Original Article

Incidence of cesarean section and analysis of risk factors for failed conversion of labor epidural to surgical anesthesia: A prospective, observational study in a tertiary care center

Samina Ismail, Shakaib Chugtai, Alia Hussain

Department of Anesthesia, Aga Khan University Hospital, Karachi 74800, Pakistan

Abstract

Background and Aims: This study aimed to analyze the effect of labor epidural (LE) on the incidence of cesarean section (CS) and assess the risk factors involved in failed conversion of LE to surgical anesthesia for CS.

Material and Methods: A prospective observational study of 18 months from January 2012 to June 2013 was conducted on all patients who had delivered in the labor room suit of our hospital. The data collected for all 4694 patients included their demographics, parity and mode of delivery. In addition a predesigned proforma, with additional information was used for 629 parturient with LE.

Results: During the study period, total numbers of deliveries performed in our hospital were 4694, with an epidural rate of 13.4% (629/4694). No significant difference ($P = 0.06$) was observed in the rate of CS among women with or without LE (28 % [$n = 176/629$] vs. 31.7 % [$n = 1289/4065$]), however, a statistically significant difference ($P < 0.01$) was observed in the rate of assisted delivery in patients receiving LE as compared to those delivering without it (8.7% [$n = 55/629$] vs. $n = 3.7$% [154/4065]).

For 176 patients requiring CS, LE utilization for surgical anesthesia was 52.8% (93/176) and factors identified for not utilizing LE in 47% (83/176) were; failure to achieve surgical anesthesia in 6.8% (12/176), emergency CS in 28.4% (50/176), patient preference in 6.8% (12/176) and inadequate labor pain relief with LE in 5.1% (9/176) patients. Non-obstetric anesthesiologists were involved in 59% (49/83) of cases where LE was not used for CS.

Conclusion: LE had no effect on the rate of CS; however it significantly increased ($P < 0.01$) the rate of assisted delivery. Factors like inadequate LE, emergency situations and non-obstetric anesthesiologists can all be responsible for failed conversion of LE to surgical anesthesia for CS.

Key words: Cesarean section, epidural analgesia, general anesthesia, labor epidural

Introduction

Controversy about the effect of labor analgesia on labor outcome is perhaps the oldest in the history of obstetric anesthesia, yet the provision of effective analgesia is one of the key components of active management of labor and its use is recommended in the labor management protocol.[1]

Despite epidural analgesia (EA) being the most effective method of pain relief,[2] there is a concern based on older studies that women who have labor epidural (LE) are more prone to cesarean section (CS).[3,4] However, Cochrane review of 2005, compared epidural with non-epidural or no analgesia; supports LE, in not having a significant effect on CS rates.[5] Neuraxial labor analgesia is not a generic procedure; therefore, its initiation and maintenance can vary among providers, institutions and countries, which may give variable results relating to its effect on CS rate.

Besides providing effective pain relief, LE can also be used to provide surgical anesthesia, if the need for CS arises during the course of labor. Switching to general anesthesia (GA)

and failure to use LE for surgical anesthesia during CS is considered a failure of regional anesthesia (RA).[6] The Royal College of Anesthetists has published the best practice guidelines for providing anesthesia for CS,[7,8] which states that an acceptable rate of GA in parturient receiving LE should not be >3%. Results from our part of the world showed a high failure rate of 20% to use functioning LE for surgical anesthesia in CS grade 1-3.[9]

An understanding of the risk factors for failed conversion of LE to surgical anesthesia can help in identification and rectification of the causes of this failure. This in turn could help to design strategies to increase the success rate for conversion of labor analgesia to anesthesia, which would improve patient safety and quality of care.

Much of the existing data on the rate of CS in patients receiving LE, and the data on the failed conversion of LE for CS anesthesia comes from developed countries.[2,10] Diversity in patient populations and anesthesia practices of different countries tend to challenge these comparisons. It is important to review data from developing countries to review the intervention rates for obstetric patients receiving LE.

Therefore the objective of this observational study is to observe if there is an increased incidence of CS/assisted delivery (increase rate of forceps/vacuum) in patients receiving LE in a hospital setting of a developing country. Further, an analysis of the risk factors for failed conversion of LE for surgical anesthesia was done, if these patients required CS during the course of their labor.

Material and Methods

A prospective observational study of 18 months from January 2012 to June 2013 was conducted. All patients who had delivered in the labor room during the study period were included. As this was an observational study and did not require patient interaction or use of patient identification, exemption from the hospital ethics committee was taken and consent was not obtained from any individual patient.

A predesigned proforma was used for data collection by one of the investigators who visited the labor room every day and filled the proforma for all patients who had delivered in the labor room suite. The data were obtained from the patients' file, LE and operating room record form.

The data for patients who had not received epidural but delivered during the study period included; demographics, parity and mode of delivery. Data for patients receiving LE, included demographics, parity, history of previous CS, cervical

dilation at the time of the epidural catheter, the vertebral level of epidural insertion, length of catheter inside the epidural space, local anesthetic volume and concentration used for epidural bolus and maintenance, and pain scores during labor. Effectiveness was assessed by numerical rating scores for every hour, number of break through pains and rescue doses mentioned in the LE record form. In addition if there was requirement of maneuvers like re-insertion of epidural or catheter manipulation mentioned in LE record form, it was recorded in our predesigned proforma as an indication of inadequate pain requiring these maneuvers. All these variables are already incorporated in the hospital LE record form and mandatory from the hospital quality assurance to be filled by the primary anesthesiologist performing LE.

The mode of delivery like normal vaginal delivery, assisted (forceps or vacuum) and CS was entered in the proforma. If CS was the mode of delivery, then an indication of CS, techniques of anesthesia like GA or extension of LE and whether the anesthesiologist providing anesthesia for CS was an obstetric anesthesiologist or non-obstetric anesthesiologist was noted. Further details like local anesthetic used for loading epidural, its concentration and volume and whether top up was given in the operating room or labor room was noted down. If GA was given, then reasons like the urgency of CS, failed epidural or patient preference was noted down. All this information is routinely available in the anesthesia record form. In our hospital set up there is a dedicated team of anesthesiologist who performs obstetric cases, however, at times when they are already involved and CS needs to be done on an urgent basis, anesthesiologist who does not perform obstetric cases on a routine basis is involved in anesthetizing these patients.

All statistical analysis was performed using Statistical Packages for Social Science version 19 (SPSS Inc., Chicago, IL, USA). The normality of the quantitative data was checked by Kolmogorov–Smirnov test. The mean and standard deviation were estimated and analyzed by the analysis of variance as well as the Bonferroni test was used for *Post-hoc* multiple compaction between groups. Proportion and percentage were computed for qualitative observation and analysed by the Chi-square test. A $P \leq 0.05$ was considered to be significant.

Results

During the study period from 1st January 2012 to 30th June 2013, total numbers of deliveries performed in our hospital were 4694, with an epidural rate of 13.4% (629/4694) as shown in Figure 1. No significant difference ($P = 0.06$) was observed in the rate of CS among women with or without LE (28% [$n = 176/629$] vs. 31.7% [$n = 1289/4065$]), however
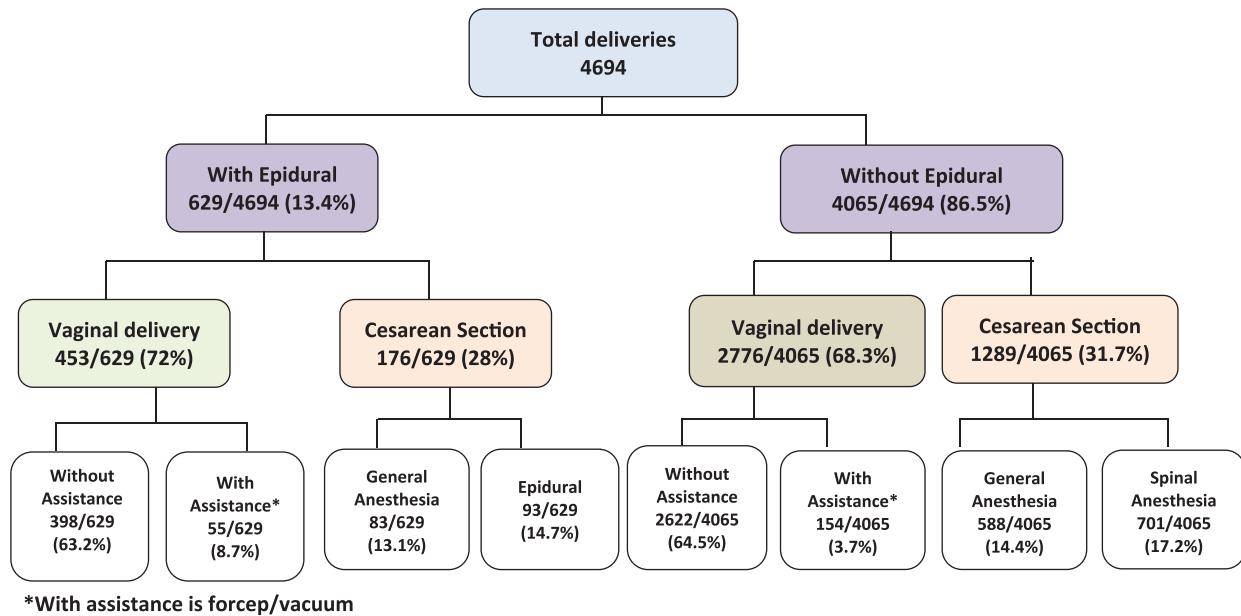
Figure 1: Flow diagram of management of total deliveries (*n* = 4697) with or without labor epidural analgesia

a statistically significant difference (*P* < 0.01) was observed in the rate of assisted delivery in patients receiving LE when compared to those delivering without it (8.7% [*n* = 55/629] vs. *n* = 3.7% [154/4065]).

On analyzing the effect of parity on the mode of delivery in patients not receiving LE; there were 21.8% (*n* = 888/4065) primiparous women, who had CS as the mode of delivery compared to 9.8% (401/4065) multiparous women. There were 2.4% (98/4065) primiparous women who required assisted vaginal delivery (AVD) compared to 1.3% (56/4065) multiparous women needing assistance in the form of forceps and vacuum for their delivery.

In patients who received LE, the effects of the factors like demographics, parity and history of previous CS on the mode of delivery is shown in Table 1. A statistically significant difference was observed in the CS and AVD rate between multiparous and primiparous women.

The effect of factors like cervical dilation at the time of LE institution, vertebral level of insertion, length of LE catheter, visual analogue score (VAS), the number of rescue doses and maneuvers like re-insertion and readjustment of an epidural catheter on a different mode of deliveries among patients with LE is shown in Table 2. Patients having a VAS of >3 during labor were found to have a significantly higher CS rate (*P* <0.05) [Table 2].

All patients with LE received bupivacaine for loading and maintenance of the LE. While analyzing the concentration

Table 1: Effect of demographic, parity and history of previous CS in patients with labor epidural on different mode of delivery (*n* = 629)

Variables	SVD (*n* = 401) (%)	AVD (*n* = 52) (%)	CS (*n* = 176) (%)	P
Age (years)	27.94±4.07	26.15±4.06*	27.37±4.05†	0.008
Weight (kg)	73.27±10.90	71.06±9.72	72.39±10.01	0.290
Height (cm)	156.74±5.84	157.51±5.63	155.08±6.20†,‡	0.003
Parity				
Primipara	07 (76.6)	1 (98.1)	154 (87.5)	0.005
Multipara	94 (23.4)	01 (1.9)*	22 (12.5)†,‡	
Previous CS				
Yes	21 (5.2)	3 (5.8)	11 (6.3)	0.620
No	380 (94.8)	49 (94.2)	165 (93.8)	

SVD = Spontaneous vaginal delivery, AVD = Assisted vaginal delivery, CS = Caesarean section. *P < 0.05 = SVD versus assisted, †P < 0.05 = Assisted versus cesarean, ‡P < 0.05 = SVD versus cesarean

of bupivacaine used for loading LE, two concentrations of bupivacaine (0.125% or 0.25%) were used. In 77.2% (*n* = 486/629) of patients, bupivacaine in the concentration of 0.125% was used compared with 0.25% bupivacaine in 22.7% (*n* = 143/629) patients. Out of 176 CS performed in patients with LE, the CS rate among patients receiving a loading dose of 0.125% bupivacaine was 49.4% (*n* = 87/176) as compared to 50.5% (89/176) receiving the bolus dose of 0.25% bupivacaine. Among the 453 vaginal delivery in patients with LE, 6.8% (31/453) requiring AVD received the loading dose of 0.125% bupivacaine as compared to 5.29% (24/453) who received loading dose of 0.25% bupivacaine. For the maintenance of epidural the standard solution was made in the pharmacy in the concentration of

0.1% bupivacaine with 2 μm of fentanyl per milliliters and it was used in all the patients in the volume range of 8-12 ml.

Out of 176 patients with LE requiring CS during the course of labor, 52% (93/176) were done with the extension of LE and 47.1% (83/176) patients were done under GA. Nonobstetric anesthesiologists were involved in 59% (49/83) of cases where GA was used as a technique of anesthesia in patients already having LE.

In 6.8% (12/176) patients, an attempt was made to extend LE, but there was a failure to achieve surgical anesthesia. Therefore they were converted to GA. In these failed LE extension cases, no significant difference was found from 52% cases (93/176) where surgery was done with LE extension in terms of the number of rescue boluses, length of the catheter, loading a dose in the operating room or labor room and whether the anesthesia was given by an obstetric anesthesiologist or nonobstetric anesthesiologist [Table 3].

There were 40.3% (71/176) patients with LE, where GA was given without any attempt to extend LE for surgical anesthesia due to reasons like emergency CS in 28.4% (50/176), patient preference in 6.8% (12/176) and inadequate analgesia during labor in 5.1% (9/176) of patients. Among 50 patients labeled as emergency CS, 42% (21/50) belonged to the category I and II and 58% (29/50) belonged to category III class of emergency CS. A statistically significant association ($P < 0.001$) was observed in patients having VAS >3 during labor and GA as the technique of anesthesia for CS [Table 4].

When analyzing the local anesthetic solution for loading the LE for CS, it was observed that there was a use of a combination of xylocaine with bupivacaine in all patients. Variable concentration of xylocaine either 1% or 2% and bupivacaine 0.25% or 0.5% in variable combination was used in a volume ranging from 12 to 20 ml. In 9 out of 12 patients, where the extension of LE failed to produce surgical anesthesia, bupivacaine in the concentration of 0.25% was used initially in the dose of 10 ml, followed by xylocaine (1%) in the volume range of 5-10 ml.

Discussion

In this observational study, no significant difference was found in the rate of CS among patients with or without epidural (28% vs. 31.7%). These results extend those reported in literature from randomized controlled trials, systematic reviews, Cochrane reviews and impact studies.[11-15] The findings from a Cochrane review of 2011, has shown an increased risk of CS for fetal distress, (relative risks [RR] 1.43, 95% confidence interval [CI]: 1.03-1.97, 11 trials, 4816 women) but there was no evidence of a significant difference in the overall risk of CS (RR: 1.10,

Table 2: Effect of cervical dilatation, characteristics of labor epidural and duration of labor epidural on the mode of delivery in patients receiving labor epidural ($n = 629$)

Factors	SVD ($n = 401$) (%)	AVD ($n = 52$) (%)	CS ($n = 176$) (%)	P
Cervical dilatation				
<3 cm	67 (16.7)	9 (17.3)	35 (19.9)	0.80
3-5 cm	324 (80.8)	41 (78.8)	138 (78.4)	
>5 cm	10 (2.5)	2 (3.8)	03 (1.7)	
Level of insertion				
L2, L3	13 (3.2)	1 (1.9)	6 (3.4)	0.92
L3, L4	290 (72.3)	38 (73.1)	134 (76.1)	
L4, L5	97 (24.2)	13 (25.0)	36 (20.5)	
L5, S1	1 (0.2)	0	0	
Length of catheter				
<4 cm	10 (2.5)	3 (5.8)	1 (0.6)	0.08
4-4.9 cm	45 (11.2)	9 (17.3)	27 (15.3)	
>5 cm	346 (86.3)	40 (76.9)	148 (84.1)	
VAS for pain*				
VAS ≤3	399 (99.5)	52 (100)	162 (92)	0.004*
VAS >3	2 (0.49)	0	14 (8)	
Maneuver	14 (2.3)	2 (6.9)	1 (0.82)	0.11
Number of rescue doses				
1	117 (29.2)	11 (21.2)	48 (27.3)	0.83
2	110 (27.4)	14 (26.9)	40 (22.7)	
3	18 (4.5)	3 (5.8)	8 (4.5)	
4	4 (1.0)	1 (1.9)	3 (1.7)	
None	52 (37.9)	23 (31)	77 (43.8)	

*SVD = Spontaneous vaginal delivery, AVD = Assisted vaginal delivery, CS = Caesarean section, VAS = Visual analogue scale. *Significant difference < 0.01*

Table 3: Comparison of characteristic between failed and successful epidural in patients with CS

Variables	Failed epidural ($n = 12$) (%)	Successful epidural ($n = 93$) (%)	P
Number of rescue doses			
<4	8 (66.7)	47 (50.5)	0.292
>4	4 (33.3)	46 (49.5)	
Length of catheter			
<5 cm	1 (8.3)	17 (18.3)	0.390
>5 cm	11 (91.7)	76 (81.7)	
Loading dose			
OR	8 (66.6)	52 (59.9)	0.47
LR	4 (33.3)	41 (44.1)	
Anesthesiologist			
Obstetric	8 (66.7)	76 (81.7)	0.220
Nonobstetric	4 (33.3)	17 (18.3)	

OR = Operating room, LR = Labor room, CS = Caesarean section

95%CI: 0.97-1.25, 27 trials, 8417 women).[16] A meta-analysis using data from 9 impact studies ($n = 37753$) concluded that the rate of CS and operative vaginal deliveries did not change during a period of low to high epidural analgesia rates, with a mean change in the CS rate of −0.67% (CI = −2.0-0.74%).[16]

Table 4: Effect of factors on the technique of anesthesia for patients requiring CS (*n* = 176)

Factors	GA (*n* = 83) (%)	Epidural top up (*n* = 93) (%)	*P*
Cervical dilatation			
<3 cm	12 (14.5)	23 (24.7)	0.19
3-5 cm	70 (84.3)	68 (73.1)	
>5 cm	1 (1.2)	2 (2.2)	
Level of insertion			
L2, L3	2 (2.4)	4 (4.3)	0.39
L3, L4	67 (80.7)	67 (72.0)	
L4, L5	14 (16.9)	22 (23.7)	
Length of catheter			
<4 cm	0	1 (1.1)	0.47
4-4.9 cm	11 (13.3)	16 (17.2)	
>5 cm	72 (86.7)	76 (81.7)	
Visual analogue score for pain			
VAS ≤3	74 (88.9)	93 (100)	0.001*
VAS >3	9 (11.1)	0	
Maneuvers	1 (1.2)	0	0.47
Number of rescue doses			
<4	52 (62.7)	47 (50.5)	0.07
None	31 (37.3)	46 (49.5)	

Data are presented as n (%). GA = General anesthesia, CS = Caesarean section, VAS = Visual analogue scale. *Significant difference < 0.01

During the study period, the rate of assisted delivery either in the form of forceps or vacuum was significantly increased ($P < 0.01$) in patients receiving LE as compared to those not receiving LE, which is more or less consistent with those quoted in the literature. Sharma *et al.*, in a randomized controlled trial found the rate of instrumental delivery was 3% in patients receiving opioid as compared to 12% in the epidural group.[14] Similar finding was observed in the more recent Cochrane review of 2011, indicating an increased risk of assisted vaginal birth (RR: 1.42, 95%CI: 1.28-1.57, 23 trials, 7935 women) and a longer second stage of labor with EA (MD 13.66 min, 95% CI 6.67 to 20.66, 13 trials, 4233 women).[16]

Studies showing an increase in the rate of instrument-assisted vaginal deliveries with epidural analgesia have shown a wide variability in practices between obstetricians and hospitals.[17] This increase has been attributed to the ease of instrumentation in a patient with relaxed pelvic muscles as also better resident teaching in such patients.[11]

Investigators have identified many characteristics of patients requesting LE that independently predict higher CS or nonspontaneous labor.[18] In this study, we observed a significantly higher rate of primiparas when compared with multiparas (81% vs. 18%) requesting for LE and these two groups differ significantly in their risk of CS.[19] A higher percentage of primiparous patient compared to multiparous women had CS both in the epidural group (24.4% vs. 3.4%) and in the non-epidural group (21.8% vs. 9.8%) was found. Floberg *et al.* used radiographic pelvimetry to demonstrate that women requesting epidural analgesia have smaller pelvic outlets, an obvious risk factor for operative delivery.[20] In a case-controlled study,[21] the CS rate was 15% in primigravida, and 1% in multigravida which indicates good clinical practice, but RR: 15; and OR: 17 were statistically significant. In addition, primiparous women had the longest and the most gradual labor curve when compared with multiparous women. Primiparas may start the active phase after 5 cm of cervical dilation[22] and there is no upper limit for the length of the latent phase.[22] Primipara have been found to be associated with a higher risk of dystocia compared with the multipara.[23]

One important and often overlooked characteristic in women choosing LE is an increased pain during labor, which itself is a marker for the CS risk. In this study, we have seen a significant association between patients with LE having VAS >3 during labor and rate of CS. Literature has also quoted high rate of CS in patients with increased breakthrough pain during labor and rate of CS.[24,25] Dysfunctional labor, large fetuses and malpositioned fetuses may increase labor pain and are associated with higher risk for CS.[18]

Another factor considered in this study was to assess the failure of conversion of LE for CS anesthesia. A 47 % failure rate was observed, where GA was used for providing anesthesia for CS in patients having an indwelling LE catheter. There were 12 (6.8%) cases where epidural catheter extension failed to achieve surgical anesthesia and GA was used. A statistically significant difference was found in the pain scores between patients receiving GA or RA for CS, indicating the fact that the extension of epidural was not attempted in patients having high VAS during labor, which is consistent with the previous studies.[26,27] Increased pain with an epidural in place should prompt the provider to evaluate the patient. Lee reported that 21 of 1025 catheters were replaced intrapartum before CS delivery; all catheters replaced were successfully converted to CS anesthesia.[28]

One significant finding of this study was the use of GA without attempting to extend the epidural for surgical anesthesia in 71 (40.3%) cases. Among the reasons for not utilizing LE, 50 (28.4%) patients were labeled as having emergency CS. Previously, authors have described the use of GA with no attempt made to convert epidural analgesia to anesthesia due to the urgency of CS.[26,27,29,30] This management may originate from the perception that it takes a longer time to convert epidural analgesia to anesthesia than to induce the patient with GA.

The recent "saving mothers' lives" report emphasizes the importance of the fast speed of block onset after an epidural top-up in a certain situation.[31] One of the deaths was due to inability to ventilate the lungs during GA for a category 1 CS. This woman had a functional epidural, but the anesthesiologist did not top-up because of the perceived delay in achieving surgical readiness. However, taking into consideration the recommended times for decision to delivery interval of various categories of CS, which is <75 min for category 3 and <30 min for category 1 emergency CS,[32] there is sufficient time to load a satisfactory LE for surgical anesthesia.[29] In an audit by Popham of 444 category 1 CS, the time from decision to delivery for GA (17 + 6 min) was not significantly different than the time for an epidural conversion (19 + 9 min).[33]

In a meta-analysis by Hillyard, the solution that offered the fastest onset for LE conversion was 2% lidocaine with epinephrine.[10] This study observed more failure rate, when 0.25% bupivacaine was followed by lidocaine, indicating that the correct use of local anesthetic in the right concentration does affect the success of epidural.

More nonobstetric anesthesiologists were involved in cases where the functional LE was not attempted for conversion to surgical anesthesia. Previous studies and meta-analysis have found a high rate of the failed conversion with general anesthesiologist.[26,27] The reason reported in literature is more awareness among obstetric anesthesiologist regarding the quality of LE analgesia, may be more likely to replace dysfunctional catheters before CS, and may use other maneuvers to avoid GA, such as manipulating the epidural catheter before drug administration, or performing another neuraxial technique. Riley reported that obstetric anesthesiologist had more success than the general anesthesiologist in conversion; he postulated that the former may be more likely to allow time for the development of an appropriate sensory level rather than opting for early use of GA.[27] Further, obstetric anesthesiologist may be able to capitalize on the familiarity with their obstetric colleagues to determine the urgency of delivery.[34]

The findings of the study are limited by a number of considerations. First, the data was taken from file notes one day after delivery. Second, while calculating the data on mode of delivery for patients without epidural, use of alternative analgesia was not taken into account which although not the study objective, but could have reflected on the effect of analgesia for patients delivering without EA. Third, the quality of surgical anesthesia and the need for supplemental analgesia for patients done with an extension of LE was not included. Fourth the results on an individual level provider were not analyzed.

Hence, it is concluded that there is no effect of LE on the rate of CS; however, the rate of instrumental vaginal delivery was doubled in our unit which is in accordance with the reported literature. Furthermore, a high rate of failure was found to convert LE for surgical anesthesia and factors associated with it were urgency of CS, inadequate pain relief during labor and non- obstetric anesthesiologist.

Therefore, it is recommended to improve awareness among patients regarding the use of epidural analgesia and remove the misconception that LE increases the rate of CS; however, they should be informed about the possible risk of AVD. There is a need of communication between obstetrician, nurses and anesthesiologist for patients at high risk of CS. The obstetric anesthesiologist should ideally be involved in the management of these patients to replace or manipulate the epidural catheter not providing adequate analgesia. Use of correct local anesthetic incorrect concentration is very important for the success of surgical anesthesia. The top up can be given in the labor room provided adequate provision is made regarding the remote risk of high block and weighing it with the balanced risk of complications resulting from emergency GA.

References

1. Hawkins JL. Epidural analgesia for labor and delivery. N Engl J Med 2010;362:1503-10.
2. Wong CA, Scavone BM, Peaceman AM, McCarthy RJ, Sullivan JT, Diaz NT, *et al.* The risk of cesarean delivery with neuraxial analgesia given early versus late in labor. N Engl J Med 2005;352:655-65.
3. Studd JW, Crawford JS, Duignan NM, Rowbotham CJ, Hughes AO. The effect of lumbar epidural analgesia on the rate of cervical dilatation and the outcome of labour of spontaneous onset. Br J Obstet Gynaecol 1980;87:1015-21.
4. Ramin SM, Gambling DR, Lucas MJ, Sharma SK, Sidawi JE, Leveno KJ. Randomized trial of epidural versus intravenous analgesia during labor. Obstet Gynecol 1995;86:783-9.
5. Anim-Somuah M, Smyth RM, Jones L. Epidural versus non-epidural or no analgesia in labour. Cochrane Database Syst Rev 2005; 12:CD000331.
6. Kinsella SM. A prospective audit of regional anaesthesia failure in 5080 Caesarean sections. Anaesthesia 2008;63:822-32.
7. Russell I. Technique of anaesthesia for cesarean section. In: Colvin J, editor. Raising the Standard: A Compedium of Audit Recipes. London: The Royal College of Anaesthetists; 2000. p. 6-8.
8. Russell I. Technique of anaesthesia for caesarean section. In: Colvin J, editor. Raising the Standard: A Compedium of Audit Recipes for Continuous Quality Improvement in Anaesthesia. 2nd ed. London: RCA; 2006. p. 166-7.
9. Ismail S, Shafiq F, Malik A. Technique of anaesthesia for different grades of caesarean section: A cross-sectional study. J Pak Med Assoc 2012;62:363-7.
10. Hillyard SG, Bate TE, Corcoran TB, Paech MJ, O'Sullivan G. Extending epidural analgesia for emergency Caesarean section: A meta-analysis. Br J Anaesth 2011;107:668-78.
11. Liu EH, Sia AT. Rates of caesarean section and instrumental vaginal delivery in nulliparous women after low concentration

epidural infusions or opioid analgesia: Systematic review. BMJ 2004;328:1410.

12. Leighton BL, Halpern SH. The effects of epidural analgesia on labor, maternal, and neonatal outcomes: A systematic review. Am J Obstet Gynecol 2002;186:S69-77.

13. Sharma SK, McIntire DD, Wiley J, Leveno KJ. Labor analgesia and cesarean delivery: An individual patient meta-analysis of nulliparous women. Anesthesiology 2004;100:142-8.

14. Sharma SK, Alexander JM, Messick G, Bloom SL, McIntire DD, Wiley J, *et al.* Cesarean delivery: A randomized trial of epidural analgesia versus intravenous meperidine analgesia during labor in nulliparous women. Anesthesiology 2002;96:546-51.

15. Halpern SH, Muir H, Breen TW, Campbell DC, Barrett J, Liston R, *et al.* A multicenter randomized controlled trial comparing patient-controlled epidural with intravenous analgesia for pain relief in labor. Anesth Analg 2004;99:1532-8.

16. Anim-Somuah M, Smyth RM, Jones L. Epidural versus non-epidural or no analgesia in labour. Cochrane Database Syst Rev 2011;CD000331.

17. Segal S, Su M, Gilbert P. The effect of a rapid change in availability of epidural analgesia on the cesarean delivery rate: A meta-analysis. Am J Obstet Gynecol 2000;183:974-8.

18. Wong CA. The influence of analgesia on labor — is it related to primary cesarean rates? Semin Perinatol 2012;36:353-6.

19. Eriksen LM, Nohr EA, Kjaergaard H. Mode of delivery after epidural analgesia in a cohort of low-risk nulliparas. Birth 2011;38:317-26.

20. Floberg J, Belfrage P, Ohlsén H. Influence of the pelvic outlet capacity on fetal head presentation at delivery. Acta Obstet Gynecol Scand 1987;66:127-30.

21. Hashim N, Naqvi S, Khanam M, Jafry HF. Primiparity as an intrapartum obstetric risk factor. J Pak Med Assoc 2012;62:694-8.

22. Zhang J, Troendle J, Mikolajczyk R, Sundaram R, Beaver J, Fraser W. The natural history of the normal first stage of labor. Obstet Gynecol 2010;115:705-10.

23. Fawole AO, Fadare O. Influence of parity on the partographic management of labour in a Nigerian tertiary hospital. Niger Postgrad Med J 2008;15:234-7.

24. Hess PE, Pratt SD, Soni AK, Sarna MC, Oriol NE. An association between severe labor pain and cesarean delivery. Anesth Analg 2000;90:881-6.

25. Alexander JM, Sharma SK, McIntire DD, Wiley J, Leveno KJ. Intensity of labor pain and cesarean delivery. Anesth Analg 2001;92:1524-8.

26. Campbell DC, Tran T. Conversion of epidural labour analgesia to epidural anesthesia for intrapartum Cesarean delivery. Can J Anaesth 2009;56:19-26.

27. Riley ET, Papasin J. Epidural catheter function during labor predicts anesthetic efficacy for subsequent cesarean delivery. Int J Obstet Anesth 2002;11:81-4.

28. Lee S, Lew E, Lim Y, Sia AT. Failure of augmentation of labor epidural analgesia for intrapartum cesarean delivery: A retrospective review. Anesth Analg 2009;108:252-4.

29. Halpern SH, Soliman A, Yee J, Angle P, Ioscovich A. Conversion of epidural labour analgesia to anaesthesia for Caesarean section: A prospective study of the incidence and determinants of failure. Br J Anaesth 2009;102:240-3.

30. Albright GA, Forster RM. The safety and efficacy of combined spinal and epidural analgesia/anesthesia (6,002 blocks) in a community hospital. Reg Anesth Pain Med 1999;24:117-25.

31. McClure JH, Cooper GM, Clutton-Brock TH, Centre for Maternal and Child Enquiries. Saving mothers' lives: Reviewing maternal deaths to make motherhood safer: 2006-8: A review. Br J Anaesth 2011;107:127-32.

32. Wee MY, Brown H, Reynolds F. The national institute of clinical excellence (NICE) guidelines for caesarean sections: Implications for the anaesthetist. Int J Obstet Anesth 2005; 14:147-58.

33. Popham P, Buettner A, Mendola M. Anaesthesia for emergency caesarean section, 2000-2004, at the Royal women's hospital, Melbourne. Anaesth Intensive Care 2007;35:74-9.

34. Bauer ME, Kountanis JA, Tsen LC, Greenfield ML, Mhyre JM. Risk factors for failed conversion of labor epidural analgesia to cesarean delivery anesthesia: A systematic review and meta-analysis of observational trials. Int J Obstet Anesth 2012; 21:294-309.

Author Help: Reference checking facility

The manuscript system (www.journalonweb.com) allows the authors to check and verify the accuracy and style of references. The tool checks the references with PubMed as per a predefined style. Authors are encouraged to use this facility, before submitting articles to the journal.

- The style as well as bibliographic elements should be 100% accurate, to help get the references verified from the system. Even a single spelling error or addition of issue number/month of publication will lead to an error when verifying the reference.
- Example of a correct style
  Sheahan P, O'leary G, Lee G, Fitzgibbon J. Cystic cervical metastases: Incidence and diagnosis using fine needle aspiration biopsy. Otolaryngol Head Neck Surg 2002;127:294-8.
- Only the references from journals indexed in PubMed will be checked.
- Enter each reference in new line, without a serial number.
- Add up to a maximum of 15 references at a time.
- If the reference is correct for its bibliographic elements and punctuations, it will be shown as CORRECT and a link to the correct article in PubMed will be given.
- If any of the bibliographic elements are missing, incorrect or extra (such as issue number), it will be shown as INCORRECT and link to possible articles in PubMed will be given.