

# Conversion of epidural labour analgesia to anaesthesia for Caesarean section: a prospective study of the incidence and determinants of failure

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**Background.** The incidence of general anaesthesia (GA) has been used as a marker for the quality of obstetric anaesthesia care. Recent guidelines suggest the rate of GA for Caesarean section in parturients with pre-existing epidural analgesia for labour should be <3%. The primary purpose of this study is to determine whether or not this is an achievable standard in a university teaching hospital. We also wished to determine the factors influencing the incidence of inadequate anaesthesia.

**Methods.** We studied a consecutive cohort of 501 patients who had a Caesarean section after epidural labour analgesia. The incidence of GA, the total incidence of failure, and the factors previously associated with failure were recorded. Factors shown to be significant with univariate analysis were used in a binary logistic regression to determine the independent risk factors for failure.

**Results.** Twenty-one of 501 parturients required GA (4.1%, 95% confidence interval 2.6–6.3%), not significantly different from 3% ( $P=0.1$ ). Fifteen of 21 (71%) of these occurred intraoperatively. The total rate of failure was 30/501 (5.9%, 95% confidence interval 4.0–8.4%). Maternal height and the number of clinician top-ups in labour were the significant independent risk factors for failure.

**Conclusions.** Intraoperative conversion to GA may increase both maternal and fetal risks. Strategies to reduce the incidence may include early recognition of inadequate labour analgesia and reliable assessment of adequacy of surgical anaesthesia.

*Br J Anaesth* 2008

**Keywords:** anaesthesia, obstetric; anaesthetic techniques, epidural; analgesic techniques, extradural; analgesia, obstetric; Caesarean section

Accepted for publication: June 20, 2008

Epidural analgesia is commonly used for labour. Many authors advocate the use of epidural analgesia in parturients who are at high risk for emergency Caesarean delivery because the time to effective surgical anaesthesia may be shortened.<sup>1</sup> Further, general anaesthesia (GA) may be avoided with the rapid induction of regional anaesthesia.

In some cases, epidural catheters placed for labour may not be reliable for use in surgical anaesthesia. In some studies, the need for an additional form of anaesthesia was as high as 26%.<sup>2</sup> Other authors have reported the incidence of GA after failed conversion of an epidural from labour to surgery to be 2.4%.<sup>3</sup>

The Royal College of Anaesthetists has published audit criteria for best practice in providing anaesthesia for

Caesarean section. These guidelines suggest that the incidence of GA in a parturient with a labour epidural *in situ* should not be more than 3%.<sup>4</sup> The purpose of this study was to determine whether or not a GA rate of 3% could be achieved in a teaching hospital. In addition, we wished to identify risk factors for conversion.

## Methods

The study was conducted in the obstetric unit of a university teaching hospital with a delivery rate of ~3750 per annum. After Research Ethics Board approval, we prospectively studied, from March 1, 2006 to June 30, 2007, all parturients who had an epidural placed for labour and

subsequently required a Caesarean section. Individual patient consent was not required for this observational study. Labour analgesia was initiated either with an epidural or with a combined spinal–epidural (CSE) technique. When epidural analgesia was used, 10–20 ml of bupivacaine 0.08% to 0.125% was given as an initial bolus. When a CSE was used, intrathecal bupivacaine (1.25–2.5 mg and sufentanil 5 µg) was given. Patient-controlled epidural analgesia with a bolus dose of 5–7 ml, lockout time of 10 min, and a background infusion of 5–10 ml h<sup>-1</sup> was maintained with bupivacaine 0.08% combined with fentanyl 2 µg ml<sup>-1</sup>. After the decision to proceed with Caesarean section was made, the patient was transferred to the operating theatre and subsequently received additional local anaesthetic to provide surgical anaesthesia. The drugs and dosages were given according to the judgement of the attending anaesthetist. All anaesthetics were given by staff anaesthetists or senior trainees with at least 5 yr experience.

All data were collected on a separate data form designed for the study. Each day an anaesthetist, not involved with patient care, collected the forms and checked them for accuracy and completion against the clinical record. Clinicians involved in the patient care were contacted when information was missing. Details concerning patient characteristics, the reason for Caesarean section, labour analgesia, Caesarean section anaesthesia, the time from the initiation of anaesthesia to incision, and previously identified determinants of failure of epidural anaesthesia<sup>1 2 4</sup> were recorded. These included: (i) maternal factors (age, weight, height, and BMI), (ii) obstetric factors (parity, grade of emergency, fetal heart rate abnormalities, cervical dilation before Caesarean section), and (iii) anaesthetic factors (preoperative airway assessment, duration of epidural analgesia before Caesarean section, incidence of CSE analgesia, grade of the anaesthetist, and epidural catheter depth to skin). The primary outcome was the incidence of GA. Secondary outcomes included the incidence of epidural anaesthesia failure (as defined by the need to use another form of anaesthesia or to replace the epidural catheter in the operating theatre) and the factors that correlated with failure.

Patient characteristics were tabulated as mean and standard deviation. Using a test of one proportion, the incidence of GA and the 95% confidence interval were calculated and compared with a population with an incidence of 3%. The incidence of failure and the 95% confidence interval were also calculated. Univariate statistics (unpaired Student's *t*-tests,  $\chi^2$  tests of two proportions, and Fisher's exact test) were used as appropriate to determine factors that correlated with failure. Factors that were associated with failure in the univariate analysis ( $P < 0.10$ ) were put into a binary logistic regression predictive model. A *P*-value of  $< 0.05$  in the multivariate model was considered statistically significant. Analyses were done using Minitab 14.2.

**Table 1** Patient characteristics ( $n = 501$ ). Data are expressed as mean (range), mean (SD) or *n*

Maternal age (yr)	33.4 (19–49)
Maternal weight (kg)	78.1 (18)
Maternal height (cm)	163 (7)
BMI	29 (6.8)
ASA I	357
ASA II	124
ASA III	20
Full dilation at the time of Caesarean	154 (30.1%)
CSE	31
Epidural	470
Catheter depth at the skin (cm)	11 (1.7)
Caesarean anaesthesia staff	373
Fellow	148

## Results

During the study period, 501 patients with epidural analgesia for labour were delivered by Caesarean section (Table 1). All but five patients received epidural lidocaine 2% with epinephrine (mean volume 18.2 ml, SD 3.9). Three patients received bupivacaine 0.5% and two received 2-chloroprocaine 2%. Sixty per cent of the patients received additional epidural fentanyl with a dose range of 50–100 µg.

In 30 patients, the anaesthetist could not provide sufficient anaesthesia using the epidural catheter placed in labour (5.9%, 95% confidence interval 4.0–8.4%). Of these, 21 received GA (4.1%, 95% confidence interval 2.6–6.3%). This incidence is comparable with the audit standards of 3% suggested by the Royal College of Anaesthetists ( $P = 0.1$ ). The reasons for conversion to GA were: insufficient analgesia intraoperatively ( $n = 15$ ), insufficient time to top-up the existing epidural catheter ( $n = 3$ ), maternal request ( $n = 2$ ), and severe, prolonged haemorrhage ( $n = 1$ ). Nine patients had the epidural catheter removed and regional analgesia repeated. Six patients had spinal anaesthesia, two had a CSE anaesthetic, and one had a repeat epidural. The mean time from the initiation of epidural anaesthesia in the operating theatre to incision was 21 min (SD 10 min) for successful epidural conversion and 36 min (SD 24.8) for unsuccessful conversion ( $P = 0.001$ ).

Fourteen patients received sedation to supplement epidural anaesthesia. Fentanyl, median dose of 100 µg (range 50–350 µg), was used in 11 patients. Other sedatives included morphine 5 mg ( $n = 1$ ), propofol 40–60 mg ( $n = 2$ ), midazolam 1.5–2 mg ( $n = 4$ ), and diazepam 2.5 mg ( $n = 1$ ). Five patients received more than one medication. All patients were responsive to verbal stimuli throughout the operation.

Univariate comparison between patients who had a successful conversion of labour analgesia to Caesarean section anaesthesia with those who did not (Table 2) found six factors which met the entry criteria into the logistic regression model—maternal height, duration of epidural analgesia, the number of unscheduled clinician top-ups, last measured cervical dilation before surgery, and fetal heart rate abnormalities. The logistic regression

**Table 2** Univariate comparisons between successful and failed conversion. Predictors with a *P*-value of <0.1 were admitted into the logistic regression model. \*Data expressed as mean and standard deviation or per cent. †Fisher's exact test

Predictors	Successful conversion ( <i>n</i> =471)	Failed conversion ( <i>n</i> =30)	Difference and 95% confidence interval	<i>P</i> -value
Mean maternal age (yr)*	33.5 (4.4)	33.1 (5.7)	0.40 (−1.7 to −2.6)	0.71
Mean maternal weight (kg) at the time of delivery	78 (18)	81 (19)	−3.0 (−10 to −4.4)	0.41
Mean maternal height (cm)	163 (6.8)	167 (8.0)	−4.0 (−7.2 to −0.71)	0.019
Maternal BMI	29 (6.4)	29 (5.9)	0.36 (−2.0 to −2.7)	0.78
Maternal BMI >35	9.8%	6.0%	3.8% (−4.0% to −11%)	0.32
Airway assessed as difficult before operation	4.0%	3.3%	0.7%	1.0†
Duration of epidural analgesia (min)	599 (318)	415 (257)	184 (78–289)	0.001
Nulliparity	89%	83%	5.4% (−19% to −8.2%)	0.44
Combined spinal–epidural	5.8%	13%	−7.6% (−19% to −4.7%)	0.11
Loss of resistance to air	94.1%	89.9%	4.0% (−1.3% to −9.2%)	0.14
Anaesthetic for CS by staff	70%	80%	−9.8% (−24% to −5.0%)	0.20
Emergency CS	18%	30%	−11% (−28% to −4.8%)	0.16
Clinician top-ups (0 or 1 compared with more than 1) (%)	0 or 1; 86%	0 or 1; 66%	−19% (−1% to −37%)	0.037
	>1; 14%	>1; 34%		
Epidural catheter depth to skin (cm)	11.2 (1.7)	11.0 (1.7)	0.15 (−0.51 to −0.83)	0.47
Last cervical dilation (cm) before surgery	7.04 (2.8)	5.15 (3.2)	1.9 (0.6–3.2)	0.006
Caesarean for non-reassuring fetal heart	25%	43%	−18% (−0.3% to −0.31%)	0.054
Multiple attempts (<3) for labour epidural	6%	17%	11%	0.03†

model (Table 3) showed that the independent variables that were statistically significant in predicting block failure were increased height ( $P=0.023$ ) and more clinician top-ups ( $P=0.016$ ).

## Discussion

This prospective study shows that it is feasible to approach the audit guidelines proposed by the Royal College of Anaesthetists concerning the conversion of epidural analgesia for labour to GA for Caesarean section. However, epidural catheter failure occurs in a significant number of patients. When it becomes apparent that the epidural will not provide sufficient anaesthesia, the anaesthetists must choose how to proceed. The best course of action will depend on the urgency of the surgery, whether or not the surgery has commenced, and maternal wishes.

In our study, only three patients required a GA because of the emergency nature of the surgery. All were for fetal reasons. While almost all patients received epidural lidocaine with epinephrine, the mean time to achieve a sufficient level is at least 10 min.<sup>5</sup> This may be too long if there is severe sustained fetal bradycardia or a prolapsed umbilical cord.

In 15 patients, conversion to GA occurred intraoperatively, representing 71% of the general anaesthetics in this cohort. Survey data from the UK reported a similar, high incidence (89%) of intraoperative conversion being to GA.<sup>6</sup> This may be due to poor reliability of tests of block height used in routine clinical practice.<sup>7</sup> Standardized testing of block height with cold, touch, and pinprick may improve reliability.<sup>8</sup> However, conversion to GA may be the only option if the patient experiences extreme pain or emotional distress. Data from the closed claims database

**Table 3** Logistic regression table. Predictors with a *P*-value of <0.05 were considered to be independent risk factors for failure

Predictor	Odds ratio and 95% confidence interval	<i>P</i> -value
Maternal height	1.08 (1.01–1.15)	0.023
More than one clinician top-ups	1.63 (1.10–2.44)	0.016
Multiple attempts (initial epidural)	3.17 (0.85–11.84)	0.086
Last cervical dilation before Caesarean section	0.84 (0.71–1.00)	0.055
Fetal heart rate abnormalities	1.11 (0.36–3.48)	0.85
Duration of labour analgesia	1.00 (1.00–1.00)	0.054

suggest that intraoperative pain during Caesarean section results in litigation more often than in non-obstetric surgery.<sup>9</sup>

We identified two independent risk factors for failure of conversion of labour epidural analgesia to epidural anaesthesia for Caesarean section—more than one clinician-initiated top-up in labour and maternal height. In our institution, labour analgesia is maintained with a continuous epidural infusion of local anaesthetic and patient-controlled boluses. In this setting, more than one clinician-initiated bolus may be an early sign that the epidural catheter may be misplaced. This factor has been shown by others to be consistently important.<sup>2 3 10 11</sup> Of interest, maternal height was identified as a factor leading to failure in our study, but increased BMI was not. Further, we could not demonstrate a difference in failure rate between patients with a BMI of >35 compared with those with a BMI <35. This may be due to a low tolerance for an imperfectly working labour epidural in obese parturients because of the high incidence of operative delivery. These are usually replaced as soon as they are identified in an attempt to prevent the need for repeating a regional technique or changing to GA.

Other factors have been identified as important predictors for failure. Clinicians with special training in obstetric anaesthesia may have a lower rate of failure than clinicians without this training.<sup>10,11</sup> The reason for this is unclear but may be related to confidence that the block will work if allowed sufficient time. In addition, in the event of failure, non-specialists were less likely to attempt a spinal anaesthetic instead of converting to GA.<sup>10</sup> We were unable to demonstrate that effect in our study because all of the supervising anaesthetists were experienced in obstetric anaesthesia.

Whether or not initiation of labour analgesia with a CSE technique could be a factor is controversial. An increased failure rate in parturients who received a standard labour epidural compared with a CSE has been described.<sup>3</sup> However, a retrospective review of 366 patients was unable to demonstrate this effect.<sup>12</sup> In this study, there was a higher proportion of failures in patients who had labour analgesia initiated with a CSE, but the difference was not statistically significant.

The local anaesthetic and dose used for conversion of labour analgesia to surgical anaesthesia may play a role in determining success. In a retrospective review,<sup>13</sup> a mean volume of 18.6 (5.6 sd) ml of lidocaine 2% with 1:200 000 epinephrine was used. They reported a 2.6% incidence of GA. There was no difference in failure rate whether or not the block was supplemented with epidural sufentanil.<sup>13</sup> In contrast, a prospective study followed a protocol that included 16 ml of lidocaine 2% with 100 µg of fentanyl and 1 ml of bicarbonate but no epinephrine and recorded a failure rate of 20%.<sup>2</sup> In our study, we experienced a GA rate similar to the former study.<sup>13</sup> The ability to titrate local anaesthetic to the height of the block may account for the differences in GA rates among studies.

Other local anaesthetics have also been used to convert epidural analgesia to surgical anaesthesia. Bupivacaine has been successfully used, but it takes longer to work.<sup>5</sup> Recently, 112 patients were randomized to receive levobupivacaine 0.5% with and without fentanyl 75 µg after labour epidural analgesia.<sup>14</sup> The mean volume was similar between the groups (22.9 vs 23.9 ml). A block to T4 developed rapidly in both groups (median 10 min with fentanyl, 11 min without). The incidence of GA was 4% in each group. Additionally, two patients (4%) required a spinal anaesthetic for an inadequate block.

Regional anaesthesia for Caesarean section has many advantages when compared with GA. These include superior postoperative analgesia, positive influence on breast-feeding, and the psychological advantages of being awake during the delivery. For some patients, particularly those who are obese, regional anaesthesia may be safer than GA because of difficulties in airway management. The incidence of unpredictable airway management problems in the obese patient may be up to 15.8 times that of normal.<sup>15</sup> For these reasons, the incidence of conversion to GA should be low.

Low rates of conversion of labour epidural analgesia to Caesarean section GA can be achieved as suggested by the Royal College of Anaesthetists. While conversion to GA does not necessarily imply poor practice for individual cases, intraoperative conversion may increase both maternal and fetal risks because of stress, time pressure, and physical constraints (drapes and instruments in the way). Strategies to reduce the incidence may include early recognition of inadequate labour analgesia and reliable assessment of adequacy of surgical anaesthesia.

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