Planned caesarean section versus planned vaginal delivery among women without formal medical indication for planned caesarean section: A retrospective cohort study of short-term complications

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ABSTRACT

Objective: To study complications, within six weeks postpartum, after planned caesarean section (CS) compared with planned vaginal delivery, among women without formal indication for caesarean section.

Design: Retrospective cohort study.

Setting: Swedish national registries.

Population: 714 326 deliveries, 2008-2017.

Methods: The risks of complications were compared between planned caesarean section and planned vaginal delivery among women without formal medical indication for planned CS. Adjusted Risk Ratios (ARR) were obtained using modified Poisson-regression models adjusting for; maternal age, parity, body mass index, smoking, country of birth, and county.

Main outcome measure: infections, haemorrhage and thromboembolism.

Results:. In the planned CS group (n=22 855), 15% had a postpartum infection compared with 10% in the planned vaginal group (n=691 471) (ARR=1.6; 95%CI 1.5-1.6), 8.4% vs 0.6% had haemorrhage >1 litre (ARR=13.4; 95%CI 12.7-14.2), and 0.08% vs 0.05% had a postpartum pulmonary embolism (ARR=1.7; 95%CI 1.0-2.6). The obtained risk estimates correspond to a Number-Needed-to-Harm estimate of 17, 14, and 3448, respectively. When dividing the infections into subgroups, an increased risk of endometritis (ARR 1.2; 95%CI 1.1-1.3), wound infection (ARR 2.7 95%CI 2.4-3.0), urinary tract infections (ARR 1.5 95%CI 1.3-1.7), and mastitis (ARR 2.0; 1.9-2.2) was found after planned CS.

Conclusion: The risks of short-term maternal complications were higher in women delivered by planned CS compared with planned vaginal delivery among women without formal medical indication for planned CS.

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Key words: caesarean section, puerperal infection, haemorrhage, thromboembolism.

Tweetable abstract: The risk of infection, haemorrhage, and thrombosis is increased after planned caesarean versus planned vaginal delivery.

BACKGROUND

Delivery by caesarean section (CS) has gradually risen in many parts of the world. From 1990 to 2014, the global average caesarean section rate increased three-fold from 6.7% to 19.1%, with an average rate increase of 4.4% per year[1, 2]. The CS rate varies considerably between different parts of the world and between counties, but the rise is a global phenomenon[1]. In Sweden, the rate of CS has increased from 5% in 1973 to 18% in 2017[3].

Historically, CS was used only in life threatening situations. With improved healthcare, CS is regarded as a safe surgical procedure and the indications for performing CS have expanded. The potential advantages of CS include decreased risks of prolapse and stress incontinence[2], avoidance of labour pain and convenience. However, most studies state increased risks of adverse outcome associated with CS, such as postpartum infections, haemorrhage and venous thromboembolism[4-14], which all are major causes of maternal death[6, 15]. Long-term effects of CS, leading to higher risk of complications in subsequent pregnancies, are uterine rupture, invasive placenta, with risk for subsequent need of hysterectomym[16].

Despite an emerging body of literature stating complications after CS[4, 5, 7, 8, 12, 13, 17, 18] a growing demand has evolved among women for planned CS without medical indication; CS on maternal request. A Cochrane report from 2012 states the lack of studies analysing the risks and benefits of CS on maternal request[19].
Complications after CS versus vaginal delivery is well described in the literature[7, 8, 11, 13]. However, to evaluate the risks and benefits of CS without medical indication, it is more adequate to compare planned CS with planned vaginal delivery.

The aim of this study was to investigate the rate of short-term complications (infections, haemorrhage, thromboembolism within six weeks postpartum) with planned CS compared with planned vaginal delivery in a group of women with no formal indication for planned CS

MATERIALS AND METHOD

Data from three Swedish national registries were merged; the Medical Birth Register (MBR)[20] , the Swedish national Patient Register (PAR)[21] and the Swedish Prescribed Drug Registry (SPDR)[22], all held by the Swedish National Board of Health and Welfare.

The MBR, started in 1973, contains medical information on 99% of all births in Sweden. Standardized record forms are used in all antenatal clinics, all delivery units, and for all paediatric examinations during the child's first month of life. All women are offered free antenatal care. Maternal data, including mode of delivery, parity, body mass index (BMI), smoking, maternal obstetrical diagnosis and procedural codes, were collected from MBR. Information regarding BMI is collected at the first prenatal visit, usually in gestational week 8-12.

The PAR contains diagnosis codes for all patients admitted to hospitals in Sweden since 1987, as well as all out-patient visits, since 2002. Codes are classified according to the International Classification of Diseases, since 1997 10th Revision (ICD-10) codes. The codes used to identify the outcomes considered in the current study were: haemorrhage postpartum >1000ml (O.67), haemorrhage causing coagulation defects postpartum (O.723), postpartum endometritis (O.85, N.71), infection of obstetric surgical wound (O.860, O.861), sepsis (A.40, A.41) urinary tract infection (O.862, N.30, N.39, N.10), mastitis (O.911, O.912), deep

phlebothrombosis in the puerperium (O.871), cerebral venous thrombosis (O.873, I.63), pulmonary embolus (O.882, I.74, I.82, I.26), disruption of CS delivery wound (O.900) and disruption of perineal obstetric wound (O.901).

Data on all prescribed and dispensed drugs in Sweden are available in SPDR, from 2005. Information regarding type of drug, amount, price and expedition date are available. Pharmaceutical consumption is classified according to the Anatomic Therapeutic Chemical Classification (ATC). ATC code J01 was used for antibacterials for systemic use.

All women who had a previous CS or had any formal medical indication for planned CS, according to a Swedish consensus agreement[3,23] were excluded. The following women with specified diagnosis or conditions were excluded: multiple gestation, none-cephalic presentation, preterm birth (gestational age <37 weeks), rupture of uterus, placenta accreta, placenta abruption, placenta praevia, diabetes mellitus, gestational diabetes mellitus, preeclampsia, HELLP, oligohydramnios, polyhydramnios, chorioamnionitis, small for gestational age (-2 birthweight SD-scores according to a Swedish ultrasound-based weight curve), large for gestational age (+2 birthweight SD-scores according to a Swedish ultrasound-based fetal weight curve[24]), macrosomia (>4500 g), prolonged pregnancy (gestational age ≥42 weeks), and previous caesarean section.

A second analysis was performed to investigate if there was any group of women, based on maternal characteristics such as age, parity, BMI etc that could benefit from planned CS or planned vaginal delivery.

The composite outcome postpartum infection included urinary tract infection, endometritis, mastitis, septicaemia, wound infection and prescription of antibiotics.

Statistical analysis

Adjusted Risk Ratios (ARR) were obtained using modified Poisson-regression models, adjusting for maternal age (years): <20, 20-34, 35-39, 40+, parity: 1-para, 2-para, 3+ para, BMI (kg/m2): >18.5, 18.5-24.9, 25-29.9, 30-34.9, 35+, maternal height: <155, 155-165,165-174,175+, maternal country of birth (Nordic countries/non-Nordic countries), and health care region: Stockholm, Uppsala/Örebro, Southeastern region, Southern region, Western region, and Northern region. Missing values (applies to smoking, BMI, and maternal height) were replaced by the overall mean. Findings with p-values below 0.05 were considered statistically significant. Possible confounders with P-value below 0.2 were included in the multivariable models.

RESULTS

Included were 714 326 deliveries to women without formal medical indication for planned CS, between 2008-2017. The selection procedure is summarized in a flow-chart (Figure 1).

Table 1 shows maternal characteristics, in relation to planned CS compared with planned vaginal delivery. Increasing maternal age, delivery of the second child (2-para), height lower than 155 cm and born in a Nordic country were associated with delivery by planned CS.

Table 2 shows the risk of short-term complications. The rate of planned CS was 3.2%. Among women with planned vaginal delivery 4.3% were delivered by emergency CS, 6.7% by vacuum extraction, and 0.1% by forceps. For most of the evaluated outcomes, the risks were increased after planned CS compared with planned vaginal delivery. The risk of haemorrhage

> 1 litre, was 13 times higher after planned CS compared with after planned vaginal delivery. For venous thrombosis and stroke, increased risks were indicated, but not statistically significant. For septicaemia, no risk increase after planned CS was indicated. The risk of any postpartum infection was 60% higher after planned CS compared with planned vaginal delivery. This was evident in each stratum; age, BMI, smoking, country of birth, and height. Hence, no group of women, depending on maternal characteristics specified above, benefited from planned CS when evaluating the effect of planned delivery mode on maternal postpartum infections.

Table 3 shows maternal characteristics and final mode of delivery among women with planned vaginal delivery (n=691 471). Increasing age, delivery of the first child (1-para), increasing BMI and height below 155 cm were associated with for delivery by emergency CS.

Table S1 to S3 (supplementary tables) corresponds to table 1-3, but with results from the unselected study group in which both women with and without medical indications or other antenatal conditions for CS were included (n = 1 111 211). As in the selected group, an association was found for planned CS with increasing age and height lower than 155 cm. An opposite association was found regarding parity, as giving birth to the first child (1-para) was associated with planned CS in the unselected group. No association was found regarding Nordic/ Non-Nordic country. Regarding BMI, an association was found in the unselected group, but showed no correlation in the selected group.

The risks of short-term complications was seen in both groups, but was not in the same magnitude in the unselected group.

DISCUSSION

Main findings

Our study, including over 700 000 deliveries among women without formal medical indication, during 2008-2017, shows increased risks of short-term complications after planned CS, compared with after planned vaginal delivery. The relative risks were less pronounced in the unselected group, in which both women with and without medical indications or other antenatal conditions for CS were included. . The group of women without formal medical indication for planned CS had overall encouraging pregnancy outcome. In trial of labour, only 4.4% were delivered by emergency CS, and almost 90% had a vaginal non-instrumental delivery. Among women with non-indicated planned CS, over 15% had a postpartum infection compared with 10% in the planned vaginal group (ARR=1.6), 8.4% had haemorrhage >1 l (ARR=13.4), and 0.08% had a postpartum pulmonary embolism (ARR=1.7). The obtained risk estimates correspond to a Number-Needed-to-Harm (NNH) estimate of 17, 14, and 3 448, respectively. No group of women based on maternal characteristics such as age, height, BMI, smoking, and country of birth benefited of planned CS versus planned vaginal delivery regarding the risk of postpartum infections.

Interpretation in light of other evidence

Several studies have been published where maternal complications after CS were compared to those after vaginal birth[4, 7], although the complications after planned and emergency CS considerably differ. Other studies have analysed emergency CS and planned CS separately but have used women with vaginal deliveries in the control group[5, 8]. To estimate the true impact of non-indicated planned CS on maternal morbidity it is important to keep an intention-to-

treat perspective and therefore adequate to compare the outcome of planned CS with planned vaginal deliveries.

A challenge is to design a low-risk group when aiming to estimate maternal morbidity after CS on maternal request. Different strategies can be used to construct a low-risk group. Planned CS in term breech presentation have repeatedly been used as a surrogacy for low-risk planned CS. As vaginal breach deliveries are not regarded to be of low-risk, it cannot be used as the comparison group. Hannah[25] did not detect any increased risks of adverse maternal puerperal outcome among women who had planned CS compared with planned vaginal delivery in term breach deliveries. The results from this study are affected by low power due to low numbers, and the high rate of emergency CS in the "trial of labour group", about 40%. The most updated (2015) systematic review of randomised controlled trials of term breach[26], concludes that the risk of short-term maternal morbidity after planned CS is slightly increased (RR 1.29). Instead, Liu (2007)[12], Dahlgren (2009)[27], and Larsson (2011)[28] used women with planned CS indicated by term breach presentation as a surrogacy for low-risk CS, but for the comparison group they selected a group of women who attempted a vaginal birth. The selection procedures differed between the quoted studies, but the intention was to include healthy women with no known pregnancy complications. The study by Larsson[28], included 541 women only, and did not have sufficient power to detect any association between planned delivery mode and risk of maternal complications. The power of the study by Dahlgren[27] was also low, but they detected a five-fold risk for wound infection after planned CS compared to after planned vaginal delivery. Studies in which the complications after planned CS were compared with non-instrumental deliveries only, will systematically under-estimate the complications after vaginal birth since they will not consider complications in the planned vaginal group occurring after emergency CS, forceps, or vacuum extractions. In our study,

we did not exclude CS with the indications foetal distress, disproportion and failed induction, as these most likely are in the "planned vaginal group". If the women with the above mentioned indications had been excluded, we would presumably have falsely decreased the risks of planned vaginal delivery.

In the current study, we used strict selection criteria for both the planned CS and the planned vaginal group to create two comparable low-risk groups. Excluded were e.g., breach deliveries, multiple births, diabetes, gestational diabetes, ablatio placentae, placenta accreta and pre-eclampsia. Our results confirm many of the associations reported in the study by Liu[12], albeit often with lower point estimates of the relative risks. The present study showed a notably increased risk of haemorrhage>1 litre after planned CS compared with after planned vaginal delivery, (ARR 13.4), while Liu et al showed an increased risk of haemorrhage requiring hysterectomy after elective CS (OR 2.1). The high RR for haemorrhage found in the present study could presumably be explained by that women in the comparison group (women with a planned vaginal delivery), indeed consisted of women with low-risk pregnancies with subsequent low risk of haemorrhage.

The present study showed increased risk for mastitis after planned CS, compared with after planned vaginal delivery (ARR 2.0). The risk was surprisingly high seen in the context that in Sweden the new born is encouraged to breastfeed already in the operation theatre.

Strengths and limitations

Our study had the ambition to compare risk of planned CS among women with no formal indication for CS, e.g., maternal request. The group of non-indicated CS was created by excluding women with diagnosis leading to medical indications for CS. We have no information on indication for planned CS in this group. Presumably, women choosing planned

CS without medical indication, will have smaller chances to vaginal delivery, if they were forced to try vaginal delivery. In that sense, the groups compared are not equal. The preferrable study design would be a randomized trial, including women eligible for vaginal delivery only. However, in a systematic Cochrane report from 2012, no RCTs appropriate for a meta-analysis including CS for non-medical reasons at term was found. In the absence of adequate RCTs, the current study, using a large study population based on high-quality register data and with a clear intention-to-treat perspective, would be the best source of information available when estimating the short-term maternal complications in planned CS versus planned vaginal deliveries.

Another limitation of our study is that only the ICD-code for obstetrical thrombosis was included (deep phlebothrombosis in the puerperium (O.871), and not the general ICD-code for all types of deep venous thrombosis (I.80). This vastly underestimates our absolute risk of venous thrombosis postpartum. Nevertheless, the relative risk ratios should not be considerably affected by this underestimation.

Conclusion: We found increased risks of short-term complications after planned CS compared with planned vaginal delivery, especially among women with no formal indication for CS. A restrictive management of planned CS without medical indication should therefore be advocated.

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Contributions to Authorship: KD, AS, and KK designed, carried out and wrote the paper. KK performed the statistical analysis; all authors were present and analysed the data. All authors approved the final version of the manuscript.

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Figure 1. Flow diagram for selection of comparison groups

Table 1. Maternal characteristics among women with planned CS and planned vaginal delivery among women without any formal medical indication for planned CS

Table 2. Risk of miscellaneous maternal post-partum complications among women without any formal medical indication for elective CS. Planned CS vs planned vaginal delivery. Adjusted RRs (ARRs) were computed adjusting for maternal age, parity, smoking, Body Mass Index, country of birth, and county.
* Endometritis, wound infection, urinary tract infection, mastitis, septicaemia, prescribed and dispensed antibiotics within six weeks

Table 3. Maternal characteristics and mode of delivery among women with planned vaginal delivery among women without any formal medical indication for elective CS.