Epidural analgesia at trial of labour after caesarean section. A retrospective cohort study over 12 years

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Background: Epidural analgesia (EA) in patients at trial of labour after caesarean section (TOLAC) remains a matter of controversy due to fear of masking symptoms suggestive of uterine rupture. The aim of this study was to evaluate if EA during TOLAC increases the risk of maternal and foetal complications. *Methods*: This study utilized a database containing details of deliveries collected prospectively by a Swiss obstetric study group over a 12-year period. The cohort was dichotomised between women with and without EA during delivery. Contingency tests and Spearman rank correlation were used for statistical analyses. A $p < 0.05$ was considered significant. *Results*: Of 4401 women, 1736 (39.4%) were delivered with EA (Group 1) and 2665 (60.6%) without (Group 2). Overall, 56.1% of the women delivered vaginally. Group 1 had a higher vaginal operative delivery birth rate (24.9% vs 9.5%, $p < 0.0001$) while Group 2 showed a greater rate of emergency caesarean section (49.1% vs 31.50%; $p < 0.0001$). The overall incidence of uterine rupture was 20/4401 (0.45%) with no difference between groups. *Conclusions*: EA during TOLAC appears to improve vaginal delivery without increasing maternal and foetal morbidity or uterine ruptur.

Keywords

Caesarean section; Uterine rupture; Vaginal delivery; Epidural analgesia

1. Introduction

Epidural analgesia (EA) is an extremely popular and effective treatment for pain relief during labour. Several side effects have been described (failure rate, dural puncture, headache, nerve damage, epidural abscess, meningitis, epidural haematoma, foetal heart abnormalities, foetal bradycardia, pruritus), but their incidence is extremely low [1]. Moreover, EA does not increase the risk of caesarean section (CS) and does not have a negative influence on neonatal adaptation [2, 3]. Due to its safety and efficacy, this procedure is ever more requested by women themselves, making EA one of the most frequently performed interventions during delivery [1, 2]. However, in patients with a prior CS who ask for a vaginal delivery, the use of EA remains a matter of debate mainly because of the fear of masking a uterine rupture (UR) [4].

UR is defined as a complete disruption of all uterine layers during labour. Although rare, it can lead to catastrophic maternal and foetal consequences, including death. Uterine bleeding, acute abdominal pain and diagnosis of foetal distress by continuous electronic foetal monitoring are the main symptoms and clinical signs of impending or complete UR [5]. In their retrospective analysis, Johnson and colleagues observed that only 22% of complete ruptures presented with abdominal pain, while 76% presented with signs of foetal distress [6]. According to subsequent studies, abdominal pain was noted by 5–69% of patients experiencing a UR [7, 8]. If we consider that poor maternal/foetal outcomes are often linked to a delayed diagnosis and management of UR, the concerns of most physicians regarding EA as a potentially dangerous mask of UR symptoms is quite understandable.

The aim of this retrospective observational study was to evaluate if the use of EA in women with a trial of labour after a caesarean (TOLAC) increases the risk maternal and foetal outcomes with particularly attention to UR.

2. Materials and methods

2.1 Study population and data collection

Data were extracted from the national database of the Swiss obstetric study group (Arbeitsgemeinschaft Schweizerischer Frauenkliniken, Amlikon, Switzerland), which prospectively collected data concerning all deliveries that occurred in more than 100 Swiss institutions between January 2005 and December 2017. The quality of the data recorded was ensured by a two-step control system. Firstly, completeness and exactness of all data were verified at each participating centre at the time of discharge by a senior obstetrician. Secondly, the plausibility of all data entered in the database was assessed by the data centre quality control group. In case of data discrepancy, the hospital was asked to verify and correct the information, if necessary.

Inclusion criteria were singleton foetus, age ≥ 18 years, history of a previous CS, scheduled for vaginal birth and uncomplicated pregnancy. Patients with any of the following

criteria were excluded from the study: preterm labour (gestational age <37 weeks), two or more previous CS, parity >2, planned CS, congenital foetal anomalies, induction of labour with prostaglandins, history of other uterine incision such as myomectomy and incomplete medical records. The sample comprised all modes of delivery (vaginal delivery, instrumental vaginal delivery and emergency CS).

Patients were than divided into two groups considering the use of EA: Group 1 delivered with EA, Group 2 without EA.

2.2 Study outcomes

The primary outcome was the success rate of TOLAC in relation to the use of EA. Secondary outcomes were maternal and neonatal adverse outcomes, defined as either incidence of UR, need for maternal blood transfusion at delivery, maternal death, 5' Apgar score <7, umbilical artery pH <7.15, transfer to the neonatal intensive care unit (NICU) and/or perinatal/neonatal death.

2.3 Statistical analysis

Descriptive statistics were used to analyse both maternal and foetal characteristics, along with delivery parameters. Variables were stratified into categories whenever reasonable, with the exception of maternal age, maternal weight and birthweight.

Statistical analysis was performed with GraphPad Prism, version 8 for Mac (GraphPad Software, San Diego, CA, USA). The Student's t-test was used to compare continuous variables. Proportions were analysed with the chi-square or Fisher's exact test where appropriate. Continuous variables were analysed using the paired t-test. Unpaired continuous data were analysed using the Mann-Whitney test. Proportions were compared by the chi-square test. Correlations were searched using the Spearman rank test. A p-value < 0.05 was considered statistically significant.

2.4 Ethical approval

Ethical approval was obtained by the local institutional review board (2019-02007 Ethics Committee of the Canton of Bern, Switzerland, approved on 18 November 2019). The study was conducted in accordance with the Declaration of Helsinki. Informed consent was not obtained as this was a retrospective cohort study.

3. Results

Of the 429,259 deliveries included in the data base, 79,775 (18.5%) had a prior CS. Out of this group 4401 (5.5%) met the study inclusion criteria.

A total of 1736 (39.4%) women received an EA (Group 1) during labour while 2665 (60.6%) women delivered without regional anaesthesia (Group 2). The incidence of EA did not change during the years, even when comparing different delivery modalities. Labor was induced in 750/4401 (17%) women (Group 1: 22.8% vs Group 2: 13.3%; $p < 0.0001$).

Overall, 56.1% of the women included in this study delivered vaginally. Of interest, women with EA had a higher overall vaginal delivery rate than those included in Group 2 (Group 1: 1128/1736 (65%) vs Group 2: 1343/2665 (50.5%); $p < 0.001$ [OR 1.83; 95% CI 1.6–2.1]). This was due to a higher vaginal operative delivery birth rate found in Group 1 compared to Group 2 (24.9% vs 9.5%, $p < 0.0001$). In Group 2 the rate of CS was higher than in Group 1 (49.6% vs 35.02%; $p < 0.0001$). Similarly, parameters of foetal outcome such as birth weight, Apgar score at 5 minutes and umbilical cord pH were also significantly different between groups (Table 1).

The prevalence of UR in the entire cohort of women with TOLAC was 20/4401 (0.45%) and was similar among patients receiving EA or not (Group 1: 0.4% vs Group 2: 0.5%; $p = $ NS). Considering only patients with UR, none of the variables considered was significantly different between the two groups, including age, BMI, mode of delivery, blood transfusion and maternal death (Table 2). In addition, no cases of hysterectomy after UR were observed.

4. Discussion

TOLAC and EA do not increase the prevalence of UR or CS and are not associated with serious adverse foetal, neonatal or maternal outcomes.

Safety of vaginal birth after CS has been confirmed by several studies, even if an increased incidence of UR has been observed [2–5]. Moreover, The National Institutes of Health Consensus Development Conference Panel recommends increasing the TOLAC rate [9]. In doing so, the overall rate of CS could be reduced.

Previous CS is the main risk factor for UR [7]. According to the literature, the incidence of UR is approximately 0.5–0.8% in cases of TOLAC [10, 11]. In our study, the incidence of UR was slightly lower (0.45%), probably due to our strict inclusion criteria. Indeed, we excluded multipara, patients with multiple pregnancies and inductions with prostaglandins, as they are important known risk factors for UR [12, 13].

The most consistent early indicator of UR is the onset of a prolonged, persistent and profound foetal bradycardia [14–16]. Other concomitant signs and symptoms of UR, such as abdominal pain (5–69%), acute absence of contractions (14%) and vaginal bleeding (27%), seem to be less consistent than bradycardia (67%) in establishing the appropriate diagnosis [6–8, 16]. In 1999, Rageth et al. [17] analysed deliveries of patients with a prior CS and found that 70% of UR occurred more often in cases with induced labour, EA, abnormal heart rate tracing and failure to progress. It would have been interesting to know the symptomatology manifested during labour by women who had a UR, but unfortunately these data were not reported in our source database.

In our study, EA was less often associated with UR but rather had a positive impact on the vaginal delivery rate. This point was confirmed by other studies. In 2019, the American Association of Obstetricians and Gynaecologists' (ACOG) guidelines explicitly recommended use of EA in TOLAC [2]. Similarly, Sun et al. [18] found no increased risk of

Table 1. Clinical characteristics of the study population dichotomised into Group 1 with, and Group 2 without epidural analgesia.

	EA	No EA	p-value
	(N° 1736—Group 1)	(N° 2665—Group 2)	
Age (mean $\pm$ SD, years)	32 $\pm$ 4	31.9 $\pm$ 4	NS
Gestational age at delivery (mean $\pm$ SD, week)	39.9 $\pm$ 1	39.6 $\pm$ 1	<0.0001
BMI (kg/m^2)	27 $\pm$ 4	26.9 $\pm$ 4	0.01
Vaginal birth—N° (%)	696 (40.1)	1091 (40.9)	0.0006
Sec. Caesarean section—N° (%)	608 (35.02)	1322 (49.6)	<0.0001
Vaginal operative delivery—N° (%)	432 (24.9)	252 (9.5)	<0.0001
Uterine rupture—N° (%)	7 (0.4)	13 (0.48)	NS
Blood transfusion—N° (%)	24 (1.3)	27 (1)	NS
Maternal death—N° (%)	0 (0)	0 (0)	NS
Birth weight (mean $\pm$ SD, g)	3450 $\pm$ 405	3408 $\pm$ 401	0.008
Apgar score at 5 min (mean $\pm$ SD)	9.1 $\pm$ 1	9.2 $\pm$ 0.9	0.0002
Umbilical cord pH (mean $\pm$ SD)	7.23 $\pm$ 0.8	7.25 $\pm$ 0.8	<0.0001
Neonatal death—N° (%)	0 (0)	0 (0)	NS
NICU—N° (%)	9 (0.51)	22 (0.83)	NS

Abbreviations: N°, number; SD, standard deviation; NICU, neonatal intensive care unit; EA, epidural analgesia; NS, not significant; BMI, body mass index.

Values are given in mean $\pm$ SD or numbers as appropriate.

postpartum bleeding or UR with the use of EA in multiparas [19, 20]. However, even if TOLAC is increasingly recommended in selected cases, EA is still not widely used due to controversy. Indeed, in Switzerland, no increase in the use of EA with TOLAC was found during the investigated study period.

Domestic and foreign studies on the application of EA in TOLAC are mostly small or retrospectively analysed. We found only one prospective cohort study evaluating the use of EA in 263 multiparas [18]. In this study, the success rate of TOLAC was 85.5% without differences in maternal (UR, blood loss) and neonatal (Apgar, pH, NICU) outcomes irrespective of the use of EA. In our study, the percentage of VBAC was lower (56.1%), which may be explained by the exclusion of multipara. Indeed, in the above described study, 55.5% had a history of three pregnancies and the Bishop score at admission was more than six, two potential biases that in our opinion could explain the high success rate of VBAC. Moreover, to avoid potential bias which could influence the second stage of labour, we expressly excluded multipara and selected only patients in their second pregnancy [18]. Interestingly, the percentage of vaginal delivery was significantly higher in the TOLAC group with EA compared to the non-epidural group (Fig. 1). Until now, controversy has existed concerning the effect of epidurals on the progress of labour, mode of delivery as well as on the foetus and neonate. However, an explanation of our results can particularly be found in the studies by Wong *et al.* [21] in 2005 and Fyneface-Ogan *et al.* [22] who demonstrated that EA can be associated with shorter first stage of labour due to an inhibitory effect of catecholamines on uterine contractility, and hence, faster cervical dilatation.
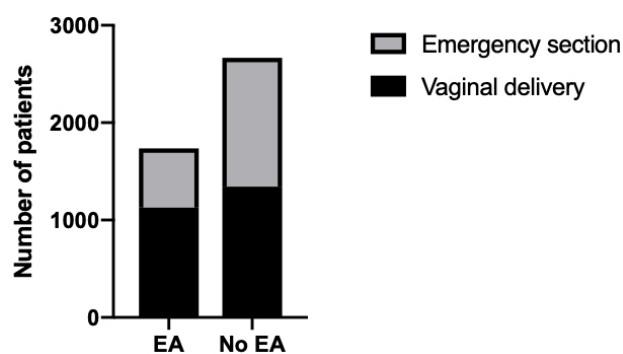

Fig. 1. Mode of delivery in patients with a trial of labour and a history of caesarean section in relation to the use of epidural analgesia.

In the current study, a significantly higher number of operative vaginal deliveries in the EA group was observed. At exception of an increased BMI and gestational age no significant differences were observed between the groups. This higher rate of operative vaginal deliveries may be explained by more labor inductions found in Group 1 mainly due to a higher gestational age, higher BMI, and a higher neonatal birth weight. In the last years, several studies observed a similar relationship, even if a recent Dutch observational study of over 600,000 deliveries did not demonstrate a change in instrumental delivery rates despite an almost tripled rate of labour neuraxial analgesia over 10 years (from 7.7% to 21.9%) [23]. However, the true effect and impact of labour with EA on risk for instrumental delivery remains poorly understood.

In recent decades, the overall CS rate increased dramatically worldwide and in 2015, the World Health Organization recommended reducing the overall rate of CS by up to 15%

Table 2. Cases with uterine rupture after trial labour with and without epidural analgesia.

Uterine rupture	EA	No EA	p-value
	(N° 7)	(N° 13)	
Gestational age at delivery (mean ± SD, week)	40.6 ± 0.7	40.6 ± 0.6	NS
Induction of labour—N° (%)	1 (14)	0 (0)	0.0002
Vaginal birth—N° (%)	1 (0.06)	0	NS
Sec. Caesarean section—N° (%)	3 (0.17)	11 (0.41)	NS
Vaginal operative delivery—N° (%)	4 (0.23)	0	NS
Blood transfusion—N° (%)	7 (0.4)	12 (0.4)	NS
Maternal death—N° (%)	0	0	/
Birth weight (mean ± SD, g)	3764 ± 364	3450 ± 611	NS
Apgar score at 5 min (mean ± SD)	9 ± 1.1	8.7 ± 1.4	NS
Umbilical cord pH (mean ± SD)	7.14 ± 0.14	7.22 ± 0.1	NS
Neonatal death—N° (%)	0	0	/
NICU—N° (%)	0	0	/

Abbreviations: N°, number; SD, standard deviation; NICU, neonatal intensive care unit; EA, epidural analgesia; NS, not significant.

[24, 25]. Interestingly, in our study, we found a decreased rate of vaginal birth after CS without EA. Therefore, we suppose that if our data are confirmed by prospective studies, EA, with adequate pain relief, could encourage more women to choose TOLAC for delivery and may help, in this way, to reduce furthermore the incidence of CS. In addition, effective regional analgesia should not be expected to mask signs or symptoms of UR, particularly because the most common sign of rupture is foetal heart rate abnormalities [2, 7, 16].

A limitation of our study is the retrospective nature and the fact that most data included in the register are categorical data. However, a major strength is its population-based national design and the stringent inclusion criteria, as the exclusion of multipara and the selection only of patients in their second pregnancy reduces the risk of bias. In addition, all the data were inserted by physicians involved in each case but unrelated to the study making the data more truthful and less prone to errors.

5. Conclusions

EA during TOLAC is safe and is not associated with a significant increase of maternal and foetal morbidity. Moreover, EA may favour, in selected cases, vaginal delivery without influence on maternal and foetal morbidity.

Author contributions

VF, DB and LR designed the research study. SAM performed the research. RT analyzed the data. VF, DB and LR wrote the manuscript. All authors contributed to editorial changes in the manuscript. All authors read and approved the final manuscript.

Ethics approval and consent to participate

Ethical approval was obtained by the local institutional review board (2019-02007 Ethics Committee of the Canton of Bern, Switzerland, approved on 18 November 2019). The study was conducted in accordance with the Declaration of Helsinki. Informed consent was not obtained as this was a retrospective cohort study.

Conflict of interest

The authors declare no conflict of interest.

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