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Epidural Analgesia for Labour Pain - Effect of Change in the Catheter length in the Epidural Space

[1]Gemavat Mahavir, Consultant Anaesthesiologist, Department of Anaesthesia, Yas Clinic, Abu Dhabi

[2]Gemavat Honey, Assistant Professor, Department of Obstetrics & Gynaecology, Lokmanya Tilak Medical College, Mumbai, India

[3]Ajoy Raj Malape, Consultant Anaesthesiologist, Department of Anaesthesia, Yas Clinic, Abu Dhabi

[4]M Khashaba, Consultant Anaesthesiologist, Department of Anaesthesia, Yas Clinic, Abu Dhabi

Corresponding Author: Gemavat Mahavir, Consultant Anaesthesiologist, Department of Anaesthesia, Yas Clinic, Abu Dhabi

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Abstract

The study is aimed to determine the optimal length of the epidural catheter for pain relief during childbirth. We conducted a prospective, randomised, double-blind study involving 240 women in active labour who requested epidural anaesthesia. The expectant women were divided into three groups: one group had the catheter threaded 3 cm into the epidural space, another group had it threaded 4 cm, and the third group had it threaded 5 cm. The study found that the group with the catheter inserted 4 cm into the epidural space had the highest success rate of analgesia and the lowest incidence of complications. The 3-cm group had a slightly higher incidence of incomplete analgesia, possibly due to catheter dislodgement, while the 5-cm group had the highest incidence of incomplete analgesia. The study suggests that inserting the multiorifice epidural catheter 4 cm into the epidural space using a cranially directed needle orifice at the L2-3 or L3-4 interspace provides the best pain relief and reduces complications during labour.

Keywords: Epidural, Labour, Parturients, Anaesthesia

Introduction

Pain caused by uterine contractions and cervical dilatation is comparable to the pain caused by amputation of a finger. Hence woman in labour has all the rights to get the relief from this pain of childbirth. (1) Though various methods are being used to relieve the labour pain, Epidural Analgesia remains the gold standard for analgesia in labour and is recommended by WHO(2). In the USA around 60 % of all the women in labour receive Epidural Analgesia for the labour pain.

At our institute about 46.15 % of women in labour requested for Epidural Analgesia in 2014. (3)

Placing the epidural catheter in place at the required level for desired effects remains the technically most challenging part of the procedure. In Spite of being done by the most experienced person, complications are not uncommon during the placement of the epidural needle or threading of the epidural catheter into the epidural space and failure rate may be as high as 8% (4). This may be attributed to poor technique, but may also be due to the abnormal placement of the epidural catheter passed through a successfully placed epidural needle. Such abnormal placement includes blocked, kinked or bent catheters, deviation through an intervertebral foramen, passage into an epidural vein, the subdural or the subarachnoid space.

In a study done by Doughty et al (1974) it was proposed that suboptimal placement of the epidural catheter within the epidural space may account for a significant number of the cases with inadequate pain relief. (5)

The causes of neuraxial labour analgesia failure include inaccurate initial epidural needle placement, suboptimal catheter siting upon threading, catheter migration within the epidural space during labour, problematic neuraxial anatomy of the parturient, or an unpredictably fast labour (6). Improper positioning of an epidural catheter is a well known problem. The length of the catheter that has been threaded beyond the tip of the epidural needle into the epidural space can be measured.

There is always a debate as to optimum catheter length to be thread into the epidural space for maximal analgesia and minimum complications. With insufficient catheter beyond needle tip there is always a possibility of catheter getting dislodged out of the epidural space and with excess placement of catheter there is possibility of inadequate or unilateral effect as the catheter may migrate sideways in the epidural space.

Hence, there was always a need to find the optimal length of epidural catheter in the epidural space for best results. One study was conducted by Yakov et al on 150 parturients with multiorifice epidural catheter and they suggested 5 cm catheter placement in the epidural space for optimal pain relief (7).

Some recommendations are to thread between 1 cm and 3 cm of catheter into the epidural space to decrease the likelihood of catheter malposition (8,9), but no data are presented in support of this. The recommendation was probably reached because of studies which documented that "too much catheter" threaded into the epidural space impacts negatively on the quality of the block (10).

Hence, we decided to conduct this study with 240 parturients requesting epidural analgesia during labour. Our aim was to further optimise the catheter placement in the epidural space to maximise the pain relief and to further reduce the complications and chances of inadequate pain relief.

The optimal length is defined as the length of catheter that when threaded beyond the tip of the epidural needle into the epidural space, is associated with the highest success rate in terms of producing analgesia and the lowest complication rate.

Method

This study was conducted at HMG Takhasusi Hospital, Riyadh, Saudi Arabia in the year 2014. The study protocol was approved by the Hospital Ethics Committee.

This prospective, randomised double blind study was conducted on 240 parturients in active labour, who were having contractions at least once every five minutes and who requested an epidural anaesthetic for relief of

labour pain. The mothers were aged between 21-38 years. All women with coagulopathies, having spinal column disorders (scoliosis and herniated discs) and those who have undergone spinal surgeries were also not included in the study. Also excluded from the study were the women with morbid obesity (BMI > 40). A written and informed consent was obtained from the parturients.

When the patient requested an epidural anaesthetic for labour analgesia she was randomly assigned to one of three groups. Women in Group I had the epidural catheter threaded 3 cm into the epidural space. Women in Group II had the epidural catheter threaded 4 cm into the epidural space, and women in Group III had the epidural catheter threaded 5 cm into the epidural space.

An intravenous solution of 500 ml of Ringer's Lactate was given to all the patients prior to performing the epidural analgesia. Procedure was done with the patient in a sitting position. An ultrasonographic examination of the lower back is done to identify the interspinous space (L2-3, L3-4) and depth of epidural space and marked.

With all aseptic precautions an 18G Touhy needle was used and epidural space was reached with loss-of-resistance-to-air technique at the L2-3 or L3-4 interspace. Ten ml of Normal Saline was injected into the epidural space. A 20-gauge multiorifice catheter (Portex) was threaded through the cranially directed tip of the epidural needle to a length according to group assignment. During insertion of the catheter, the occurrence of paresthesias and intravenous or subarachnoid location of the catheter were noted. Even though there were no specific instructions given, the anesthesiologist who inserted the catheter made an effort to use the minimum length necessary. This ensured that once the epidural needle was removed, the catheter would still be positioned 3, 4, or 5 cm within the epidural space. In case there was excess catheter left in the epidural space, it was retracted to achieve the desired length. If there was insufficient catheter remaining within the epidural space, the patient would have been excluded from the study, but fortunately, this situation did not arise. All epidural anaesthetics were initiated in the presence of another anesthesiologist who confirmed both the position of the catheter and the occurrence of any complication.

While the patient was still sitting, attempts to aspirate blood or cerebrospinal fluid from the catheter were made using a 3-mL syringe. If there was no aspirate, a 3-mL test dose of 0.1 % Ropivacaine without epinephrine was administered through the catheter. The presence of clinical signs of an intravascular injection were sought for the following 2-3 min by asking the patient whether she felt dizzy, had tinnitus, or had a metallic taste in her mouth. If there were no signs of an intravascular injection, the catheter was then secured with a Lockit Plus Trademark (Portex). The epidural site dressed with Tegaderm transparent dressing and tape and the patient placed in the supine position with left lateral uterine displacement. Five minutes after the test dose, if there were also no clinical signs of a subarachnoid injection, as evidenced by the patient's ability to move her legs and the absence of hypotension, an additional 10 mL of 0.1 % Ropivacaine mixed with 20 mcg Fentanyl was administered, in two divided doses 5 min apart. If the epidural catheter was placed into the intravascular or subarachnoid space, the catheter was removed and the procedure repeated at a different interspace. The epidural infusion of 0.1 % Ropivacaine with Fentanyl 2mcg/ml was started at the rate of 12 ml / hr. Epidural infusion rate was titrated between 12-20 ml per hour as per the pain assessment and hemodynamic condition of

the patient. Patient was monitored after the procedure. Any hypotension, if occurred, was promptly treated.

The adequacy of the resultant analgesia was assessed 15 min after the starting of epidural infusion by a second anesthesiologist who does not know about the patient's group assignment. Qualitative analgesia was assessed by asking the patient whether she felt any pain at the peak of a contraction and to point to the location of the pain. She was told to indicate only if she had pain, not pressure. The height of the sensory block and any unanesthetized area was assessed with ice and motor power was assessed by asking the patient about any new or unusual weakness of their limbs.

Confirmed unsatisfactory sensory blockade was classified as complete (failed epidural) if the patient had no areas of sensory blockade, and incomplete if the patient had "missed segments." All patients who had satisfactory analgesia were observed for the remainder of their labour in order to detect subsequent failures. Results were analysed with the Wilcoxon tests and Chi squared tests where appropriate to examine for differences among the groups. Differences were considered statistically significant at $P < 0.05$; data are expressed as mean +/- SD.

Results

1. The heights or weights among the three groups of patients were comparable. The Lumbar interspace used in all the groups were similar and were L2-3 or L3-4. (Table 1).

Table 1

2. There were 256 epidural catheter placements for the 240 women enrolled in the study. During catheter placement, there was a 36.72 % incidence of paresthesias, 0% incidence of subarachnoid location, and a 7.42 % incidence of intravenous placement of catheter, being highest in frequency ($P < 0.05$) in the 5-cm group. All intravenously placed catheters were detected by the presence of blood in the catheter, and not by eliciting clinical signs after administration of test or bolus dose of Ropivacaine 0.1%. Also, all intravenous catheter placements and paresthesias occurred during the first attempt at placement and not when the catheters were reinserted. No patient had a failed epidural.

Table 2

3. Overall, there was a 7.81 % incidence of incomplete analgesia with the lowest rate ($P < 0.05$) in the 4-cm group (Table 2). Two patients had an epidural fail after having a successful block initially, one in Group I (3-cm group) and another in Group III (5 cm). This occurred approximately 2 & 3 h after its placement and having a successful block initially.

Incomplete analgesia in Group I (5.63 %) is marginally more than Group II (4.49 %). However, incomplete analgesia was highest in Group III (13.92%).

Discussion

Following the insertion of an epidural catheter and the administration of local anaesthetic, there may be a segment that remains unblocked due to insufficient spread of the anaesthetic within the epidural space. This can be attributed to variations in epidural anatomy in some cases, but it is primarily caused by suboptimal positioning of the catheter within the space.

Suboptimal positioning of the epidural catheter is a common occurrence (11).

Bridenbaugh et al. conducted radiographic studies and found that only approximately 12% of epidural catheters directed in a cephalad direction reached the intended anatomical levels. They observed that 21% of catheters formed a terminal loop, 48% coiled at the insertion site, and 5% went in a caudad direction or migrated through

an intervertebral foramen. However, they did not correlate the failure rate of the anaesthetic with the position of the catheter (12).

Another study by Sanchez et al. also utilised radiographic studies and demonstrated that the majority of epidural catheters (53%) did not follow the intended course. They recommended the use of radiography to determine the location of the catheter in cases of incomplete epidural analgesia. However, this recommendation is impractical for labouring women. Nonetheless, it is feasible to measure the length of the catheter threaded into the epidural space (13)

There are currently two commonly used types of catheters: multiorifice and single-orifice. The single-orifice catheter has one hole at the end, while multiorifice catheters differ in terms of the distance between the most proximal hole and the tip, as well as the spacing between holes. In our study, we used a multiorifice catheter with three side-ports arranged at 120-degree intervals, spaced 4 mm apart, and with the first hole located 6 mm from the tip. Similarly, catheters from other manufacturers would also not function properly if threaded only 1 cm into the epidural space.

Several studies have compared the success rates and complication rates of the two types of catheters, but they have not considered the effect of varying the length of catheter threaded into the epidural space on the resulting analgesia. Only one study has evaluated the impact of varying the amount of catheter threaded into the epidural space, and it was specifically focused on the single-orifice catheter (14).

In our study, none of the patients experienced complete failure of the epidural; all failures were of the incomplete variety. We found that patients with catheters threaded 4 cm into the epidural space had the lowest incidence of incomplete analgesia (6.3%). It is possible that the catheters sited at 3 cm may have been dislodged enough that the proximal hole was no longer within the epidural space, which is consistent with the findings of another study. This study also reported that catheters have a tendency to migrate further into or out of the epidural space after being secured. They recommended inserting catheters more than 3 cm into the epidural space. Dislodgment of the catheter could also explain the subsequent failure experienced by one patient in the 3-cm group. The catheters placed at 5 cm may have migrated out through an intervertebral foramen.

Conclusion

To sum up our findings, we discovered that among women in labour, the highest success rate of analgesia with 0.1% Ropivacaine was observed in those who had multiorifice epidural catheters (Portex) inserted 4 cm into the epidural space using a cranially directed epidural needle orifice at the L2-3 or L3-4 interspace. In comparison, women with catheters inserted 3 or 5 cm into the epidural space had lower rates of successful analgesia. Moreover, the 4-cm group experienced a lower incidence of epidural anaesthesia complications compared to the 5-cm group, while their complication rate was similar to the 3-cm group. Although our study focused exclusively on Portex Registered Trademark catheters, we believe that similar results would be obtained with other brands that have multi-orifice catheters designed similarly to the ones we utilised. Based on our findings, we recommend threading multi-orifice epidural catheters 4 cm into the epidural space for women in labour for the best results with minimum complications.

References

1. Hawkins J. Epidural analgesia for labour and delivery. N Engl J Med. 2010;362:1503-1510.
2. Ashagrie, Henos Enyew, Demeke Yilkal Fentie, and Habtamu Getinet Kassahun. "A review article on epidural analgesia for labour pain management: A systematic review." International Journal of Surgery Open 24 (2020): 100-104.
3. Leighton, Barbara L., and Stephen H. Halpern. "The effects of epidural analgesia on labour, maternal, and neonatal outcomes: a systematic review." American journal of obstetrics and gynaecology 186, no. 5 (2002): S69-S77.
4. DUCROW M. The occurrence of unblocked segments during continuous lumbar epidural analgesia for pain relief in labour. British Journal of Anaesthesia 1971; 43: 11724
5. Doughty A. A precise method of cannulating the lumbar epi- dural space. Anaesthesia 1974;29:63—5.
6. Arendt K, Segal S. Why epidurals do not always work. Rev Obstet Gynecol. 2008 Spring;1(2):49-55. PMID: 18769661; PMCID: PMC2505163.
7. Beilin, Yaakov MD; Bernstein, Howard H. MD; Zucker-Pinchoff, Barbara MD. The Optimal Distance That a Multiorifice Epidural Catheter Should Be Threaded into the Epidural Space. anaesthesia & Analgesia 81(2):p 301-304, August 1995.
8. Brown DL. Spinal, epidural and caudal anaesthesia. In: Miller RD, ed. anaesthesia. 4th ed. New York: Churchill Livingstone, 1994:1522—5.
9. Shnider SM, Levinson G, Ralston DH. Regional anaesthesia for labour and delivery. In: Shnider SM, Levinson G, eds. anaesthesia for obstetrics. 3rd ed. Baltimore: Williams & Wilkins, 1993: 135—53.
10. Kumar CM, Dennison B, Lawler PGP. Excessive dose requirements of local anaesthetic for epidural analgesia. How far should an epidural catheter be inserted? Anaesthesia 1985;40: 1100 —2.
11. Usubiaga JE, Dos Reis A, Usubiaga LE. Epidural misplacement of catheters and mechanisms of unilateral blockade. Anesthesi- ology 1970;32:158—61.
12. Bridenbaugh LD, Moore DC, Bagdi P, Bridenbaugh PO. The position of plastic tubing in continuous-block techniques: an x-ray study of 552 patients. Anesthesiology 1967;29:1047—9.
13. Sanchez R, Acuna L, Rocha F. An analysis of the radiological visualisation of the catheters placed in the epidural space. Br J Anaesth 1967;39:485—9.
14. D'Angelo R, Berkebile B, Gerancher JC. Does epidural catheter insertion length make a difference? [abstract] Anesthesiology 1994;81:A1124

Legend Tables

Table 1: Maternal Characteristics and Insertion Sites of the Epidural Needle

		Groups			
		Group I	Group II	Group III	Overall
Insertion Depth (cm)	cm	3	4	5	
No. of patients		81	83	76	240
Avg Height (cm)*	cm	159.23 ± 3.2	161.15±2.8	160.71±1.5	160.23±3.2
Avg Weight (kg)*	Kg	75.53±13.30	75.03±10.89	74.70±12.22	75.09±13.30
BMI	$Kg.cm^{-2}$	29.78	28.89	28.92	29.24
Insertion Site					
	L 2-3	53	47	42	142
	L 3-4	28	36	34	98

Average Height, Average Weight, and Average BMI are expressed as mean

Table 2: Maternal Characteristics and Insertion Sites of the Epidural Needle

		Groups			
		Group I	Group II	Group III	Overall
Insertion Depth (cm)	cm	3	4	5	
Number of patients		81	83	76	240
Number of catheters inserted		88	89	79	256
Redo Insertion		7(8.64%)	6(7.23%)	3(3.95%)	16(6.67%)
Parasthesia		28(31.82%)	30(33.71%)	34(43.04%)	94(36.72%)
Intravenous Location *		3(3.41%)	4(4.49%)	12(15.19%)	19(7.42%)
Intrathecal Location *		0	0	0	0
Incomplete Analgesia #		5(5.68%)	4(4.49%)	11(13.92%)	20(7.81%)
Inadvertent Lumbar Puncture		2(2.27%)	3(3.37%)	1(1.27%)	6(2.34%)
Failed Epidural					
Initially					
Subsequently		1	0	1	2

*Based on total numbers of catheter inserted

#Based on total numbers of patients