Breech at term

Early and late consequences of mode of delivery

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INTRODUCTION

Breech presentation at term is associated with higher rates of perinatal mortality and morbidity than cephalic presentation (26, 39, 56, 70, 86). During pregnancy the incidence of breech presentation decreases from 25% at 28 weeks of gestation to 3-4% at term (57, 99). A rational explanation of why the foetus presents by the breech at term is found in only about 15% of cases (99).

Factors associated with increased risk of breech presentation may be related to maternal constitution or pregnancy complications (2, 26, 84, 99, 141). Maternal constitutional factors include nulliparity, grand multiparity, contracted pelvis, high maternal age and uterine anomalies including fibroma. Pregnancy complications include foetal growth retardation, foetal malformations, polyhydramnios, oligohydramnios, placenta praevia, and short umbilical cord. Many of these factors may, regardless of the presentation, be associated with an increased risk of poor foetal outcome. Thus, they may act as confounders when trying to determine the adverse effect of the breech presentation, as such, on foetal outcome. Also, there may be some pregnancy complications, such as intrauterine infections that might result in foetal brain damage that affects foetal movements and thereby increases the risk of breech presentation at term. These complications might be subclinical, which means that it is often difficult to conclude from descriptive studies whether it is maternal constitution, pregnancy complications, or the mode of delivery per se, that is responsible for the increased risk at birth.

External cephalic version in pregnancy is used to reduce the incidence of breech presentation at term. The success rate of external cephalic version varies considerably depending on the skill of the person carrying out the manoeuvre and maternal factors such as parity, liquor volume, engagement and position (59, 90, 151). A review of 17 studies found success rates to vary from 35% to 86% (6).

The benefit of external cephalic version after 37 weeks has been appraised in 6 randomised controlled studies (59). The rate of caesarean delivery was reduced (Relative Risk (RR)=0.42; 95% Confidence Interval (CI): 0.39-0.71), and the rate of non-vertex presentation was reduced (RR=0.42; 95% CI: 0.35-0.50). The foetal outcome was unchanged (59).

Some studies have reported an increased risk of intervention during delivery following external cephalic version due to dystocia and foetal distress (36, 90, 120, 151). This is in accordance with the knowledge that breech presentation during pregnancy, in some cases, is caused by contracted pelvis or foetal complications.

Clinical complications at external cephalic version are rare. In 979 reported cases no foetal losses were reported (60), and emergency caesarean delivery in less than 1% of cases (90).

A randomised study of 233 women with breech presentation found that external cephalic version performed at 34 to 36 weeks compared with 37 to 38 weeks might further reduce the risk of non-cephalic presentation at delivery (65). A large a multi-centre study comparing term and preterm external cephalic version is in progress in Canada in order to assess this approach further in terms of caesarean section rates and neonatal outcomes.

Until the 1950s all women with breech – both term and preterm – were prescribed a trial of labour. Then Wright (148) and Trolle (132) in 1959 and 1960, respectively, reported that vaginal delivery was associated with a three to fourfold increased risk of perinatal mortality, even after exclusion of premature and malformed infants. They suggested caesarean delivery for all breech presentations.

In the following years maternal complications related to caesarean delivery decreased, and during the 1960s and the 1970s the rate of caesarean delivery of breech infants increased. From 1985 to 1999 the rate of caesarean delivery of term breech was about 80% and did not change significantly (**Figure 1**).

In the nineties there were different opinions among Danish obstetricians and midwives regarding which mode of delivery to recommend (66, 91, 138). Publications of small retrospective studies with differing undocumented conclusions led to changes in local guidelines on recommended mode of delivery from time to time.

In a survey of the 30 Danish departments of obstetrics in 1994, clinical guidelines for management of breech at term were investigated (78). Two departments recommended caesarean delivery to all parturients and ten departments to all primipara. The criteria for recommendation of vaginal delivery were complex and varied between the departments regarding pelvimetry, external cephalic version, pain relief during labour and induction of labour. We also found a significant difference in rates of vaginal delivery between the eastern and western parts of Denmark that was not associated with structural differences in attendance of paediatricians and anaesthesiologists at birth. All together, the different guidelines reflected local attitudes and clinical experience more than results of appropriate studies.

Several issues needed to be addressed to determine whether the total population or a subgroup could be recommended vaginal delivery. We needed to balance foetal and maternal risks in terms of perinatal mortality, short and long-term morbidity and maternal complications in emergency caesarean section in women selected for vaginal delivery, against the maternal risks associated with planned caesarean delivery. There was also a need for an assessment of the degree of potential avoidability of perinatal mortality and morbidity by improved clinical handling during pregnancy and delivery.

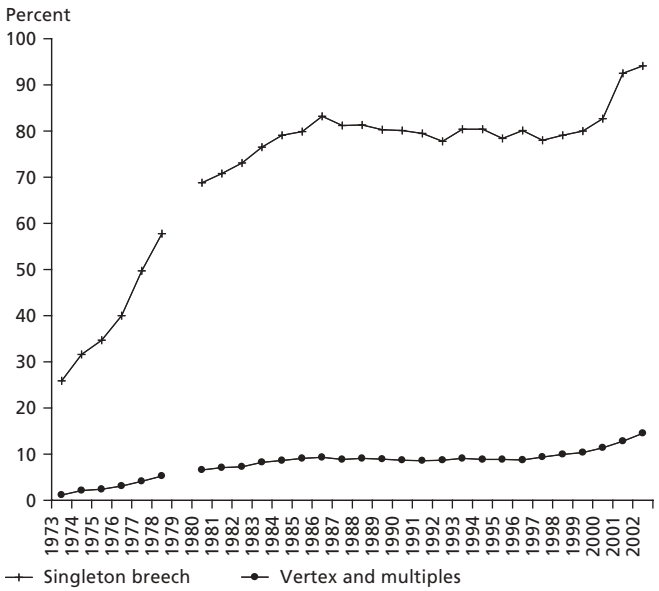

Figure 1. Caesarean delivery rates. Denmark 1973-2002.

Thus, there was a need for a proper analysis of the results of term breech deliveries in a large Danish population.

AIMS OF THE PRESENT THESIS

1. Describe perinatal mortality and morbidity according to actual and planned mode of delivery in breech presentation at term.
2. Identify risk factors for perinatal mortality and morbidity.
3. Determine the potential avoidability of perinatal death.
4. Study long-term impairments in breech infants with low Apgar-scores.
5. Investigate the relation of breech at term to cerebral palsy and epilepsy in childhood.
6. Study the short and long-term maternal consequences of mode of delivery.

SHORT-TERM FOETAL OUTCOME

RETROSPECTIVE STUDIES

A large number of retrospective studies (hospital audits) have been published. Many studies do not compare results by intended mode of delivery. They compare vaginal and caesarean delivery regardless of whether the caesarean section was planned or performed as a result of an unsuccessful vaginal delivery.

During the nineties two meta-analyses of data on planned mode of delivery and foetal complications after term breech delivery were published (21, 43).

The first (Cheng) (21) included all studies published between 1966 and 1992 that presented results by intended mode of delivery. They found a higher perinatal mortality (Odds Ratio (OR))=3.86; 95% CI: 2.22-6.69) after planned vaginal delivery compared with planned caesarean delivery. Also the risk of low 5-minute Apgar score (OR=1.95; 95% CI: 1.45-2.61) and neonatal morbidity due to birth trauma (OR=3.96; 95% CI: 2.76-5.67) was increased, when vaginal delivery was planned. The largest study included was a British register-based study of 3,447 deliveries (130), which did not present the result according to the intended mode of delivery. Another weakness of the meta-analysis is that some of the studies included are more than 20 years old and might reflect a clinical practice very different from today. Examples of changes in clinical practice are the availability of intrapartum CTG and ultrasonography to estimate foetal weight antenatally, the willingness among physicians to do caesarean deliveries on foetal indication because of the lower frequency of maternal complications at caesarean delivery and the improvement of neonatal care.

The second meta-analysis (Gifford) (43) included studies published between 1981 and 1991 that specified the selection criteria for vaginal delivery and allowed for analysis by intended mode of delivery. The pooled risk for any injury was 1.0% after a trial of labour and 0.09 after elective caesarean delivery. For any injury or death the risk was 1.23% after a trial of labour and 0.09% after elective caesarean delivery.

Updated meta-analysis

We performed an updated review of all descriptive, consecutive studies on term breech delivery indexed in the MEDLINE search program from 1990 until May 2003. A total of 22 studies were retrieved and reviewed (3, 11, 22, 28, 29, 34, 37, 45, 46, 48, 56, 67, 71, 73, 88, 89, 92, 106, 114, 116, 117, 122, 147). Seventeen publications that presented data on singleton term breech deliveries according to the intended mode of delivery were included in a meta-analysis (**Table 1**). Data extraction was performed according to the guidelines of the Review Manager Program published by the Cochrane Collaboration (62). Perinatal mortality figures were uniformly revised by exclusion of antepartum stillbirths and congenital malformations. The effect of planned vaginal delivery, compared with elective caesarean delivery, was determined by calculation of a typical odds ratio. Data were analysed in terms of short-term foetal complications (intrapartum and early neonatal mortality, low 5-minute Apgar score, traumatic neonatal morbidity and neonatal neurological morbidity defined as hypoxic ischemic encephalopathy (HIE) and/or seizures. Data were analysed by a fixed effect model using the method of Mantel-Haenszels (62). The results of the four meta-analyses are presented in Figures 2-5.

The analysis of perinatal mortality included 16 perinatal deaths after intended vaginal delivery (0.3%) and 4 deaths after planned caesarean delivery (0.1%). The difference was not statistically significant with a typical OR=1.49; 95% CI 0.64-3.46 (**Figure 2**). This is not in accordance with the metaanalysis that included older studies and RCT's. The main reason for this discrepancy is probably that newer technology has lowered the general rates of perinatal mortality. Other hypothesis that may have contributed are, that the selection criteria for vaginal breech delivery may have become stricter, clinicians may be moving more quickly to an emergency caesarean

Table 1. Planned vaginal versus planned caesarean delivery for term breech presentation. Descriptive studies 1990-2003.

	Population studied		Planned VD		Planned CD	
Author	**no. studied**	**inclusion characteristics**	**total no.**	**CD rate (%)**	**total no.**	**CD rate (%)**
El Gammal et al 1990 (37)	51	1 previous CD	21	0	30	100
Christian 1990 (22)	123	Frank breech, EFW 2000-4000 g, pelvimetry[a]	85	19	37	100
Roumen and Luyben 1991 (114)	247	BPD < 10 cm	234	16	13	100
Han et al 1993 (48)	159	Pelvimetry[b], EFW < 3500 g	72	29	87	100
Laros et al 1995 (88)	290	Failed version, EFW ≤ 3850g pelvimetry[c]	143	63	147	100
Obwegeser et al 1996 (106)	388	GA > 34 weeks, EFW < 3500 g	280	20	108	100
Schiff et al 1996 (117)	846	EFW 2000-3500 g, no previous CD	613	47	233	100
Albrectsen et al 1997 (3)	1144	Pelvimetry[b], EFW 2500-4500 g	758	21	386	100
Irion et al 1998 (67)	705	GA ≥ 36 weeks, EFW ≤ 3600 g, BPD ≤ 96 mm	385	30	320	100
Koo et al 1998 (73)	306	EFW 2500-4000 g	234	27	72	100
Golfier 2001 (46)	1116	Pelvimetry[d], EFW ≤ 4000 g, no previous CD	414	17	702	100
Herbst 2001 (56)	1050	EFW< 4000 g	699	14	327	100
Sanchez-Ramos et al 2001 (116)	848	GA ≥ 35 weeks, EFW 2000-4000 g	272	25	576	100
Lashen 2002 (89)	841	EFW< 4000 g, no failed version	492	48	349	100
Giuliani 2002 (45)	699	EFW 2500-4000 g, BPD < 10 cm	481	29	218	100
Kayem 2002 (71)	501	No previous CD, Pelvimetry[e], BPD < 98 mm	322	39	179	100
Belfrage 2002 (11)	575	GA ≥ 36 weeks, pelvimetry[f] or previous baby > 2500 g, EFW < 4500 g	448	16	127	100

VD = Vaginal delivery; CD = Caesarean delivery; EFW = Estimated fetal weight; BPD = Biparietal diameter; GA = Gestational age.

Pelvimetry[a]: Anteroposterior diameter of the inlet ≥ 10.0 cm, transverse diameter of the inlet ≥ 11.5 cm, transverse diameter of the midpelvis ≥ 9.5 cm, posterior sagittal diameter of the midpelvis ≥ 4.0 cm.

Pelvimetry[b]: Anteroposterior diameter of the pelvic inlet ≥ 11.5 cm.

Pelvimetry[c]: Anteroposterior diameter of the pelvic inlet ≥ 12.0 cm, transverse diameter of the midpelvis ≥ 10.0 cm, transverse diameter of the inlet ≥ 11.0 cm.

Pelvimetry[d]: Transverse diameter of the inlet ≥ 12.5 cm, obstetric conjugate ≥ 10.5 cm, biischial diameter ≥ 9.5 cm.

Pelvimetry[e]: BPD < interspinous diameter, anteroposterior diameter of inlet ≥ 10.5 cm, transverse diameter of the inlet ≥ 12.0 cm.

Pelvimetry[f]: Sum of outlet diameters > 32.5 cm, anteroposterior diameter of the pelvic inlet ≥ 11 cm.

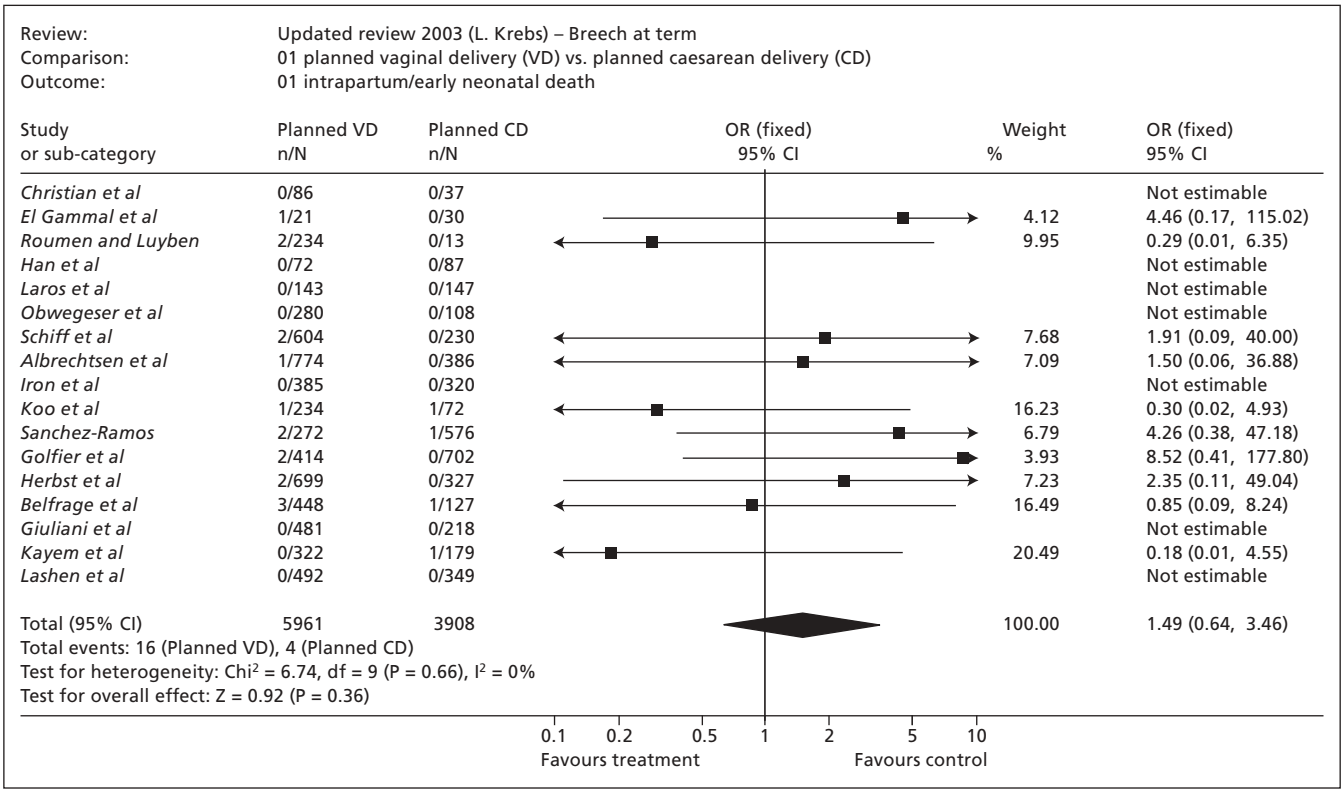

Figure 2.

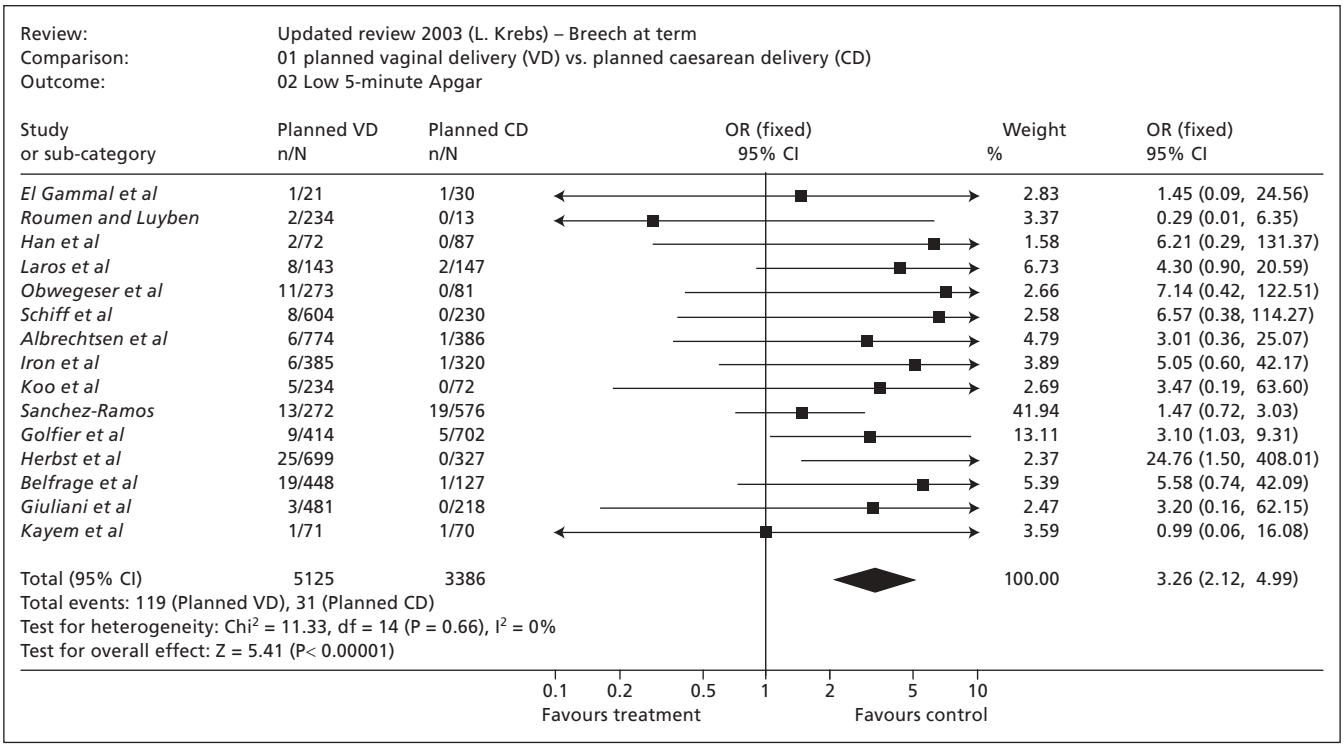

Figure 3.

during the course of a planned vaginal breech delivery than in previous years, the population having breech babies may be healthier and the foetuses less prone to perinatal death, and/or that neonatal care has improved in recent years. Considering the incidence and sample size, the lack of statistical significance is not surprising. The rates of mortality are similar to those found in a Danish register-based study (77). Based on the results from this study it was calculated that a sample size of 18,000 parturients was needed to establish statistically significant results at 5% level with 90% certainty (type B error) when comparing mode of delivery.

According to the meta-analysis planned vaginal delivery was associated with a higher perinatal morbidity in terms of low 5-minute Apgar score (OR=3.26; 95% CI: 2.12-4.99) (**Figure 3**), birth trauma (OR=4.06; 95% CI 2.57-6.42) (**Figure 4**) and neonatal neurological short-term morbidity (OR=5.81; 95% CI: 2.25-16.01) (**Figure 5**).

In general, meta-analyses give an excellent opportunity to achieve a sufficient sample size in comparing an intervention with a very low rate of complications. However, the analyses do not integrate the influence of potential confounders relating to factors such as baseline characteristics of the study group, the criteria for allowing a trial of labour, and the actual management of labour and delivery. In this specific meta-analysis, selection criteria for intended mode of

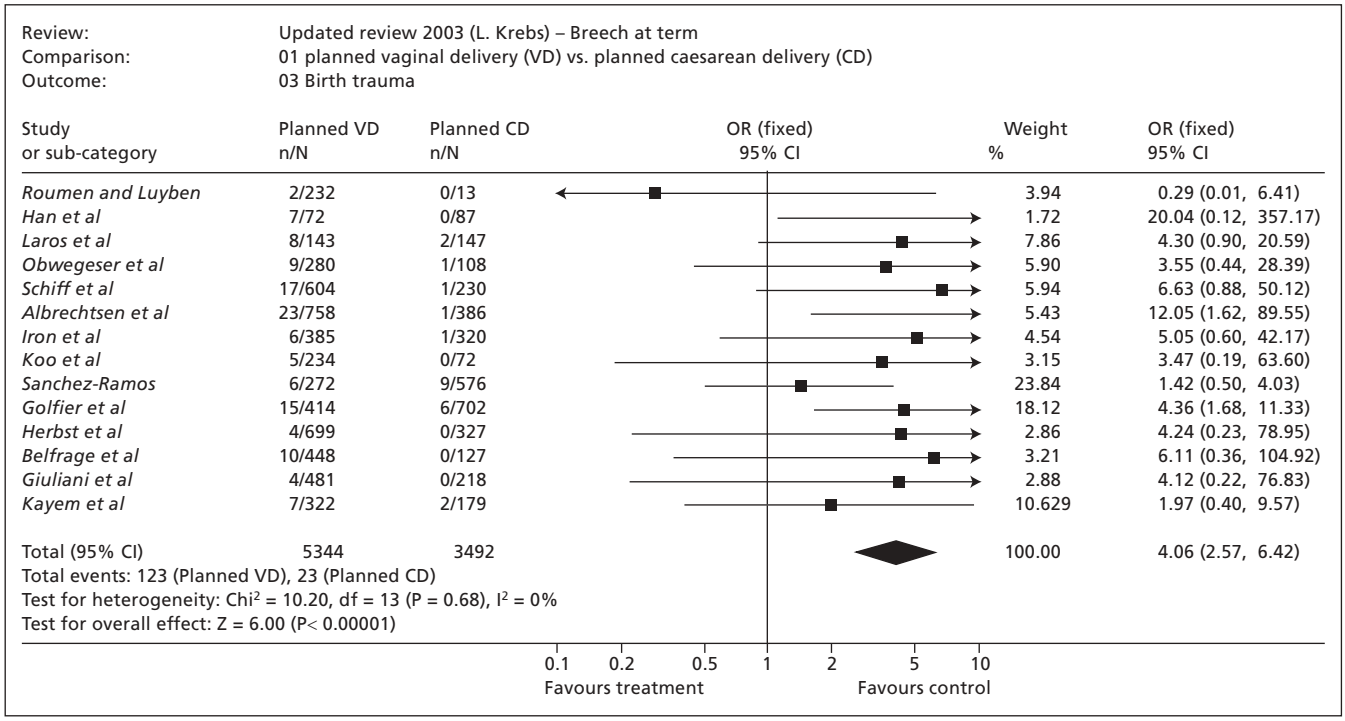

Figure 4.

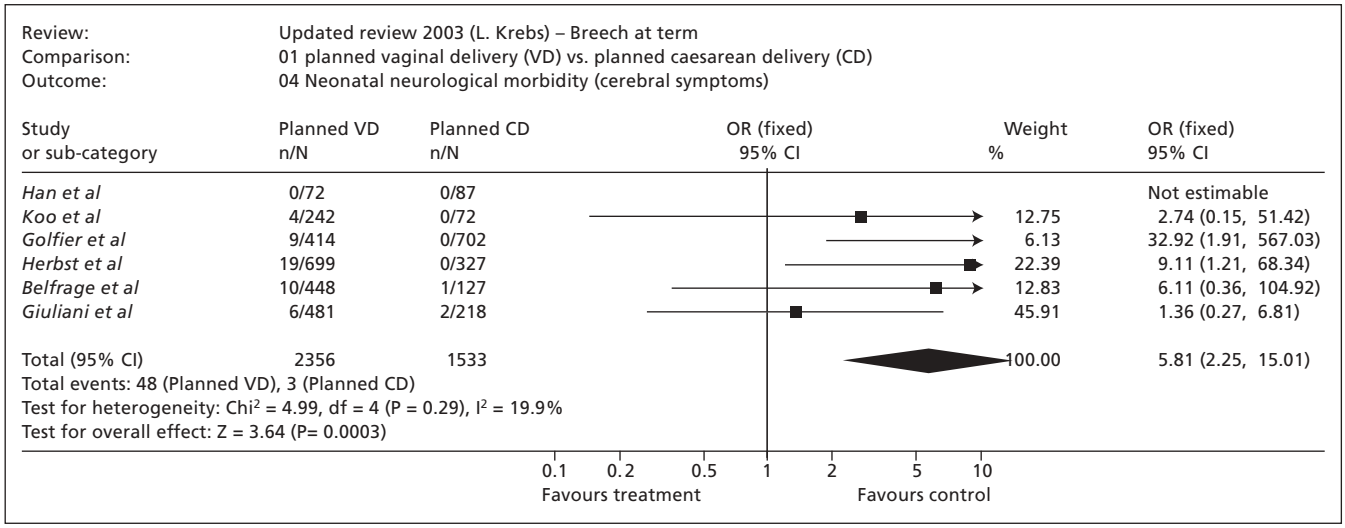

Figure 5.

delivery led to more high-risk deliveries in the planned caesarean section group. According to the protocols of the studies, women with medical or obstetrical complications were offered elective caesarean delivery resulting in a bias toward an increased risk of poor outcome in the planned caesarean group. These considerations, however, are in favour of the conclusion of the meta-analysis indicating an increased risk associated with intended vaginal delivery.

In conclusion, the updated meta-analysis on seventeen descriptive studies showed that there was an insignificantly increased risk of perinatal death, and significantly increased risks of low Apgar score, birth trauma and neurological morbidity following planned vaginal delivery.

REGISTER-BASED COHORT STUDIES

Thorpe-Beeston et al. presented data from St Mary's maternity information system on 3,447 singleton foetuses presenting by the breech at term (130). In this study, 28% were delivered vaginally, 42% by elective caesarean section and 30% by emergency caesarean section. Analysis were performed by actual and not by intended mode of delivery. Perinatal mortality among non-malformed infants was 0.83% in vaginally delivered infants compared with 0.03% in infants delivered by elective caesarean section (RR=20; 95% CI: 2.5-163). Rates of Apgar scores (<7) at five minutes were 4.6% in vaginally delivered infants compared with 2.2% in infants delivered by elective caesarean section (RR=2.0; 95% CI: 1.3-2.9).

Thus, results from the British study indicated an increased foetal risk associated with vaginal delivery of term breech. In order to determine if these figures were valid for a much larger Danish population of parturients, we performed population-based study.

Based on information from the Danish Medical Birth Register we studied all singleton infants delivered in breech presentation at term without malformations in Denmark 1982-1990 (I, 77). A total of 19,999 (3.9%) singleton infants presenting by the breech were identified in the register and analysed. Term infants (n=16,234) were classified as having a gestational age of more than 259 days, or if gestational age was unknown a birth weight of 2500 g or more. Term infants with malformations (n=478) and antepartum foetal deaths (n=45) were excluded.

Of the non-malformed term breech infants alive at onset of labour (n=15,718), a total of 3,247 (20.7%) were delivered vaginally,

Table 2. Intrapartum death, early neonatal mortality and Apgar score below 7 at 5 minutes by mode of delivery of breech at term. Danish Medical Birth Registry 1982-1990.

Mode of delivery	Vaginal N=3247	Elective CD N=7106	Emergency CD N=5356	OR (95% CI) VD vs EL-CD	VD vs EM-CD	EM-CD vs EL-CD
Intrapartum and early neonatal death	12 (0.37%)	9 (0.13%)	14 (0.26%)	2.93 (1.24-18)	1.41 (0.64-3.10)	2.07 (0.89-4.99)
Low Apgar (5'<7)	66 (2.03%)	20 (0.28%)	61 (1.14%)	7.35 (4.35-2.45)	1.80 (1.26-2.56)	4.08 (2.51-6.94)

VD = vaginal delivery; CD = caesarean delivery; EL = elective; EM = emergency.

7,106 (45.3%) by elective caesarean and 5,356 (34.1%) by emergency caesarean delivery. The risk of intrapartum or early neonatal death was lower in infants delivered by elective caesarean (0.13%) than in those delivered vaginally (0.37%) or by emergency caesarean section (0.26%). Also the frequency of Apgar score below 7 at five minutes (**Table 2**) was significantly lower in infants delivered by elective caesarean section, i.e., 0.28% compared with vaginal delivery (2.03%) and emergency caesarean (1.14%).

In vaginal deliveries, parity was not correlated with perinatal death or low Apgar score. The incidence of low Apgar score was significantly higher in infants with birth weight above 4000 g compared with those with birth weight between 2500 g and 4000 g.

In a register-based study from the Swedish Medical Birth Registry, 1991-1992, on 6,542 infants delivered in breech presentation after 34 completed weeks of pregnancy (94), rates of vaginal delivery elective caesarean section and emergency caesarean section were, respectively, 35.9%, 26.9% and 35.9%. Information on perinatal deaths was validated by medical records. After exclusion of infants with malformations and infants delivered outside hospital, no difference in infant mortality was found between vaginal delivery and caesarean section (0.09% and 0.05% respectively). Risk of Apgar score below 7 at five minutes was significantly increased among vaginally delivered infants compared with infants delivered by elective caesarean section (3.1% and 0.93% respectively RR=3.38; 95% CI: 2.02-5.33).

In another study from the Swedish Medical Birth Registry 1987-1993, Roman et al. found a higher perinatal mortality rate (0.3% (OR=2.5; 95% CI: 1.1-5.9) compared with elective caesarean section (0.15%), and risk of low Apgar score at 5 minutes (OR=9.5; 95% CI: 5.8-18.89) in infants delivered vaginally compared with elective caesarean section (113). Information on perinatal deaths, however, was not validated by medical records in this study. Also, birth injuries and neonatal convulsions were more common among vaginally delivered infants compared with infants delivered by elective caesarean section (2.6% vs. 0.2% (OR=12.2; 95% CI: 6.8-21.8) and 0.2% vs. 0.08% (OR=2.7; 95% CI: 0.9-8.1) respectively).

A Dutch study of 33,824 deliveries reported to the Dutch Perinatal Database found that vaginal delivery was associated with a sevenfold increase in low Apgar score (OR=6.67; 95% CI: 4.24-11.1), a threefold increase in birth trauma (OR 3.03; 95% CI: 1.41-6.25) and a twofold increase in perinatal mortality (OR=2.33; 95% CI: 1.06-5.00) when compared with planned caesarean delivery (111).

Thus, results from large population-based materials in Denmark, Sweden, the Netherlands and UK are consistent and show an increased foetal risk associated with vaginal delivery of term breech.

However, in these studies vaginally delivered breeches are mixed populations regarding planned mode of delivery. They include cases where 1) the presentation was diagnosed, and vaginal delivery was planned, 2) the presentation was undiagnosed, and vaginal delivery was decided at admission to hospital, and 3) the presentation was diagnosed so close to delivery that caesarean section could not be considered. It is possible that a majority of cases of death and low Apgar score belonged to the two latter groups and therefore were more or less unavoidable.

Likewise, the population of emergency caesarean section is a combination of groups of women with 1) planned caesarean delivery where emergency caesarean section was performed because of pregnancy complications or onset of labour before the scheduled operation, 2) undiagnosed breech where a caesarean delivery was decided at admission, and 3) planned vaginal deliveries. Thus, different outcomes in these three groups influence the results when comparing intended vaginal delivery with intended caesarean delivery.

Register-based studies may be limited in completeness and in the accuracy of coding of obstetrical data (33, 85, 123). We validated information on term breech presentation from the Danish Medical Birth Registry (II, 79). A review of medical records from all cases of perinatal death and a sample of selected controls showed that foetal malformations in perinatal deaths were consistently under-reported. Among the perinatal deaths supposed to be without foetal malformations 71.1% actually had malformations. The reason for this discrepancy is that at the time the study was conducted information on malformations diagnosed in the neonatal period was not automatically added to the Medical Birth Registry, but reported to a separate registry of congenital malformations.

In infants with low Apgar score only 72.8% selected from the birth register were correctly reported. The most common reason for this was the reading of a handwritten "10" as "6". In the other variables used for analysis (breech presentation, gestational age ≥37 weeks, alive at onset of labour), the agreement between the register and the medical records was above 90%.

Thus, results from large population-based studies in Denmark, Sweden, the Netherlands and UK are consistent and show an increased foetal risk associated with vaginal delivery of term breech.

QUANTITATIVE AUDIT

Predictability of adverse outcome

The Danish register-based study showed that vaginal delivery and emergency caesarean section was significantly related to perinatal mortality or morbidity (I, 77). However, the increased risk might be a result of poor selection of women for vaginal delivery, or of insufficient care during pregnancy or delivery. This question has not previously been addressed in a population-based controlled study. In order to obtain information regarding intended and actual mode of delivery, pre-labour diagnosis of the breech, antenatal risk factors and management during labour, a review of medical records was performed (II, 79). The study was designed as a case-control study including all cases with an Apgar score below 7 at 5 min, based on information from the Danish Medical Birth Register 1982-92.

Altogether, 24,100 singleton infants (3.8%) were delivered in breech presentation, of whom 19,476 were non-malformed, alive at onset of labour, and delivered at term (gestational age ≥259 days, or if gestational age unknown, birth weight ≥2500 g). Cases were identified as intrapartum or early neonatal deaths (n=45) and infants with Apgar score below 7 at 5 minutes (n=175). For each case, two subsequent deliveries of non-malformed infants in breech presentation at term were selected as controls. Cases that fulfilled the criteria for the review of the medical records after validation of information from the register (non-malformed, breech presentation, alive at onset of labour and delivered at term) were selected for further analysis. Intended mode of delivery was categorised in five groups:

1. Selected for a trial of vaginal breech delivery before admission in labour.
2. Selected for elective caesarean delivery.

Table 3. Planned mode of delivery in cases with low 5-minute Apgar score and in controls. Term breech deliveries in Denmark 1982-1992.

Categories of mode of delivery	Case (Apgar 5'<7) N=130	Control N=398	OR (95% CI)
Breech diagnosed and mode of delivery planned before admission			
1. Planned vaginal delivery	56 (43.1%)	66 (16.6%)	15.1 (7.8-29.9)
2. Planned caesarean delivery	13 (10.0%)	231 (58.8%)	
Breech undiagnosed or mode of delivery not planned before admission			
3. Vaginal delivery decided	36 (27.7%)	44 (11.1%)	1.9 (1.0-3.7)
4. Caesarean delivery decided	24 (18.5%)	56 (14.1%)	
5. Delivered before admission	1 (0.8%)	1 (0.3%)	–

3. Undiagnosed breech presentation or mode of delivery not planned before admission in labour – a trial of vaginal delivery decided at admission or at diagnosis of the breech.
4. Undiagnosed breech presentation or mode of delivery not planned before admission in labour – a caesarean delivery decided at admission or at diagnosis of the breech.
5. Undiagnosed, unplanned and delivered at home or on the way to hospital.

Mode of delivery was planned before admission in labour in 53% of cases and in 75% of controls. When mode of delivery was planned before admission (groups 1 and 2), intended vaginal delivery was associated with a higher risk of mortality or low Apgar score (OR: 15.1; 95% CI: 7.8-29.9) than when a caesarean delivery was planned (**Table 3**).

When breech was undiagnosed or mode of delivery not planned at admission (groups 3 and 4), a trial of labour was also associated with a higher risk of mortality or low Apgar score (OR=1.9; 95% CI: 1.0-3.7).

Pregnancies complicated by pre-eclampsia and small-for-gestational-age (SGA) were significantly more frequent in cases than in controls. But if pregnancies with pre-eclampsia and/or SGA were excluded, planned or unplanned vaginal delivery was still (and with higher OR) associated with low Apgar score or death.

A multivariate analysis showed that planned vaginal delivery and SGA were prelabour predictors for low Apgar score/perinatal death. However, nulliparity, birth weight above 4000 g, previous birth weight, maternal age, post-term pregnancy were not significant predictors.

In order to identify predictors for low Apgar score/perinatal death during labour in planned vaginal deliveries, we tested for induction of labour, administration of oxytocin for augmentation of labour, duration of first and second stage of labour, and PROM. In a multivariate analysis, only a prolonged second stage of labour (>30 minutes) was found to be a predictor for low Apgar score.

A number of different criteria determine whether the parturient is offered a vaginal or a caesarean delivery (53, 78). These criteria and elements of care presented in guidelines for conducting a vaginal breech delivery have not been proved clearly beneficial. It was not the aim of the present study to test the benefit of the individual interventions. We are well aware that we have studied relations that are modified by obstetric practice and interventions. However, the design of the present study allows us to investigate the relation of adverse outcome to specific mishaps and/or complications avoidable by increased attention to specific risk factors.

In conclusion, planned vaginal delivery was associated with a 15-fold increased risk of low Apgar score/perinatal death compared with planned caesarean delivery. A prolonged second stage of labour was a predictor for low Apgar score in the present population of women selected for vaginal breech delivery.

QUALITATIVE AUDIT

Are perinatal deaths potentially avoidable?

In Denmark during 1982-1992 a total of 13 non-malformed infants delivered in breech presentation at term died during labour or the first week of life (II, 79). However, these deaths might have been due to unavoidable complications related to the presentation itself, or to suboptimal care during pregnancy or delivery.

In order to estimate the degree of potential avoidability of intrapartum or early neonatal death associated with term breech delivery we designed a controlled audit (III, 75). This is the first published controlled audit of adverse outcome by mode of delivery. One case was excluded, in which the parturient insisted on a home delivery in spite of given advice. A panel of 11 experienced obstetricians reviewed the obstetric history of the 12 cases (**Table 4**) and 23 controls (selected as two succeeding breech deliveries in the database with same planned mode of delivery). The obstetricians reviewed narratives of the cases, which ended when the infant was delivered to the umbilicus. They were asked to answer a structured questionnaire focusing on suboptimal care during pregnancy and delivery and were asked, whether the infant was thought to be a case or a control. No information on the outcome was given.

The majority of the auditors thought that five (58%) cases and two (9%) controls had died. Antenatal and intrapartum care was found to be suboptimal in, respectively, 17% and 25% of cases and 4% and 26% of controls. The assumed death was found possibly or certainly avoidable in 58% of cases and 17% of controls.

The themes of the comments on suboptimal care that were given significantly more often in cases than in controls were: Undiagnosed IUGR, inadequate observation and intervention in pregnancies with preeclampsia, placental abruption and post maturity, too long a time lapse between decision and performance of caesarean section, and poor compliance between the woman and the staff. Some issues were not stated more often in relation to cases than in controls: Undiagnosed breech during pregnancy or at admission, insufficient foetal monitoring, insufficient reaction to prolonged labour or foetal-pelvic disproportion, and footling not delivered by caesarean section (**Table 5**). Thus, according to the opinion of the Danish peers, the deaths of term breech infants largely were potentially avoidable.

Perinatal audit has been found to be a valuable tool for quality assessment in perinatal care (8, 9, 30, 140). Ideally, a qualitative audit like the present should rely on explicit criteria. But in obstetrics clinical decisions are often not based on evidence, but rather what is commonly considered good clinical practice. Therefore, activities in the present audit largely have to rely on implicit criteria. This means that the results reflect not only the quality of perinatal care, but also the personality, experience and more or less evidence-based knowledge of the assessor. This is a major problem in uncontrolled audit, where only cases with adverse neonatal outcome are assessed, and the auditor may be biased by knowledge of the outcome (7). The number of cases considered "potentially avoidable deaths" was significantly higher than the number of controls. However, suboptimal care was not uncommon in controls, and a majority of obstetricians found that about $^1/_5$ of controls were considered "potentially avoidable deaths".

In conclusion, auditors blinded to the outcome had more comments on suboptimal care in perinatal deaths than in controls. Fur-

Table 4. Foetal deaths during labour or in the early neonatal period. Term breech deliveries in Denmark, 1982-1992.

1. 36-year-old para II, The previous deliveries uneventful (birth weight 2300 g and 3750 g). Pregnancy uncomplicated, breech presentation was diagnosed at week 36+6 and verified by ultrasound. No information on attempt on external cephalic version. Vaginal delivery was planned at prelabour consultations. She was admitted to the labour ward at 37+1 weeks. Labour was augmented with oxytocin when cervix had been 5 cm dilated through 5 hours. Four hours later the foetus was spontaneously delivered to umbilicus, delivery of arms was complicated, and the head was entrapped. A dead infant was delivered by forceps 30 min later. Information on birth weight and length is not available.
2. 32-year-old para III. Previously she had 2 uncomplicated deliveries (birth weight 3350 g and 3550 g) and one twin pregnancy delivered vaginally 6 weeks before term. Breech presentation was diagnosed at week 36+6. Information on attempt of external cephalic version lacking. Birth weight was estimated clinically to 3000 g. A vaginal delivery was planned. She was admitted to the labour ward at 38+5 weeks with ruptured membranes and contractions. Vaginal examination discloses feet and umbilical cord in vagina. Orificium was 4 cm dilated. Foetal heart rate was normal. A dead infant was delivered by emergency caesarean section 45 minutes later. Attempt at resuscitation was without success. Birth weight 3490 g, length 56 cm.
3. 34-year-old para 0. No pregestational risk factors. Pregnancy was uncomplicated. Breech was diagnosed during pregnancy, but in spite of this she had wished to deliver in a maternity home. At 41+1 weeks the membranes broke and she was admitted to the maternity home. 9½ hours later cervix was fully dilated and expulsion started. One hour later the truncus was delivered. The head was entrapped and delivered with great difficulty by forceps. Attempt at resuscitation was unsuccessful. Birth weight 3300 grams, length 50 cm.
4. 31-year-old para 0. Pregnancy was uncomplicated and the breech presentation diagnosed. She was advocated an elective caesaran delivery, but insisted on a home-delivery. She delivered 40+1 weeks. Birth was assisted by a midwife, foetal bradycardia was present through the expulsion stage, but the patient refused any intervention. Infant was delivered a.m Mauriceau-Levret, Apgar 1/1, 4/5, transferred to neonatal care unit, died shortly after birth.
5. 25-year-old para 0, No pregestational risk factors. Pregnancy was complicated by mild hypertension. Breech presentation was diagnosed at 36+0 weeks. An attempt at external cephalic version failed. At week 37+0 another attempt at external cephalic version was performed without success. Estimated birth weight was 2300 g, BPD estimated by ultrasound was 85 mm. A third attempt at external cephalic version was performed at 37+6 weeks. Estimated birth weight 2800 g and BPD 87 mm. Mode of delivery was discussed, but not finally decided at the prelabour consultations. Admitted after 4 hours in labour with ruptured membranes. Cervix was nearly fully dilated and the foetus presented as a complete breech. One hour after admission labour was augmented, and after a further one hour foetal bradycardia was registered. The buttock had now descended to the pelvic floor. A dead infant was delivered by emergency caesarean section after half an hour. Placenta was abrupted (50%). The infant was growth retarded, birth weight 2450 g length 49 cm.
6. 33-year-old para IV, of Turkish origin with no pregestational risk factors. Her previous deliveries were uncomplicated (birth weight 2000 - 4000 g, the last birth was 10 years previously). Pregnancy was complicated by transverse lie and preeclampsia. At week 35+5 external cephalic version was performed successfully. at week 36+4 the foetus had turned back to transverse lie. She was recommended to admit early in labour for external cephalic version. At week 40+0 she was admitted with hypertension (BP 150/100), the foetus was in breech presentation. Her blood pressure normalised, but CTG showed decreased variability. Labour started spontaneously, her blood pressure increased to 116/110 and was treated with intravenous Nepressol. Labour was augmented with oxytocin and 5½ hours after onset of labour her cervix was fully dilated. Shortly after the membranes broke, the foetus was presenting by the feet. The head was entrapped and delivered after amylnitrite and extraction a.m. Mauriceau-Levret. Apgar score was 2/1, 5/5, 9/15 and 10/45. The infant was transmitted to neonatal care unit, but died 3 days old. Information on birth weight and length are not available.
7. 37-year-old para II, No pregestational risk factors. Her previous deliveries were uneventful (birth weight 3700 and 4200 g). Pregnancy uncomplicated. Examined by obstetrician at 39+5. The foetus was in transverse lie, vaginal examination showed immature cervix. A new examination was planned one week later. Examined by obstetrician at 40+4, the foetus was in transverse lie and turned to cephalic presentation by external cephalic version. Estimated birth weight 3800 g. At 40+5 the patient was admitted with bloody discharge and slight menstrual pain. The foetus was again in transverse lie. She was advised to admit early in labour in preparation for a new external cephalic version. She was admitted again 41+0 in labour. The foetus was in breech presentation, estimated birth weight was 3300 g and vaginal delivery was decided. Intensity of labour decreased when orificium was 8 cm and was augmented with oxytocin. The foetus presented as an incomplete breech, CTG showing tachycardia. A caesarean section was decided, but 15 minutes after the decision the foetus body and arms were delivered. The head was entrapped and delivered by forceps nearly one hour later. Apgar scores were 1/1, 2/7, and pH in the umbilical artery 6.79. The infant died 3 hours after birth. Birth weight 3850 g, length 41 cm.
8. 28-year-old para I, Her first delivery was uncomplicated (birth weight 3250 g). Pregnancy was complicated by mild preeclampsia and transverse lie. Was admitted because of hypertension (at admission 135/90) and mentioned decreased foetal movements. CTG showed "silent pattern". Delivered by caesarean section later, the same day. Placenta had 50% infarction. The infant was growth retarded, birth weight 2100 g, appeared dead at birth, but was resuscitated and transmitted to neonatal care unit. Died 5 days old (necrotizing enterocolitis).
9. 30-year-old para I. No pregestational risk factors, The previous delivery was uncomplicated (birth weight 2500 g). Pregnancy was uneventful; and breech presentation had not been diagnosed at prelabour consultations. At week 38+1 she was admitted after five hours of labour, with a 9 cm dilated cervix, foetal heart rate was normal, the foetus was in breech presentation. Estimated foetal weight was 2400 g and an attempt at vaginal breech delivery was decided at admission. 45 minutes after admission her membranes broke, and the foetus was delivered. The head was entrapped. The forceps could not be applied due to a spasm of the cervix. After halothane and incision of cervix the head was delivered by forceps after one hour. Apgar score was 1/1. Resuscitation was not possible. Birth weight 2000 g length 49 cm.
10. 35-year-old para 0 with schizophrenia and drug abuse. Gestational age was unknown. Pregnancy was recognized 2 weeks before delivery. She was committed to a mental ward in the same period, where she was suffering from a severe psychosis and resisted any contact. Breech had not been detected during pregnancy. At admission in labour, orificium was 5 cm dilated and she resisted any intervention. Two hours after her membranes broke and it was recognized that the foetus was presenting by the feet. Labour was stimulated with oxytocin. One hour later vaginal examination showed cord prolapse and feet in the vagina. Shortly after, she delivered. Apgar score was 0/1, 0/5 pH 7.05 SBE 11.2. Resuscitation was not possible. Birth weight 2900 g, length 50 cm.
11. 26-year-old para 0. Pregnancy was uncomplicated and there were no prenatal risk factors. Breech presentation had not been diagnosed during pregnancy. She was examined by midwife at 40+1 weeks and by an obstetrician at 41+1 weeks. At week 41+2 she called the labour ward and reported that contractions had started and that the membranes possibly have ruptured. She is recommended to call for emergency assistance immediately. She delivers at home with great difficulty 35 minutes later. The head was delivered by her sister after a further 20 minutes. The baby was admitted to the NICU, but died the day after. Birth weight 2750 grams, length 41 cm.
12. 40-year-old para III. No pregestational risk factors. The previous deliveries were uneventful, birthweight 3000-3500 g. Amniocentesis was normal. Four weeks before delivery she had tumbled, with subsequent contractions. Breech presentation had not been detected during pregnancy. She was admitted at 38+0 weeks. Her membranes had broken 12 hours before and contractions had started 4 hours before. She was thought to be in early labour with a foetus in cephalic presentation. Four hours after admission, labour was stimulated with oxytocin, 2 hours later cervix was 4-5 cm dilated and the foetus was diagnosed as a breech. One hour later cervix was fully dilated, CTG with episodes with bradycardia. The infant was delivered without difficulties a.m. Bracht. Apgar score: 0/1 1/2 1/11. Resuscitation was initialised, but the infant died after 30 min. Birth weight 3550 g length 50 cm.
13. 26-year-old para 0. No pregestational risk factors. Pregnancy was uncomplicated and breech presentation was not diagnosed. She was admitted at 38+5 weeks after 24 hours with contractions. Cervix was 3-4 cm dilated. Breech presentation was diagnosed one hour after admission. At the same time foetal bradycardia was recognised and an emergency caesarean delivery was prescribed. Ten minutes later the infant was delivered by emergency caesarean section Apgar score 0/3, 3/20, 4/45, 5/120. The infant was intubated and transmitted to neonatal care unit. Treatment was stopped because of an isoelectric EEG, and the infant died 2 days old. Birth weight 2540 g.

Table 5. Comments on suboptimal care during pregnancy and delivery by 11 auditors on intrapartum or early neonatal deaths (N=12) and controls (N=23). Term breech deliveries in Denmark 1982-1992.

	Case N=12	Control N=23	Total
Pregnancy			
Undiagnosed breech	21	38	59
Suboptimal care of IUGR	6	20	26
Undiagnosed IUGR	24	0	24*
External version not performed	11	7	18
Risk factors not considered	7	7	14
Poor compliance (woman/professionals)	6	2	8
Other	10	13	23
Insufficient antenatal care	85	87	172*
Delivery			
Insufficient surveillance	31	47	78
Inadequate reaction to pathologic CTG	16	22	38
Insufficient reaction to prolonged labour	11	16	27
Undiagnosed breech in labour	7	10	17
Footling presentation not delivered by CS	0	14	14*
Insufficient reactions to pregnancy complications	13	1	14*
Too long a delay from decision to performance of CS	12	2	14*
Poor compliance	10	2	12*
Inadequate reaction to foeto-pelvic disproportion	4	2	6
Other	0	7	7
Insufficient care during delivery	104	123	227*
Total number of issues raised	189	210	399*

*) $p<0.05$.

thermore, deaths during labour and delivery were found to be potentially avoidable in more than half of the cases.

RANDOMISED TRIALS

Until year 2000 only two small randomised trials had been published. Collea et al. evaluated 200 women with frank breech foetuses at term with estimated birth weight between 2500 and 3800 grams. Nearly half of the women were excluded based on results from an X-ray pelvimetry. A total of 60 infants were delivered vaginally, all survived, but two had sustained brachial plexus injuries (25).

In another study from the same clinic, Gimovsky et al. (1983) reported the results of 105 women with nonfrank breech presentation at term and estimated birth weight between 2000 and 4000 grams. One infant died after randomisation to vaginal delivery and none after caesarean delivery (44).

The lack of statistically significant differences between the groups in these studies is not surprising considering the size of the materials and the low incidence of mortality and morbidity in the population.

In year 2000 the results of the "Term Breech Trial" (TBT), a large international randomised multicentre trial, were published in The Lancet (51). A total of 2,083 women from 121 centres in 26 countries were randomised. Prior to randomisation the women were carefully evaluated and only frank or complete breech presentations with no evidence of foeto-pelvic disproportion were included. The eligibility criteria were agreed upon at a perinatal consensus meeting prior to the trial (53). Women having a vaginal breech delivery were attended by an experienced clinician at delivery. Of 1,041 women assigned for planned caesarean delivery, 941 (90.4%) were delivered by caesarean section. Of 1,042 women assigned planned vaginal delivery 591 (56.7%) delivered vaginally. After exclusion of lethal congenital anomalies, the risk of perinatal/neonatal mortality was 1.3% after planned vaginal delivery and 0.3% after planned caesarean delivery ($p=0.01$). The risk of perinatal/neonatal mortality or serious neonatal morbidity was 5.0% and 1.6%, respectively ($p<0.0001$). Serious perinatal morbidity was defined as birth trauma, which included subdural haematoma, intracerebral, or intraventricular haemorrhage, spinal-cord injury, basal skull fracture, peripheral-nerve injury present at discharge from hospital, or clinically significant genital injury; neonatal seizures, Apgar score below 4 at 5 min; cord-blood base deficit of at least 15; hypotonia more than 2 h; intubation more than 24 hours; admission to NCU more than 4 days. The benefit of planned caesarean delivery was higher in countries with a low perinatal mortality rate. Stratification by experience of the clinician attending the birth did not influence the results, nor did exclusion of vaginal breech deliveries after a prolonged labour or after labour was induced or stimulated with oxytocin or prostaglandins. Thus, the authors conclude that planned caesarean delivery is better for the term foetus in breech presentation.

The term breech trial confirms the knowledge that breech infants benefit from caesarean delivery first reported by Wright in 1959 (148) and confirmed by several meta-analyses (21, 43, 81) and large register-based studies (77, 94, 113, 130). The trial was launched, because recommendations for a general policy of planned caesarean section for term breech were perceived to be supported inadequately by evidence from randomised trials (58).

Publication of the TBT has stimulated intense discussion on the quality of the trial (47, 72, 96, 136). The internal validity has been criticised in several areas. It has been argued that the quality of care at delivery was suboptimal since an obstetrician attended only 78,4% of births in the planned vaginal delivery group. Also, a high rate of protocol failure resulted in 10% of women with planned caesarean delivery actually having a vaginal breech delivery (among these women, labour was even induced in 7 cases and augmented in 24 cases). Selection criteria were incompletely followed as revealed by the fact that selection of candidates for inclusion in the study of non-malformed, living, singleton term infants included one anencephalic infant, one infant with a large meningomyelocele, 2 women whose infants were dead at the time of randomisation and a case of preterm twins.

The major criticism concerns the external validity of the trial (47, 72, 96). The relevance of using data, of which more than half originate from countries with a perinatal mortality in excess of 20 per 1000, has been questioned (72). In order to correct for the different levels of standard of perinatal care in the trial, the comparisons of outcome were stratified by countries with a high and a low rate of perinatal mortality as reported by WHO (more or less than 20/1000) (144). But even in the group of countries with low rate of perinatal mortality the rate is much higher than in Denmark. Therefore, the size of the difference in adverse outcome by mode of delivery cannot be applied to our population.

In conclusion, results from randomised controlled studies confirm the results of retrospective and register-based cohort studies that elective caesarean delivery is associated with improved short-term foetal outcome. Rates of adverse outcome in the international multi-centre trials, however, may not be valid for Danish parturients.

LONG-TERM FOETAL OUTCOME

CONSEQUENCES OF LOW APGAR SCORE

Since planned vaginal delivery of term breech is associated with an increased risk of short-term neonatal morbidity in terms of birth trauma, low Apgar score and neurological symptoms, a similar increase in long-term adverse outcomes might be anticipated (42, 95).

Danelian et al. presented a follow-up at school age of 1645 breech infants of which 64 were born after intended vaginal delivery (27). They found no significant differences in terms of severe handicap or any other outcome measures between those delivered by elective caesarean section and planned vaginal delivery.

An investigation of 80% of infants from the TBT did not find a significant reduction in risk of death or neuro-developmental delay in children at 2 years of age delivered by planned caesarean section (145). The results are not surprising since the material is far too small to investigate the size of differences in rare adverse outcomes reported by descriptive studies.

A follow-up of 35 term breech infants with low Apgar score found that only one child had sequelae at 5 years of age (13). Thorngren-Jerneck et al. analysed data from the Swedish Medical Birth Registry and found that vaginal breech delivery was the strongest predictor for low Apgar score among term infants (129). Infants with low Apgar scores had OR's of 31.4 (95% CI: 27.3-36.1) for diagnosis with cerebral palsy, 7.9 (95% CI: 6.58-9.39) for epilepsy and 9.5 (95% CI: 7.18-12-5) for mental retardation.

The increased risk of low Apgar score in term breech delivery may to some extent be related to prenatal injury. Growth retardation has also been found related to breech presentation as well as to low Apgar score (70, 84, 99, 129). Since low Apgar score is related to mode of delivery, prenatal origin of the distress at delivery does not seem likely. However, we cannot exclude the possibility that women are primarily selected for caesarean delivery on the basis of disproportion, and if a prenatal injury is the cause of the breech presentation, the latter category more likely will be selected for a vaginal delivery. In other words, IUGR-fetuses will more often be selected for vaginal delivery (77).

However, we found that even after exclusion of term breech infants with IUGR, planned vaginal delivery was associated with a substantially increased risk of low Apgar score. With an uncertain knowledge of the impact and predictive value of low Apgar score in term breech presentation, we recognised a need for a population-based follow-up of term breech infants with low Apgar score, which has not previously been performed in a sufficiently large sample.

Based on the cohort of breech infants in the Danish Medical Birth Registry, delivered 1982-92 and validated by a review of medical records (II, 79), we identified 115 cases with low Apgar score. A population-based follow-up by questionnaires to the parents of 105 cases with low Apgar scores and 218 controls was performed in year 1997. The controls were selected as two subsequent deliveries of term breech in the same hospital with Apgar score above 6 at five minutes (IV, 76). Response rate was 83% in cases and 86% in controls.

The parents were asked in general terms if their child had any handicap or disease. Detailed information regarding the child's present condition was requested. Specific questions were asked concerning vision, hearing, walking, development of speech and language including information on pedagogical support in kindergarten or school.

Four cases compared with one control were reported to have cerebral palsy; one of the cases was also multi-handicapped. In infants without cerebral palsy, speech/language problems were reported in 10.6% of cases and 3.2% of controls (p=0.02). There were no differences in the rates of cognitive development delay/learning disability, deficits in attention, motor control and perception (DAMP) or DAMP-related symptoms or epilepsy.

Some form of handicap or disability was reported in 22 (25%) cases and 18 (8%) controls (OR=3.9; 95% CI: 3.9-7.9) (**Table 6**).

In conclusion, there is a small increased risk of long-term neurological impairment associated with low Apgar score.

CEREBRAL PALSY AND EPILEPSY

Several studies have addressed the relationship between breech presentation and cerebral palsy (104, 115, 129, 141). Cerebral palsy among infants born at term has been found to be unrelated to events during labour in 80%-90% of cases (150), and the extent to which breech presentation is a marker of a prenatal problem is not clear. A multivariate analysis of prenatal and perinatal factors predicting cerebral palsy found that breech presentation was a predictor in infants weighing ≥2500 g at birth, but vaginal breech delivery was not (104).

These hypotheses were addressed in a large register-based study examining relationships between presentation, mode of delivery, SGA and cerebral palsy. The analyses were performed in three steps correlating 1) breech presentation at term and cerebral palsy, 2) mode of delivery in breech at term and cerebral palsy, and 3) Apgar score, SGA, type of cerebral palsy on the one hand, and presentation on the other, in infants with cerebral palsy (V, 84).

Data on infants with cerebral palsy delivered in 1979-1986 and recorded in the Cerebral Palsy Register of East Denmark were linked to the Danish Medical Birth Register, and a cohort of all singleton term infants born in East Denmark was identified. The cohort was described by presentation at birth, mode of delivery, birth weight, Apgar score, SGA (defined as birth weight 2 SD below mean (or <2.5th centile) using a Danish-Swedish intrauterine growth curve (101). Infants with cerebral palsy were described by type and severity of the handicap.

During the study period, 218,344 (93.4%) were delivered in vertex and 6,076 (3.5%) in breech presentation. A total of 345 singleton term infants with CP were identified, of whom 313 (90.7%) were cephalic and 18 (5.2%) breech. Breech infants had a borderline significant risk of cerebral palsy, compared with other infants (OR=1.56; 95% CI: 0.9-2.4). Of the 18 breech infants with CP, five were born vaginally and only one of these deliveries was described as traumatic. Breech presentation infants were more often

Table 6. Handicaps or disabilities among term breech infants with low Apgar score (5′<7) and controls. Term breech deliveries in Denmark 1982-1992.

	Cases N=83	Controls N=186	OR (95% CI)
Cerebral palsy[1]	4 (4.5%)[2]	1 (0.5%)[3]	8.96 (1.09-222.85)
Cognitive developmental delay or learning disability	1 (1.2%)	3 (1.6%)	0.74 (0.03-7.09)
DAMP or DAMP-related symptoms[4]	4 (4.8%)	6 (3.2%)	1.52 (0.37-5.69)
Autism	1 (1.2%)	0	–
Epilepsy	1 (1.2%)	1 (0.5%)	2.26 (0.05-88.43)
Visual defect	4 (4.8%)	3 (1.6%)	3.08 (0.62-16.82)
Auditory defect	1 (1.2%)	1 (0.5%)	2.25 (0.06-88.43)
No unassisted walking	0	0	–
Speech/language problems	9 (10.6%)	6 (3.2%)	3.64 (1.23-11.31)

1) Including one multi-handicapped child.
2) N=87.
3) N=187.
4) Concentration and/or perception problems, hyperactivity.

Table 7. Low Apgar score, low birth weight (< 2500 g) and small for gestational age (SGA) in infants delivered at term in East Denmark, 1979-1986 with and without cerebral palsy (CP) according to presentation at birth.

	CP-infants		All infants	
	vertex N=313	breech N=18	vertex N=218,344	breech N=8076
Apgar 5'<7	47/301 (15.6%)	3/17 (17.6%)	912/216,568 (0.4%)	78/7994 (1.0%)
SGA	43/293 (14.7%)	3/16 (18.8%)	7836/198,617 (3.9%)	482/7411 (6.5%)
BW <2500 g	36/310 (11.6%)	3/18 (16.6%)	4179/218,002 (1.9%)	379/8058 (4.7%)

Table 8. Breech and vertex term infants with and without cerebral palsy (CP) by intrauterine growth (appropriate for gestational age (AGA) and small for gestational age (SGA)). East Denmark 1979-1986.

	CP-infants	All infants	OR (95% CI)
AGA infants			
N	263	197,710	
Breech	13 (4.9%)	6,929 (3.5%)	1.4 (0.8-2.4)
Vertex	250 (95.1%)	190,781 (96.5%)	
SGA infants			
N	46	8,318	
Breech	3 (6.5%)	482 (5.8%)	1.1 (0.3-3.3)
Vertex	43 (93.5%)	7,836 (94.2%)	

SGA than infants delivered by the vertex (**Table 7**). After stratification by being small for gestational age, the risk of cerebral palsy was not related to the presentation (**Table 8**). There were no differences between breech and vertex infants with cerebral palsy in terms of low Apgar score, being small for gestational age, mode of delivery, and severity of the handicap.

Perinatal hypoxia has been regarded as a frequent cause of epilepsy in studies from 25-40 years ago (12). Churchill (23) found that breech delivery was six times more frequent in patients with petit mal than in the general population. Subsequent studies, however, have been unable to confirm an association between epilepsy and breech delivery (31, 128). Improvement of perinatal care and increased rate of caesarean delivery might have reduced the risk of complications in pregnancies with breech presentation.

A prospective study of 51,285 pregnancies did not find birth complications or Apgar scores related to non-febrile seizure disorders in children without cerebral palsy (103). Still, both in descriptive studies and in the TBT, planned vaginal delivery of breech presentation at term has been found related to a higher risk of birth trauma (including intra-cerebral or intra-ventricular haemorrhage), neonatal seizures and low Apgar score at five minutes (51, II, 79).

We therefore decided to investigate the relation of breech at term to epilepsy in childhood in a large register-based study (VI, 74). A total of 7,514 singleton infants without malformations born between 1980 and 1994 and hospitalised with epilepsy until year 1996 were identified in the National Patient Registry.

For each case delivered in breech presentation (n=290) the two subsequent deliveries of non-malformed, singleton infants delivered in breech presentation at term at the same hospital were selected as controls (n=580). It was found that breech presentation was a risk factor for epilepsy (OR=1.2; 95% CI: 1.1-1.3). Breech infants with epilepsy were more often small for gestational age (9.7%) than breech infants without epilepsy (4.7%). Mode of delivery and low Apgar score were not significantly correlated to epilepsy (**Table 9**).

Thus, the most important finding in the two studies of the correlation of breech at term to CP and epilepsy in childhood was that SGA was slightly more common in breech at term than in other presentations, and that SGA was a predictor for CP and epilepsy, but mode of delivery was not. The correlation of SGA to cerebral palsy is well known (15, 35, 41). SGA and IUGR of term infants is a risk factor for impaired neuro-developmental outcome in terms of lower cognitive scores, neurological abnormalities, lower IQ scores, behavioural problems, and deficits in schooling- or academic achievements (16). To our knowledge, no studies have evaluated SGA or IUGR as isolated risk factors for epilepsy. A Swedish study showed that breech infants weighed 4.9% less than their vertex controls in relation to gestational age (98).

In conclusion, breech at term is associated with a slightly increased risk of cerebral palsy and epilepsy. This relation is explained by an increased occurrence of SGA among term breech infants.

MATERNAL COMPLICATIONS

Delivery of term breech by elective caesarean reduces the foetal mortality and morbidity. Until recently, it has been argued that caesarean delivery poses a threat to the woman at delivery and in future pregnancies (102). Therefore, obstetricians have been reluctant to recommend caesarean delivery for term breech. However, there is consistent evidence that emergency caesarean delivery is associated with a higher risk than elective caesarean delivery for the mother. This is important as nearly one-third of planned vaginal deliveries end up with caesarean delivery (51, 80). Furthermore, there is consistent evidence that maternal complications are more common at emergency than at elective caesarean deliveries (134).

In the Term Breech Trial, intended caesarean delivery was not associated with a higher risk of maternal mortality or morbidity in the first 3 months after delivery (50, 51). The sample size was too small, and the follow-up time was too short for valid estimates of differences in rare but serious adverse outcomes and long-term complications.

A meta-analysis of studies published between 1966 and 1992 of planned caesarean versus planned vaginal delivery for breech presentation at term, showed that planned vaginal delivery was associated with a lower short-term maternal morbidity and mortality (OR=0.61; 95% CI: 0.47-0.80) than planned caesarean delivery. In a total of 3,377 deliveries one maternal death was reported, being the result of a pulmonary embolism subsequent to a planned vaginal delivery. Three women underwent hysterectomy (one in the group planned for vaginal delivery and two among women who had elective caesarean deliveries). The incidence of minor short-term maternal morbidity including endometritis, urinary tract infections, wound infections and need for blood transfusion was 17%-44% (21).

Table 9. Obstetrical risk factors for childhood epilepsy in breech deliveries at term in Denmark 1980-1994.

	Epilepsy N=290	Control N=580	OR (95% CI)	p-value
Mode of delivery				
Vaginal	65 (22%)	139 (24%)	0.91 (0.65-1.28)	0.67
Elective CD	115 (40%)	220 (38%)	1.08 (0.80-1.43)	0.66
Emergency CD	71 (24%)	151 (26%)	0.92 (0.66-1.27)	0.68
Unclassified CD	39 (13%)	70 (12%)	1.13 (0.74-1.71)	0.59
SGA	28 (9.7%)	27 (4.7%)	2.19 (1.26-3.80)	0.007
Apgar <7 at 5 min	7 (2.4%)	10 (1.7%)	1.41 (0.51-3.71)	0.60

CD = caesarean delivery; SGA = small for gestational age.

In a Dutch study on all births during 1983-92, the risk of obstetric death was 0.13 per 1000 caesarean deliveries and 0.04 per 1000 vaginal births (118). However, it is not clear how many deaths were due to the caesarean section.

In general, caesarean delivery has been found associated with miscarriage, ectopic pregnancies, lower fertility (54, 55) and lower subsequent delivery rates (1). Furthermore, increased risks of placental complications (54, 68), uterine rupture (100, 139) and increased infant and maternal mortality and morbidity in future pregnancies have been reported (55, 121). Vaginal delivery, on the other hand, has been found to be associated with descensus of the uterus, stress incontinence (61, 110, 137) and anal incontinence caused by lesions of the sphincter ani (49).

Previous studies on maternal morbidity and mortality following caesarean delivery are inconclusive or hampered by the fact that the women having a caesarean delivery have conditions, pregnancy complications and/or delivery complications that are associated with increased maternal morbidity/mortality. Also, most studies combine elective and emergency caesarean delivery, which have different complication rates. Thus, it has not been possible to conclude if the caesarean section as such or the intended mode of delivery were associated with increased risk.

A follow-up by questionnaire of women from the term breech trial evaluated the effect of planned mode of delivery on maternal outcomes two years after birth (52). Intended mode of delivery was not related to differences in breast feeding, relationship with child or partner, pain, subsequent pregnancy, incontinence, depression, urinary, menstrual or sexual problems, fatigue or distressing memories of the birth experience. Women with planned caesarean delivery had a higher risk of constipation than women with planned vaginal delivery. This difference, however, disappeared when actual mode of delivery was considered.

In order to compare maternal complications of elective caesarean delivery for breech at term to those after vaginal delivery or emergency caesarean delivery, we conducted a large population-based retrospective cohort study of 15,441 primiparas, who delivered singleton breech at term in Denmark during 1982-1995 (VII, 82). The cohort was identified in the Danish Medical Birth Register and described by information from the Register of Death Causes through year 1998 and by information from the National Patient Register through year 2001. A total of 7,503 primiparas (48.6%) were delivered by elective caesarean (caesarean delivery before labour), 2,363 (15.3%) vaginally and 5,575 (36.1%) by emergency caesarean delivery (caesarean delivery after onset of labour). Followed up to year 1998, a total of 83 of the women from the cohort died (**Table 10**). Three women, all with emergency caesarean at first delivery died in relation to pregnancy or childbirth. Two primiparous women died 40 and 55 days after emergency caesarean delivery, both had a diagnosis of hypertensive disorder of pregnancy and puerperium. One woman died 39 days after her second delivery. Her first delivery was by emergency caesarean, but the second was an uncomplicated vaginal delivery.

Elective caesarean delivery was associated with a lower risk of puerperal fever and pelvic infection, haemorrhage and operation for wound infection compared with emergency caesarean delivery. There was a higher rate of puerperal fever and pelvic infection than for vaginal delivery. Thromboembolic disease occurred in 0.1% of women with caesarean delivery and anal sphincter rupture in 1.7% of women with vaginal delivery (**Table 11**).

Hospitalisation with vaginal descensus or urine incontinence was not related to mode of delivery in the follow-up period 5-18 years after the first delivery. The rates of subsequent hospitalisations with ectopic pregnancy and miscarriages were not related to mode of delivery.

A significantly lower proportion of women delivered by elective caesarean (55%) had a second child compared with 61% of women delivered vaginally and 59% of those delivered by emergency caesarean (**Table 12**).

Women with elective caesarean delivery were more often delivered by elective caesarean in their second pregnancy compared with women delivered vaginally (**Table 13**).

Mode of delivery in first pregnancy did not influence the outcome

Table 10. Deaths in 1982-1998 among primipara, who delivered a singleton infant in breech presentation at term in Denmark, 1982-1995, by mode of delivery.

	Mode of delivery (1st delivery)			
	elective CD N=7503	vaginal N=2363	emergency CD N=5575	Total N=15,441
Malignancies	19	3	16	38 (45.8%)
Suicide	6	1	3	10 (12.0%)
Accidents	2	0	4	6 (7.2%)
Abuse of alcohol/narcotics	3	0	3	6 (7.2%)
Medical disorders[1]	6	1	6	13 (15.7%)
Obstetric causes[2]	0	0	3	3 (3.6%)
Unknown	4	1	2	7 (8.4%)
Total	40 (0.5%)	6 (0.3%)	37 (0.7%)	83 (0.5%)

CD = caesarean delivery.
1) Acquired immunodeficiency syndrome, pulmonary embolism, acute myocardial infarction, meningitis, cerebral haemorrhage/infarction.
2) Two deaths 40 and 55 days after delivery (both with hypertensive disorder of pregnancy and puerperium).
One death from pulmonary embolism 39 days after a second delivery (vaginal).

Table 11. Maternal puerperal morbidity according to mode of delivery. Term breech deliveries in Denmark 1982-1995.

	Mode of delivery (1st delivery)					
	elective CD (EL-CD) N=7503	vaginal (VD) N=2363	emergency CD (EM-CD) N=5575	Total N=15,441	RR (95% CI) EL-CD vs VD	RR (95% CI) EL-CD vs EM-CD
Minor						
Anemia and/or haemorrhage	430 (5.7%)	142 (6.0%)	393 (7.0%)	965 (6.2%)	1.00 (0.94-1.03)	0.91 (0.84-0.97)
Puerperperal fever/pelvic infection	110 (1.5%)	12 (0.5%)	126 (2.3%)	248 (1.6%)	1.20 (1.11-1.25)	0.81 (0.70-0.92)
Wound infection (operated)	65 (0.9%)	16 (0.7%)	98 (1.8%)	179 (1.2%)	–	0.69 (0.57-0.83)
Bladder injury	5 (0.1%)	0	10 (0.2%)	15 (0.1%)	–	0.58 (0.23-1.02)
Major						
Thrombo-embolism	6 (0.1%)	0	7 (0.1%)	13 (0.1%)	1.31 (0.95-1.32)	0.80 (0.38-1.26)
Rupture of the anal sphincter	0	41 (1.7%)	0	41 (0.3%)	–	–

CD = caesarean delivery.

Table 12. Fecundity (proportion of women having a second birth after 0-18 years) by mode of delivery at first delivery. Term breech deliveries in Denmark 1982-1995.

	Mode of delivery (1st delivery)					
	elective CD (EL-CD) N=7503	vaginal (VD) N=2363	emergency CD (EM-CD) N=5575	Total N=15,441	RR (95% CI) EL-CD vs VD	RR (95% CI) EL-CD vs EM-CD
Women with a second delivery	4126 (55.0%)	1451 (61.4%)	3270 (58.7%)	8847 (57.3%)	0.94 (0.92-0.96)	0.94 (0.91-0.97)
Interdelivery interval (days) (mean/range)	1271 (292-4866)	1180 (249-4555)	1295 (327-531)	1265 (249-5311)	–	–
Low risk mothers[1]	3296 (61%)	1204 (64%)	2682 (64%)	7182 (62%)	0.93 (0.91-0.96)	0.91 (0.88-0.95)

CD = caesarean delivery.
1) Women below the age of 30 and without diabetes, hypertensive disorders and perinatal death at first delivery.

Table 13. Mode of delivery in second pregnancy by mode of delivery in first pregnancy. Term breech deliveries in Denmark 1982-1995.

	Mode of delivery (1st delivery)					
	elective CD (EL-CD) N=7503	vaginal (VD) N=2363	emergency CD (EM-CD) N=5575	Total N=15,441	RR (95% CI) EL-CD vs VD	RR (95% CI) EL-CD vs EM-CD
Women with a second delivery	N=4126	N=1451	N=3270	N=8847		
Breech presentation	685 (16.8%)	174 (12.0%)	481 (14.8%)	1340 (15.1%)	1.05 (1.02-1.09)	1.06 (1.00-1.12)
EL-CD	634 (15.5%)	71 (4.9%)	405 (12.5%)	1110 (12.5%)	1.25 (1.21-1.29)	1.11 (1.05-1.18)
EL-CD (non breech)	207 (6.0%)	20 (1.9%)	126 (4.5%)	353 (4.7%)	1.24 (1.19-1.29)	1.12 (1.02-1.22)
EM-CD	624 (15.3%)	48 (3.3%)	384 (11.8%)	1056 (11.9%)	1.30 (1.27-1.33)	1.13 (1.07-1.19)
EM-CD (non breech)	374 (10.9%)	14 (1.3%)	190 (6.8%)	578 (7.7%)	1.33 (1.30-1.36)	1.21 (1.13-1.28)

CD = caesarean delivery.

Table 14. Complications in second or third pregnancy by mode of delivery in first pregnancy. Term breech deliveries in Denmark 1982-1995.

	Mode of delivery (1st delivery)					
	elective CD (EL-CD) N=7503	vaginal (VD) N=2363	emergency CD (EM-CD) N=5575	Total N=15,441	RR (95% CI) EL-CD vs VD	RR (95% CI) EL-CD vs EM-CD
No. of deliveries[1]	N=4924	N=1790	N=3894	N=10,608		
Placenta previa	5 (0.1%)	1 (0.06%)	3 (0.08%)	9 (0.08%)	1.14 (0.61-1.35)	1.12 (0.52-1.60)
Abruptio	19 (0.4%)	6 (0.3%)	25 (0.6%)	50 (0.5%)	1.04 (0.78-1.22)	0.77 (0.52-1.04)
Uterine rupture	5 (0.1%)	0	2 (0.05%)	7 (0.07%)	1.36 (0.93-1.36)	1.28 (0.63-1.69)
Placental/uterine complications[2]	29 (0.6%)	7 (0.4%)	30 (0.8%)	65 (0.6%)	1.10 (0.90-1.24)	0.88 (0.66-1.11)
Preterm delivery (GA < 37 weeks)	177 (3.6%)	101 (5.6%)	242 (6.2%)	520 (4.9%)	0.86 (0.78-0.94)	0.75 (0.66-0.83)
BW < 2500 g	433 (8.7%)	220 (12.2%)	469 (12.0%)	1122 (10.6%)	0.89 (0.84-0.94)	0.85 (0.79-0.91)
Low Apgar (5' < 7)	58 (1.1%)	20 (1.1%)	50 (1.2%)	128 (1.2%)	1.01 (0.87-1.14)	0.96 (0.79-1.23)
Foetal death before onset of labour	11 (0.2%)	5 (0.2%)	11 (0.3%)	27 (0.3%)	0.94 (0.61-1.19)	0.90 (0.54-1.25)
Intrapartum death	3 (0.06%)	1 (0.06%)	4 (0.1%)	8 (0.08%)	1.02 (0.38-1.34)	0.77 (0.23-1.38)
Early neonatal death	19 (0.4%)	4 (0.2%)	11 (0.3%)	34 (0.3%)	1.13 (0.87-1.29)	1.13 (0.82-1.42)

CD = caesarean delivery; BW = birth weight.
1) Second and third delivery.
2) Placenta previa, abruptio placentae or uterine rupture.

of the second or third pregnancy in terms of Apgar score and perinatal death. The incidences of placental abruption, placenta previa in second or third pregnancy were not related to mode of delivery in the first pregnancy. Uterine rupture in second or third pregnancy occurred in five women (0.1%) with a first elective caesarean delivery, in two (0.05%) with a first emergency caesarean delivery and none of those delivered vaginally in first pregnancy (**Table 14**).

In conclusion, a policy of elective caesarean delivery for term breech does not seem to imply an increased risk of severe medical complications for the mother in present and future pregnancies.

COMPLICATION RATES AT INTENDED VAGINAL DELIVERY

The increased risk of foetal and maternal adverse outcome at intended vaginal delivery is usually given by odds ratios and with 95% confidence intervals.

These ratios are relevant when comparing different intended modes of delivery. However, the odds do not provide any information on the size of the increased risk in the background population.

What is needed for valid information is a combination of true rates and the corresponding odds ratio. The historical true rates in Denmark may be estimated using the register-based information given in the present thesis (**Table 15**).

The origin of background data used for analysis of crude rates and estimation of rates may be described as follows:

According to data in the Danish Medical Birth Register, the rate of intrapartum or early neonatal death among term breech infants delivered vaginally without malformations was 3.8/1000. Validation of data, however, suggested that the mortality rate in the present low-risk population was overestimated, as 42.2% of the infants registered as non-malformed in fact had malformations. In the register-based case-control study, data were validated by information from medical records. Provided that the distribution of planned mode of delivery in the control group in that study is representative of the background population, the presumed rates of mortality in the present population can be estimated by extrapolation of data. The mortality rate in planned vaginal delivery was at least 1.2/1000 (four deaths in a population of 16.6% of 19,476), and 0/1000 in planned caesarean deliveries (0 deaths in a population of 58% of 19,476). These figures express minimum rates, but are probably not far from the true rates. From the results of the follow-up study of term breech infants with low Apgar score, it could be estimated that, provided the rate of low Apgar score in planned vaginal delivery was 2% compared with 0% in elective caesarean delivery, and that there was an excess of 17% of those with low Apgar score who developed a disability, only

Table 15. Complications at delivery of term breech infants in Denmark 1982-1995. Estimated rates by intended mode of delivery per 1000 pregnancies.

	Planned caesarean delivery	Planned vaginal delivery
Infant[1]		
Perinatal death	0	1.2
Low Apgar score	1.1	17
Low Apgar score and neurological sequelae	0.2	3
Mother[2]		
Puerperal fever	15	17
Wound infection	9	14
Anemia and/or haemorrhage	57	67
Rupture of the anal sphincter	0	5
Thrombo-embolism	1	1
Subsequent pregnancies[2]		
Uterine rupture	1	0.4
Placenta previa	0	0.7
Caesarean section rate	30%	16%
Foetal death	2.8	3.6
Early neonatal death	3.9	2.6

1) Rates of complications based on results from a Danish case-control study.
2) Rates of complications per 1000 subsequent deliveries based on results from a register-based study, where women with emergency caesarean section are included in the vaginal delivery group.

0.3% of infants born subsequent to planned vaginal delivery will develop neurological sequelae due to the mode of delivery. In table 15, the cumulative excess incidence of complications in 1000 term breech pregnancies is balanced according to planned mode of delivery.

Considering those differences as being clinically important can be regarded as a statement of unrealistically high expectations regarding the health of term breech infants. The results confirm that elective caesarean delivery is an extremely safe procedure for the infant. Presently, women and obstetricians are thus likely to accept a number of unavoidable consequences of vertex vaginal birth, but may not accept those of vaginal breech birth. No randomised trials have studied the effect of planned mode of delivery in vertex infants, and it can be argued that such a trial is unethical due to an increased maternal mortality rate associated with caesarean delivery.

One descriptive study of mode of delivery in term breech has matched 600 breech infants with 600 controls delivered by the vertex (3). The study found that breech infants were more often admitted to a neonatal intensive care unit than vertex infants. In vaginally delivered breech infants, 2.5% were given a clinical diagnosis of birth asphyxia compared with none of the vaginally delivered vertex infants.

The low rates of maternal and foetal risk at caesarean section might stimulate a discussion if infants in vertex presentation would also benefit from elective caesarean delivery. A strict scientific evaluation of the safest mode of delivery, however, cannot be made since only few women choose caesarean delivery in term vertex without medical or obstetric indications.

THE IMPACT OF PUBLISHED STUDIES ON MODE OF DELIVERY IN DENMARK

The overall rate of caesarean delivery for breech at term in Denmark increased rapidly in the sixties and seventies, levelled out in the eighties and nineties at about 80%, and increased to more than 90% after the turn of the century (Figure 1).

In 1959 there were three intrapartum deaths of term breech infants at one of the two departments of obstetrics at Rigshospitalet (132). One infant had an entrapped after-coming head, one had prolapse of the umbilical cord and the third had sepsis following PROM. Professor Trolle performed a retrospective analysis of all deliveries in the department in 1959, and concluded that the risk of perinatal death was 35 times increased in breeches compared with vertex at term. He concluded that caesarean delivery might be considered reasonable in all breech presentations.

The publication, however, originated from one of the two departments at Rigshospitalet with a different policy on obstetric management in general. At that department (where also medical students were trained) the rate of caesarean delivery increased significantly, whereas at the other department (where midwifery students were trained) it was considered "poor obstetrics" to prefer caesarean delivery. The women were randomly allotted to one of the two departments at entry to antenatal care, but a comparison of the two different policies was never published.

In the late 1980s and early nineties a number of small descriptive studies from three Danish hospitals were published. Even though the materials were too small to document significant differences, two of the studies concluded that vaginal delivery was safe (66, 91), and the third that routine caesarean delivery should be recommended (138).

In 1995, a very large population-based cohort study concluded that even when 45% had elective caesarean delivery, vaginal delivery was associated with a significantly increased risk of foetal death or low Apgar score at 5 min (I, 77). The impact of this publication was not a significant change in policy (Figure 1). Among clinicians the results were considered possibly biased since the analyses were made in a retrospective material, and it was very difficult to convince most obstetricians that a possible bias would be supportive of the conclusion, since those with intended vaginal delivery were highly selected. In the late nineties the Cochrane collaboration was very active and increased focus on the advantages of RCT over all other types of studies when evidence was sought, and clinicians were asked for evidence-based guidelines. Thus, in the mid 1990s the concept of evidence-based medicine based on the results of RCTs was promoted and descriptive studies were regarded as more or less useless. It was not until recently that the limitations of RCTs of complex clinical interventions have been generally accepted and the usefulness – especially regarding external validity – of descriptive studies recognized (14, 87).

In year 2000 the results from the RCT "Term Breech Trial" were published (51). For several years the ongoing trial was discussed and promoted at international conferences and large efforts were made to include more centres.

Even though only one patient from the Scandinavian countries was included, the results were accepted as valid for our population among leading obstetricians, and within two months of the publication of the trial a national conference was arranged to discuss the impact of the results on clinical practice in Denmark. At this conference it was concluded that all women should be informed about the results of existing evidence (TBT) in order to be able to make an informed choice of mode of delivery, with the consequence that in 2001 fewer than 10% delivered vaginally and in 2002 the figure was as low as 6% (Figure 1).

CLINICAL GUIDELINES

Local guidelines are essential for interpretation of the results of all the clinical studies above. Even in the randomised controlled trials the results are valid only for similar populations in which obstetricians with the same level of education and experience follow similar guidelines (external validity). This means that the results of epidemiological studies cannot be interpreted without a thorough understanding of the complex clinical setting, which may vary considerably.

A number of different protocols for prelabour selection for vaginal delivery and intrapartum management of term breech have been elaborated and published (21, 38).

Even though some of these protocols have been evaluated, none have been compared using scientifically strict methods. Thus, none of these protocols can be viewed as being superior to the others. Furthermore, the specific criteria of the protocols have never been tested individually.

Eligibility criteria for intended vaginal delivery and intrapartum management of vaginal breech at term were discussed at two international workshops in the nineties (38, 53). At both workshops guidelines were elaborated by consensus. In many aspects there was agreement between the two guidelines: Caesarean delivery should be recommended when estimated birth weight was above 3500-4000 g and in cases of total or incomplete footling. Furthermore, breech extraction should be avoided.

The Canadian workshop was organized prior to the term breech trial (53). Experts skilled in vaginal breech birth were invited to a consensus conference in order to reach agreement on management of breech delivery. They agreed, that women were eligible for vaginal breech delivery with a frank or complete breech presentation. Frank breech was defined as hips flexed, knees extended; complete breech was defined as hips flexed, knees flexed, but feet not below the foetal buttocks. There should not be hyperextension of the foetal head. During labour, augmentation with oxytocin could be used with caution, to correct inadequate uterine activity as long as there was no evidence of relative foeto-pelvic disproportion. After reaching 3-cm dilatation, the first stage of labour should progress at least 0.5 cm/hr in cervical dilatation.

The FIGO committee on Perinatal Health on Guidelines for the Management of Breech Delivery, published in 1993, recommended caesarean section when a protracted labour was likely in cases of high position of the breech, immature cervix and insufficient descent of the breech in spite of adequate contractions and cervical dilatation.

PRELABOUR SELECTION CRITERIA

Specific criteria used for prelabour selection have been investigated in descriptive studies with different conclusions.

Parity

Some clinicians consider parity as an important criterion for selection of parturients to deliver vaginally. This is based on the assumption that a previous vaginal delivery excludes the possibility of a contracted pelvis.

Some materials have found that the benefit of caesarean delivery was greater for primiparae than for multiparae (40, 106). Two other studies did not find any difference in infant mortality (108) or pH in the umbilical cord vein (97) between primipara and multipara. Secondary analysis of data from the term breech trial did not find that parity was associated with adverse perinatal outcome (126).

Also, the studies of the present thesis found no significant difference in mortality or morbidity between primiparae and multiparae who delivered vaginally (77), and parity was not found to be a predictor for low Apgar score in planned vaginal deliveries (79). However, we cannot exclude that this is a result of a more restrictive policy on vaginal delivery in primiparae.

Maternal age

The conventional view is that elderly pregnant women, especially primiparas, should best be delivered by caesarean section.

A review of the literature did not show any relationship between maternal age and adverse perinatal outcome in breech at term in absence of other risk factors (53).

In the present register-based case-control study maternal age was not found to be a predictor for low Apgar score or perinatal death (79).

Type of breech presentation

There is general consensus based on old studies that perinatal mortality and morbidity is increased in footling breech due to an increased risk of cord prolapse and entrapment of the aftercoming head by an incompletely dilated cervix (53). The circumference of the breech is somewhat less when the foot/feet are delivered before the breech than when the hips are flexed. Average figures for circumference of presenting breech are 32 cm for complete breech, 27 cm for frank breech, and 24 cm for footling (18).

In the TBT, the frequency of adverse perinatal outcome did not differ between frank and complete breeches (3.4%) (126).

The register-based case-control study identified only one case and two controls delivered in footling presentation. This might be interpreted as the result of an effective prelabour selection excluding footling presentations from planned vaginal delivery or the consequences of a rare occurrence of footling presentation of term breech (79).

Foetal size

Ultrasonography provides important information in term breech presentations in terms of congenital anomalies, type of breech, hyperextension of the foetal head, estimated foetal weight, amniotic fluid volume, localisation of placenta and uterine anomalies.

Studies from 30-40 years ago document that a birth weight greater than 4,000 g may be associated with perinatal mortality and morbidity due to mechanical difficulties at delivery (53). However, prediction of birth weight by ultrasound has been found to be imprecise, especially in suspected macrosomia (146). Also the sonographically determined birth weight seems to be less accurate in foetuses presenting by the breech compared with the vertex (20).

Clinical guidelines for term breech often focus on size of the foetus and pelvic dimensions in order to prevent foeto-pelvic disproportion. However, multivariate analysis of results from the term breech trial showed that the risk of adverse perinatal outcome was higher in infants with a birth weight less than 2800 g (126). Also, in the present case control study, SGA was an important predictor for adverse neonatal outcome.

The results might reflect that SGA infants are more vulnerable to birth trauma and distress. Finally, the results of the observational study might imply that prenatal and intrapartum care was effective in terms of identifying macrosomic infants for caesarean delivery, but less sufficient regarding SGA pregnancies (79). This was confirmed by the audit of the 12 cases of intrapartum or early neonatal death, where there were significantly more comments raised on undiagnosed growth restriction in pregnancy than in controls (75). Thus, more attention should be paid to the diagnosis and care of term breech pregnancies with foetal growth restriction.

Hyperextension of the foetal head has been identified as a risk factor for perinatal mortality and neonatal neurologic morbidity, in vaginally delivered breech infants (19, 127, 142).

Pelvimetry

Some older studies have suggested a high predictive value of pelvimetry for successful vaginal delivery of term breech (107). Subsequently several protocols have included pelvimetry as an important parameter to measure women's eligibility for planned vaginal breech delivery (3, 4, 10, 25, 44, 83). The measures provided by X-ray pelvimetry, expressed in millimetres, give an impression of exactness and are suitable for use in a scoring system (143).

A randomised controlled trial evaluated the benefit of magnetic-resonance pelvimetry in 235 women with breech at term (135). In 118 cases the results of the examination were reported to the obstetrician and in 117 cases the results were disclosed until 8 weeks post partum. The overall rate of caesarean delivery did not differ between the groups, but MR pelvimetry significantly reduced the rate of emergency caesarean delivery (19% vs. 41%). The neonatal outcome did not differ between the groups. Thus, relieving the obstetrician of concern for a contracted pelvis improved the rate of success in planned vaginal delivery.

PRELABOUR DIAGNOSIS OF BREECH PRESENTATION

It is important to diagnose the breech presentation in order to offer an attempt of external cephalic version, and to plan mode of delivery. Some small studies have been unable to find an association be-

tween undiagnosed breech presentation and adverse foetal outcome (24, 93, 105, 133).

In the present case-control study (79), prelabour diagnosis of the breech presentation was associated with a lower risk of low Apgar score or perinatal death (OR=0.4: 95% CI: 0.3-0.7). This information is essential for planning of routine consultations in antenatal care.

INDUCTION OF LABOUR

Induction of labour for usual medical or obstetrical indications has not been found to increase the risk of complications in vaginal breech delivery (53, 112). Since birth weight above 3500-4000 g is considered a risk factor in planned vaginal delivery of term breech, induction of labour before birth weight exceeds 3500 g could be considered an option. No studies have evaluated this intervention in term breech pregnancies.

INTRAPARTUM MANAGEMENT

Duration of labour

Some earlier studies show an increase in adverse neonatal outcome where active labour proceeded beyond 20-30 hours (53).

Progress less than 0.5-1 cm/hour indicates dysfunctional labour that might be an indicator of foeto-pelvic disproportion.

Analysis of results from TBT did not identify duration of the first stage of labour as a significant risk factor for adverse neonatal outcome (126).

In the case-control study of the present thesis, duration of the first stage of labour was not a significant risk factor for adverse perinatal outcome (79).

Augmentation of labour

Oxytocin is used for augmentation of labour in 40% of all vaginal deliveries in Denmark in order to overcome dystocia or slight foeto-pelvic disproportion. In general administration of oxytocin, the fact that hyperstimulation is not caused does not increase the risk of adverse outcome.

The TBT found that administration of oxytocin or prostaglandins was associated with an increased risk of adverse outcome (OR=2.20; 95% CI: 1.24-3.39) (126).

In the Danish material (79), augmentation of labour with oxytocin was not a significant predictor of low Apgar score.

Second stage of labour

A prolonged second stage of labour may be a result of insufficient descent due to disproportion or umbilical cord complications or it might be the result of dystocia, partly caused by insufficient labour contractions.

The Canadian consensus conference concluded that caesarean section was indicated if the breech had not descended to the pelvic floor after two hours of being in the second stage without active pushing, or if vaginal delivery was not imminent after one hour of active pushing (53).

Results from the TBT confirmed that the duration of the active phase of second stage of labour was correlated to adverse perinatal outcome (126).

In the study of the present thesis (79), duration of second stage of labour was correlated to low Apgar score, and a second stage exceeding 30 minutes was a predictor for low Apgar score.

Foetal distress

Breech presentation by itself has not been found as an indication for electronic foetal monitoring (51, 126). This does not reflect the fact that there is an increased risk of IUGR and low Apgar score in foetuses presenting by the breech. It is obvious, however, that identification of asphyxia in early labour should be a matter of higher priority in breech presentations compared with cephalic presentations in order to identify early stages of foetal distress as the foetus might need extra resources in the late second stage of labour.

In the controlled audit of perinatal deaths in term breech, insufficient surveillance or inadequate reaction to pathologic CTG was the most frequent issue raised on suboptimal care during delivery in cases as well as in controls (75).

Manual procedures

Different techniques for delivering a breech per vagina are recommended (5, 17, 109, 131). No scientific evidence can guide us in preferring one manoeuvre to another.

Based on physiologic knowledge and clinical experience the following is currently recommended:

Usually, it is recommended that delivery should proceed spontaneously until the foetal umbilicus appears at introitus. Reasons given for this are, for example, that early tactile stimulus may initiate breathing movements and aspiration, cause retraction of foetal arms, or extension of the foetal head. Some workers have described an approach that is in contrast to this procedure (109), i.e., that constant pressure is applied to the breech (retention of the foetus) in order to let the cervix retract and gain a more expedited delivery when active pushing with progression is allowed.

It is usually recommended that a loop of the umbilical cord be gently pulled down – which is of questionable value, but at least provides information if the umbilical cord is very short.

After the umbilicus has emerged, gentle downward traction can be used to deliver the infant's torso. Bracht's manoeuvre or Lowsett's manoeuvre for delivery of the arms include rotation of the foetal back from one anterior oblique to the other. The tip of the foetal scapula will come into view and the anterior arm can be swept down across the foetal chest. Rotation of the foetus into the opposite oblique allows delivery of the opposite arm in a similar fashion.

In order to promote flexion of the foetal head, the manoeuvre of Mauriceau Smellie Veit can be used. One of the operator's hands is placed above the foetus with one finger inserted into the vagina and placed on the occiput, and one finger on each of the foetal shoulders. The other hand is placed beneath the foetus. The classical manoeuvre describes placing a finger in the mouth. As an alternative, two fingers can be placed on the maxillae in order to avoid dislocation of the jaw (5).

The head is then flexed through the pelvis and the foetal body is raised upward in a large arc. An assistant should apply subrapubic pressure to flex the head through the pelvis.

In Danish literature it is recommended to let the foetal head remain in the vagina with the body hanging between the legs of the parturient for one minute (131). This is thought to be beneficial for the descent of the head and flexion of the neck (provided that the occiput is posterior), and it will certainly worsen a state of asphyxia.

Thus, there are several possibilities when choosing between the different manual procedures that make up the mode of vaginal delivery of term breech. There are procedures that are necessary, beneficial or even harmful according to different beliefs/attitudes. The complexity of the mode of delivery that should be performed in a very short period of time is usually stressful for the obstetrician and midwife. Furthermore, several specialities are present at delivery, including the anaesthesiologist and neonatologists, which adds to the stress. The advantage that several aspects are included in the clinical decision-making may very well be exceeded by the disadvantage of a less stringent and even zigzag course, and a delay in urgent decisions.

However, the complexity and the lack of evidence for each of the procedures are major obstacles for the education of health professionals.

EDUCATION

The lack of clinical experience in vaginal delivery can be used as an argument for lowering as well as for increasing the rate of vaginal breech deliveries. In 1994 we calculated that the annual number of vaginal breech deliveries in Denmark was around 400. A total of 950

midwives and 250 obstetricians attended births. It was calculated that, with a rate of 22% of breeches delivered vaginally, the frequency of attending a vaginal breech delivery would be 1.7/year per obstetrician and 0.4/year per midwife (78).

Since 1994 the annual rates of vaginal beech deliveries have been further reduced, and there is a growing understanding among obstetricians that practice and training in vaginal breech delivery cannot be obtained solely in the delivery rooms. However, even with a policy of recommendation of caesarean delivery to all women with breech presentation there might still be women who wish to deliver vaginally and, furthermore, there may occur unavoidable situations with very rapid deliveries of unrecognised breeches, where the woman cannot be offered caesarean delivery.

In 1994 a national audit into the level of training in vaginal breech delivery was conducted on all registrars in the UK (119). As many as 60% of the registrars felt that they were sufficiently trained in vaginal breech delivery. However, only 39% of the respondents had received their training in UK.

One way to obtain competence in the management of emergency situations is practical training where a simulator or a phantom is used. A mannequin used for instruction of midwives was introduced more than 300 years ago, and the method was even recommended as late as in 1964 in "Ars Pariendi" (131). Three international training programmes that have become popular during the last decade are based on training by phantoms in combination with theoretical lectures (64, 69, 149). The advantage of the training is that it offers an opportunity to teach and maintain competence in rare, critical events. However, training in clinical manoeuvres cannot stand by itself, but must be supplemented with training in clinical decision-making, communication and teamwork in emergency situations. The training should involve all relevant professionals, midwifes, assistants, obstetricians, anaesthesiologists and paediatricians. Ideally, the training should be conducted in the usual setting with the usual equipment (124).

Multi-professional training in the handling of events like cord prolapse, vaginal breech delivery and neonatal resuscitation is recommended by "Clinical Risk Management Standards for Maternity Services" (63) as well as in the report "Confidential enquiry into maternal death" (32).

Our knowledge of the benefit provided by the different teaching programmes is limited. In a study from Denmark, the effect of training using a phantom in education of specialists in obstetrics was evaluated (125). The participants in the course were asked to score themselves before and after training in procedures for amnioninfusion, shoulder dystocia, vaginal breech delivery, post partum haemorrhage, vacuum extraction and foetal blood sampling. After training using a standardized simple protocol, the confidence in participants' skills was found to be lowest regarding vaginal breech delivery, which indicates that this is the most difficult manual technique in obstetrics.

SUMMARY

The present thesis analyses the impact of mode of delivery of term breech in a large Danish material from 1982-1995. For the first time a thorough investigation of foetal, neonatal and maternal short-term and long-term outcomes provides a comprehensive picture with rates and correlations from the same population.

The descriptive design has advantages over a randomised controlled trial – a much larger material in a relevant population and a longer follow-up period. But it has also disadvantages – the risk of bias that might influence the outcome.

The present results reflect the clinical reality in a population with 45% elective caesarean, 17% intended vaginal, 34% emergency caesarean and 21% successful vaginal deliveries.

In such a population we found that intended vaginal delivery was associated with a 15-fold increased risk of low 5 min Apgar score or intrapartum/early neonatal death. Low Apgar score was not predictable before the second stage of labour, but a prolonged second stage was a significant risk factor. By means of qualitative audit, a panel of experts blinded to outcome found that nearly half of the deaths during delivery or in the early neonatal period might have been avoided by improved care.

The actual rates of foetal complications per 1000 intended vaginal deliveries, however, are low: 1.2 deaths, 17 infants with low Apgar score (5'<7), of which 3 developed a handicap or a minor disability.

Furthermore, a small but significant correlation was found between term breech and cerebral palsy and epilepsy. This correlation could be ascribed to a higher frequency of being small for gestational age among breech infants.

Elective caesarean section was associated with a higher risk of infections and haemorrhage than successful vaginal delivery, but emergency caesarean delivery was more often complicated than elective caesarean delivery. Therefore, elective caesarean delivery was not associated with increased risk of maternal complications when compared with intended vaginal delivery and emergency caesarean delivery. During the study period, there were no maternal deaths associated with elective caesarean delivery of term breech.

Long-term complications and adverse foetal or maternal outcome in subsequent pregnancies were not increased after elective caesarean section. Altogether 75% of women with a term breech caesarean had a subsequent vaginal delivery. When the caesarean was elective, however, the subsequent delivery was more often by caesarean than when the breech had been delivered by emergency caesarean section.

When informed of the small but significant risk of perinatal morbidity, most women with breech at term will probably choose a caesarean delivery. This implies that vaginal breech delivery is becoming a very rare event in the labour ward. However, there will still be women who consider the rewarding experience of a natural birth more important than the minimal risk of perinatal morbidity, and there will be women who arrive late in labour, where a caesarean delivery is no longer an option. In order to provide those women the best obstetric care, we need to continue to educate midwives and obstetricians in conduction of labour and the manual skills associated with vaginal breech delivery.

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