKs respectievelijk 11% en 18%. Ten tijde van een proefbaring stierf er één vrouw met thyrotoxicose aan een bloeding ten gevolge van een uterusruptuur. Haar kind overleed eveneens; dit was de enige perinatale sterfte die toegeschreven kon worden aan een proefbaring na een eerdere keizersnede. Proefbaring na een eerdere keizersnede was veilig in ons onderzoek in Mberengwa. Ook andere studies uit Afrika ondersteunen deze visie.

In Nederland bevalt onder de verantwoordelijkheid van onafhankelijke vroedvrouwen of huisartsen ongeveer 30% van de vrouwen thuis. Misschien is als uitvloeisel hiervan het aantal van 13% keizersnedes in Nederland nog steeds laag in vergelijking met dat van andere Westerse landen. Al vanaf 1945 hebben verscheidene Nederlandse studies en proefschriften een lans gebroken voor vaginale baring na een keizersnede. Doordat de Landelijke Verloskundige Registratie (LVR) geen code kent voor VBNK, zijn er geen landelijke VBNK cijfers beschikbaar. In het Academisch Medisch Centrum werden dossiers onderzocht van 214 vrouwen, waarvan de eerste à terme zwangerschap was beëindigd door een keizersnede in het onderste uterussegment tussen 1988 en 1999, om zodoende risicofactoren ten tijde van een keizersnede te identificeren die in verband gebracht kunnen worden met het mislukken van een proefbaring in een volgende zwangerschap. Het aantal proefbaringen was 69%, met 71% vaginale uitkomst; het totale aantal VBNKs was 49%. Een baringsbeloop ten tijde van de

eerste zwangerschap dat gekarakteriseerd werd door het gebruik van oxytocine, door meer dan 12 uur weeën of door ontsluiting van de baarmoedermond met minder dan 1cm/uur, deed het risico van een mislukte proefbaring toenemen. Ontsluiting met minder dan 0,5 cm/uur of een geboortegewicht van de pasgeborene van meer dan 4.000 gram ten tijde van de baring, volgend op een eerdere keizersnede,werden in verband gebracht met het mislukken van een proefbaring. Ten tijde van een proefbaring, volgend op een keizersnede, kan een partogram een instrument zijn voor de baringsbegeleiding, evenals een partogram verkregen tijdens de eerste baring van een vrouw.

Vrouwen met twee of meer keizersnedes, die bevielen gedurende een periode van 10 jaar (1988-1997) in het Leids Universitair Medisch Centrum of in het Academisch Medisch Centrum, werden bestudeerd. Er werden 246 vrouwen geïncludeerd; 187 (76%) bevielen door een electief herhaalde keizersnede; 59 (24%) hadden een proefbaring, waarvan 49 (83%) vaginaal bevielen. Er traden drie uterus rupturen op; één was tijdens een proefbaring die werd ingeleid met prostaglandines en deze ruptuur werd gecompliceerd door een hysterectomie. Er was geen maternale sterfte en de perinatale sterfte stond niet in verband met de wijze van bevallen. Een proefbaring die volgt op twee of drie eerdere keizersnedes lijkt een veilige keuze, mits een spontaan begin van de baring wordt afgewacht.

Richtlijnen voor vaginale baring na keizersnede

Koorts postpartum, wondinfectie, bloedtransfusie, hysterectomie, ongemak voor de moeder en de duur van het ziekenhuisverblijf komen allemaal minder vaak voor bij een vaginale baring na een keizersnede dan bij een herhaalde keizersnede. Bovendien ondervinden kinderen die vaginaal geboren worden minder lagere luchtwegproblemen. Echter ten tijde van een vaginale proefbaring na een keizersnede kunnen complicaties optreden, zoals bijvoorbeeld een uterus ruptuur. Het risico van een uterus ruptuur neemt toe met het aantal eerdere keizersnedes. De volgende punten zijn essentieel in het beleid rondom een vaginale baring na een keizersnede:

- Vrouwen met een eerdere uterus ruptuur, een klassiek litteken, een placenta praevia of andere duidelijke contra-indicaties voor een proefbaring, behoren te bevallen door middel van een herhaalde keizersnede;
- Van alle vrouwen behoort men het voorafgaande operatie verslag te verkrijgen, evenals aantekeningen van de voorgaande baring, indien van toepassing;

- Een vrouw wordt voorgelicht over de succeskansen van een proefbaring. Afhankelijk van de indicatie van de eerdere keizersnede ligt het succes tussen de 50 en 80%. Eerdere wanverhouding tussen hoofd en bekken in combinatie met een verwacht geboortegewicht van meer dan 4.500 gram of een extreme adipositas kan de succeskans doen afnemen tot ruim onder de 50%;
- Een electief herhaalde keizersnede, indien medisch noodzakelijk of op verzoek van de vrouw, behoort na 39 weken zwangerschap te worden verricht;
- Een spontaan begin van de baring heeft de voorkeur; inleiden met oxytocine verhoogt de kans op een uterus ruptuur tot iets meer dan 1%, maar na een inleiding met prostaglandines neemt dit risico toe tot 2,5%. Daarom behoort men bij voorkeur niet met prostaglandines in te leiden;
- Een proefbaring behoort plaats te vinden in een instituut dat 24 uur per dag kan omgaan met obstetrische spoedgevallen;
- Een partogram tijdens een proefbaring is verplicht; een niet vorderende baring kan een teken zijn van wanverhouding, maar anders is bijstimulatie met oxytocine toegestaan;
- Foetale bewaking kan door intermitterende auscultatie of door cardiotocografie plaatsvinden. Foetale nood kan een teken zijn van een uterus dehiscentie of een uterus ruptuur; een herhaalde spoedkeizersnede behoort overwogen te worden in plaats van foetaal microbloedonderzoek;
- Een herhaalde keizersnede behoort overwogen te worden indien er, ondanks adequate weeën, geen progressie is gedurende meer dan twee uur ten tijde van de actieve fase van het ontsluitingstijdperk;
- Er zijn geen voorgeschreven tijdsgrenzen wanneer de uitdrijvingsfase van een proefbaring te beëindigen, maar foetale nood kan een vroeg teken zijn van een uterus ruptuur;
- Een kunstverlossing op zich verhoogt het risico van een uterus ruptuur niet.

In arme landen behoort het aanbieden van een proefbaring de voorkeur te hebben boven een electief herhaalde keizersnede. Het gebruik van wachthutten voor zwangeren moet gestimuleerd worden als het ontbreekt aan bereikbaarheid van gezondheidsinstituten die kunnen omgaan met obstetrische spoedgevallen.

Dankwoord

Als de eindstreep van een proefschrift nadert overheerst er een kluizenaarsgevoel. Het nadenken over het dankwoord drukt je met de neus op de feiten dat in de loop der jaren velen hebben bijgedragen aan het tot stand komen van het uiteindelijke resultaat.

Jos van Roosmalen, alsof je je betrokkenheid bij de "safe motherhood" wilde doorgeven gaf je me na mijn co-schap verloskunde/gynaecologie het boek "The Joys of Motherhood" van Buchi Emecheta. Je had ideeën voor het waiting home onderzoek in Zimbabwe, voor onderzoek in het LUMC en het AMC en nog veel meer. Je gedrevenheid hield nooit op, maar je vertrouwen dat het me zou lukken ook niet....., bedankt.

Prof. Otto Bleker, bedankt voor je optimisme en je inzet om de grote lijnen uit "poeki-poeki" en Nederland tot een geheel te smeden! Behalve mijn promotor, was je ook mijn opleider in het AMC. Je credo "in een sfeer van veiligheid durven dokters hun fouten met elkaar te bespreken, en daar wordt de patiënt uiteindelijk beter van" vind ik nog steeds de kern van de medische opleiding.

De leden van de promotiecommissie dank ik voor het kritisch doorlezen van het manuscript.

Frans van der Velde, samen hing ons in Zimbabwe een "act of misconduct" boven het hoofd omdat Dr Kirunda, een soort Zorregieta in het regime van Idi Amin, ons beleid na een sectio in de voorgeschiedenis afkeurde. Ons verzet werd het begin van mijn proefschrift en versterkte onze vriendschap.

Hoofdstuk drie was niet mogelijk geweest als Hans Wolf de selecties uit de perinatale database van het AMC niet had gemaakt. Vanuit het AMC legden de student-assistenten Laura van der Vliet en Myrthe Sluis, en in het LUMC Bemmy Röell-Schorer, de basis voor de artikelen in dit hoofdstuk. Hartelijk dank voor jullie enorme inzet!

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homes. In Nederland hielp Lottie Lubsen met het zoeken naar al eerder verschenen proefschriften over de sectio caesarea, hartelijk dank hiervoor. Door de bibliotheek van het Gelre Ziekenhuis zijn talloze artikelen wereldwijd besteld, dat was werkelijk een fantastische service!

Dank natuurlijk ook voor mijn maatschapsleden: Anjoke, Bert, Marcel, Marten, Marieke en Peter. Jullie hebben me aangemoedigd door te zetten en me uit de wind gehouden wat betreft de oneindige taken naast de directe patiëntenzorg. Ik kijk uit naar de toekomst in ons nieuwe Gelre Ziekenhuis.

I would like to thank Mrs Elizabeth Harding who kindly and rapidly proofread the text of this thesis.

Van Leiden tot in Afrika, van kamperen tot ontberingstocht, van verliefdheid tot vaderschap, van dienstweigeren tot promoveren, jullie hebben ervan geweten. Kortom, ik kan me geen betere paranimfen voorstellen! Erik van Biemen en Charlotte van Gent bedankt.

Weinigen hebben mijn overgang van co-assistent tot agio en van tropen-dokter tot doctor van dichtbij meegemaakt. Er was er één die dat zelfs vrijwillig deed en tevens veel tijd stak in het lezen en verbeteren van dit proefschrift. Zoiets doe je niet met je verstand, dat kan alleen uit liefde.....bedankt.

Curriculum Vitae

Wilbert Spaans (Den Haag, 4 januari 1962) behaalde in 1980 zijn VWO diploma aan het Christelijk Gymnasium Sorghvliet in Den Haag. In datzelfde jaar ging hij geneeskunde studeren aan de Rijksuniversiteit Leiden. Na zijn artsdiploma in augustus 1987 werkte hij tot januari 1988 als artsonderzoeker aan de Erasmus universiteit van Rotterdam. Vervolgens begon hij met de tropenopleiding waarvoor verschillende arts-assistentschappen werden gevolgd tussen januari 1988 en januari 1990: *Orthopaedie*, Southport, United Kingdom; *Poort-arts*, Ziekenhuis Rijnoord, Alphen a/d Rijn; *Chirurgie*, Reinier de Graaf Gasthuis, Delft; *Verloskunde/Gynaecologie*, Eudokia Ziekenhuis, Rotterdam en Princess Marina Hospital, Botswana. Tussen februari 1990 en juli 1990 was hij als artsonderzoeker verbonden aan het National Women's Hospital, Auckland University, New Zealand. In het najaar van 1990 volgde hij de tropencursus aan het Koninklijk Instituut voor de Tropen in Amsterdam. Tussen april 1991 en juni 1994 werkte hij als tropenarts (Medical Superintendent, acting District Medical Officer) in het Mnene Hosptial, Mberengwa District, in Zimbabwe. Na terugkeer uit de tropen volgde hij van oktober 1994 tot oktober 2000 de opleiding tot gynaecoloog in het Onze Lieve Vrouwe Gasthuis (Amsterdam, Dr. M.F. Schutte), het Academisch Medisch Centrum (Amsterdam, Prof. Dr. O.P. Bleker) en het Flevoziekenhuis (Almere, B. van Aken). Tijdens zijn opleiding werden de studies uit Zimbabwe gepubliceerd en werd begonnen met de Nederlandse studies met betrekking tot een sectio caesarea in de voorgeschiedenis. Na zijn registratie als gynaecoloog werkte hij enkele maanden als chef de clinique in het Sint Antonius Ziekenhuis in Nieuwegein. Op 1 februari 2001 trad hij toe tot de maatschap gynaecologie in het Gelre Ziekenhuis te Apeldoorn. In zijn huidige werkkring heeft hij als aandachtsgebied de uro-gynaecologie en de minimaal invasieve chirurgie. Wilbert is getrouwd met Carla van Wiechen en samen hebben zij twee zonen Theun en Gijs.

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Stellingen

Behorende bij het proefschrift

Vaginal Birth after Caesarean Section in Zimbabwe and the Netherlands

1. In landen met een hoge maternale sterfte na sectio caesarea heeft een proefbaring bijna altijd de voorkeur boven een electief herhaalde sectio caesarea.

2. Tussen wachthutten en wachtlijsten ligt een wereld van verschil.

3. Een partogram van een baring die eindigt in een sectio caesarea bevat informatie die van nut is voor het beleid rondom een eventuele toekomstige bevalling.

4. Vaginale baring na een sectio caesarea in de voorgeschiedenis moet een verplichte code worden in de LVR2-registratie.

5. Het getuigt van zorgvuldigheid om ook de kansen op een vaginale baring te bespreken met een vrouw die meer dan één sectio caesarea in de voorgeschiedenis heeft.

6. Artsen die met de huidige arbeidsvoorwaarden nog kiezen voor een baan in de tropen verdienen een pluim, meer wil de Minister van Ontwikkelingssamenwerking er niet voor uittrekken.

7. De erfopvolging in de monarchie is uit de tijd en moet worden afgeschaft. Om te weten wat voor vlees men in de kuip heeft kan het staatshoofd beter gekozen of gekloond worden.

8. Op de beurs en in het huwelijk bieden in het verleden behaalde resultaten geen garantie voor de toekomst. Investeren in het huwelijk uit eigenbelang leidt echter altijd tot koersverlies.

9. Wanzi baba, wada kamusha kake (vrij vertaald: als een man kiest voor het vaderschap, moet hij ook alle verantwoordelijkheden onder ogen zien) Shona gezegde.

10. Voor de emancipatie van zowel man als vrouw is het goed als werkende mannen vaker vader en werkende moeders vaker vrouw durven te zijn.

11. Aan de hand van eindtermen van de opleiding tot gynaecoloog behoort bepaald te worden of een arts zich mag inschrijven in het specialistenregister; tot nu toe lijkt dit vooral afhankelijk te zijn van vraag en aanbod op de arbeidsmarkt.

12. Robert Mugabe en Cornelis Spaans waren beiden "freedom fighter". Rob werd dictator en Cor kreeg de kogel. Wie leeft nu verder als een held?

13. Trams en magneettreinen dragen bij aan een schonere wereld; de enige milieuvriendelijke auto vind je op een computerspelletje (*Theun Spaans, 11 jaar*).

14. Tangconstructies en tangverlossingen moet een (schrijvend) gynaecoloog proberen te vermijden (*vrij naar Lenneke Nowee*).

Wilbert Spaans
12 mei 2004