

A Clinical Audit on Technical Difficulties during Epidural Catheter Placement

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ABSTRACT

Introduction: Epidural catheter placement is a routinely performed invasive procedure conducted by anaesthesiologist's world over. A functional epidural catheter improves, not only the quality of anaesthesia but also patient satisfaction. Placing an epidural catheter is a skill which has its own set of technical difficulties.

Aim: To conduct an audit to study the common technical difficulties faced during epidural catheter placement and their management.

Material and Methods: The audit was conducted by evaluating the responses to a structured, self-administered questionnaire consisting of 10 questions distributed to post-graduate students, senior residents and consultants working in the Department of Anaesthesiology and Intensive care at a tertiary care centre in New Delhi during June 2017. The questions pertained to the respondent's years of experience in Anaesthesiology and their

response and management of the common technical difficulties encountered during epidural catheter placement.

Results: Out of a total of 111 respondents, 64.86% had less than 5 years and 13.51% had more than 10 years of experience in the field of anaesthesiology. Almost 92% used air for locating the epidural space by the Loss Of Resistance (LOR) technique. Varied responses were obtained regarding difficulties in catheter advancement and management of presence of CSF or blood in the catheter and regarding the use and benefits of placing an intrathecal catheter and the duration of keeping an intrathecal catheter in situ. Only 2.70% had experienced shearing of an epidural catheter and in all the cases, this was during catheter removal in the postoperative period.

Conclusion: There are no standard guidelines available for management of technical difficulties encountered during epidural catheter placement and this audit identified certain lacunae in knowledge and management of these difficulties.

Keywords: Catheter migration, Dural puncture, Regional anaesthesia, Shearing

INTRODUCTION

Epidural catheter placement is one of the most routinely performed procedures in anaesthesia practice. However, placing an epidural catheter is an invasive procedure with its own set of complications [1]. Although the advent of ultrasound has helped anaesthesiologists in identifying the epidural space in patients with difficult anatomical landmarks, it is not used routinely for all epidural cannulations.

Through the observations from the present study at the centre made us realise that some of the practices followed by working anaesthesiologists could prove harmful to the patient. We reviewed the literature and to the best of our knowledge there has been no audit conducted regarding technical difficulties faced during epidural catheter placement. There are no standard guidelines formulated by any anaesthesiologist society giving recommendations on management of technical difficulties faced during an epidural catheter placement. The most commonly encountered technical problems like an inadvertent dural puncture or a bloody tap while threading a catheter can be managed in a lot of different ways [1]. However, there is no consensus on which technique is better over the other which not only creates confusion but also puts the patient at risk of epidural related complications which otherwise can be warded off. Whilst these difficulties are usually handled by the concerned anaesthesiologist performing the procedure depending on their level of experience and clinical judgement, improper management of these problems may result in considerable postoperative morbidity. Hence, the audit was conducted in a tertiary care hospital where the working anaesthesiologists were questioned about the difficulties faced during epidural catheter placement and how they circumvented these difficulties.

MATERIAL AND METHODS

An audit was conducted at tertiary care hospital in New Delhi, in order to analyse the technical difficulties encountered by anaesthesiologists while placing a lumbar epidural catheter in an unanaesthetised patient in sitting position. A structured, self-administered questionnaire pertaining to technical difficulties while epidural catheter placement was distributed to all post-graduate students (n=29), senior residents (n=72) and consultants (n=30) working at a single tertiary care hospital. In the study, the 1st year post-graduate students and the consultants who formulated the questionnaire from the audit were excluded. The anonymity of the person filling the proforma was ensured. The questionnaire was prepared and validated by a departmental committee comprising of four senior anaesthesiologists with more than 10 years of experience in the field of anaesthesiology and consisted of ten questions pertaining to the technical problems encountered during epidural catheter placement with primary focus on the most common problems namely dural puncture, intravascular placement and catheter shearing and the management of these problems. The audit was undertaken to assess the knowledge and current practices in anaesthesia and, if required, suggest pertinent modifications to current practice after reviewing the literature in order to prevent complications in the future.

The first question was on the years of experience that the respondent had in the field of anaesthesiology. The second question enquired about the preferred medium (air, saline, air and saline mixture) for locating the epidural space using the Loss of Resistance (LOR) technique. The next three questions were related to accidental dural puncture either by the epidural needle or epidural catheter and management of the same.

These were followed by questions regarding the accidental intravascular placement of the epidural catheter, how this was managed and how correct placement of catheter was finally achieved. The last few questions were about any experience of catheter shearing and how this was managed. And last but not the least, the respondents were asked whether they had ever encountered difficulty while removing the catheter and if they had, then what was their plan of management. A database was then created and the questions were analysed.

RESULTS

A total of 111 anaesthesiologist consisting post-graduate students, senior residents and consultants participated in the audit. While the questionnaire was distributed to 29 post-graduate students, 72 senior's residents and 30 consultants, a total of 111 filled proformas were received back. The anaesthesiologists were between 24 to 62 years of age of either sex. To maintain the anonymity, the person filling the proforma was required to fill their respective designation only. The demographic profile would not have any role in this audit and hence was not included in the proforma. The questionnaire with responses obtained is in [Table/Fig-1].

Only 13.51% of the respondents had experienced encountering resistance while trying to remove an epidural catheter. All of them experienced this resistance at the time of catheter removal in the postoperative period. They were able to remove the catheter once the patient was asked to flex the spine and relax.

Of the 111 respondents, only 3 (2.70%) had experienced shearing of the epidural catheter i.e., absence of an intact tip after withdrawal and in all cases this was at the time of catheter removal in the postoperative period. No anaesthesiologist had ever experienced shearing of the catheter tip during the procedure of epidural placement.

Also, some of the results have been discussed in the discussion section and wherever relevant they have been correlated with the years of experience.

DISCUSSION

Despite improvements in the type and quality of epidural catheters, some technical difficulties still persist. Without the use of ultrasound guidance epidural cannulation is essentially a blind procedure and certain procedural difficulties are encountered by the practising anaesthesiologist. These problems are not unusual or uncommon and we decided to conduct an audit to study how trainee and consultant anaesthesiologists handle the commonly encountered problems faced during epidural catheter placement.

The audit revealed that 91.89% respondents used air as the medium of choice for locating the epidural space, while only 8.10% used a mixture of air and saline. No one used only saline for locating the epidural space. Both air and fluid can be used as a medium for localising the epidural space using the LOR technique. One of the reasons cited for reluctance in using saline is historical; until the nineteen seventies syringes were made of glass and were non-disposable. Fluid made the syringes sticky and hence it was replaced by air [1,2]. Although historically air has been used, it is associated with certain complications suggesting a need to move over to either saline alone or saline with a small bubble of air [2]. The reported incidence of dural puncture using LOR with saline is lower as compared to that with air [2]. Studies, where saline has been used, report an incidence of 0.3 -0.5%, whereas while using air, the incidence can be as high as 2% [2-4]. The reason cited is that when using saline the epidural space is entered with continuous pressure on the plunger of a saline filled syringe which pushes the dura away thereby reducing the incidence of dural puncture [2]. In the literature, many other complications pertaining to the use of air in the epidural space have been documented [3,4]. These include patchy blockade, spinal cord and nerve root

Question	Re-sponse (%)	Num-bers
How many years of experience do you have in Anaesthesiology? a) <5 years b) 5-10 years c) >10 years	64.86 21.62 13.51	72 24 15
For locating the epidural space by LOR technique do you use? a) Air b) Saline c) Air and saline mixture	91.89 0 8.10	102 0 9
In the event of an accidental dural puncture with the epidural needle, what do you do? a) Immediately withdraw the needle completely b) Withdraw the needle till CSF flow ceases and then attempt to pass the epidural catheter c) Place a catheter intrathecally and use it as a spinal catheter d) Place a catheter intrathecally but do not administer any drugs through it	51.35 0 37.83 10.81	57 0 42 12
In the event of an accidental dural puncture while threading the epidural catheter, what do you do? a) Place the catheter intrathecally and use for spinal anaesthesia b) Place the catheter intrathecally but do not administer any drugs through it c) Remove the entire epidural needle-catheter assembly and reattempt epidural catheterisation at a different level d) Remove the epidural needle and slowly withdraw the catheter till CSF flow ceases and give test dose e) Withdraw the catheter through the needle and then try to pass the epidural catheter again	59.45 8.10 29.72 0 2.70	66 9 33 0 3
If you have placed the epidural catheter intrathecally, when do you remove it? a) At the end of the surgery b) After 12-24 hrs c) After 24-48 hrs d) After 36-48 hrs	35.13 5.40 35.13 24.32	39 6 39 27
After locating the epidural space at a depth of about 4cm and threading the epidural catheter till about the 14 cm mark, the catheter doesn't advance any further. What will you do? a) Ask the patient to take a deep breath and try to advance the catheter b) Remove the entire needle catheter assembly and start the procedure again c) Withdraw the catheter through the needle; rotate the needle and then try to advance the catheter again d) Withdraw the catheter through the needle; inject saline via the epidural needle and then try to advance the catheter again e) Apply more force to thread in the catheter f) Rotate the epidural needle with the catheter in situ and then try to advance the catheter again	16.21 10.81 13.51 51.35 0 8.10	18 12 15 57 0 9
The epidural space is located at a depth of 4cm and the catheter is threaded till 18-20 cm mark when free flow of blood is seen in the catheter. What would you do? a) Remove the needle, flush the catheter and withdraw it till no blood is seen on aspiration and then secure it at the correct distance b) Remove the entire needle catheter assembly and start the procedure again at a different level c) Remove the needle catheter assembly and abandon the procedure	78.37 21.62 0	87 24 0
How do you confirm for "no blood on aspiration" in epidural catheter? a) Negative aspiration with a syringe b) By holding the catheter end below the level of insertion and seeing for free flow of blood c) Both	59.45 10.81 29.72	66 12 33
Have you ever encountered resistance while attempting to remove an epidural catheter? a) Yes b) No c) If yes, how did you manage?	13.51 86.48	15 96
Has the end of your epidural catheter ever sheared off? a) Yes b) No c) If yes : During procedure/ Postoperative removal	2.70 97.29	3 108

[Table/Fig-1]: Questionnaire and responses obtained.

compression, retroperitoneal air, subcutaneous emphysema, venous air embolism and pneumocephalus [3]. Of the 8.10% (nine respondents) who used a saline and air mixture for localising the

epidural space, seven had less than five years of experience in the field of anaesthesiology and were perhaps more aware and updated about more current practices.

An accidental dural puncture by an epidural needle is a common mishap, likely to be committed by many anaesthesiologists during their training period. This may occur either during the identification of the epidural space with the epidural needle or during the passage of the catheter with a properly placed needle in the epidural space. The results of this audit revealed that if this happened with the needle while identifying the epidural space, the majority of anaesthesiologists (51.35%) withdrew the needle reflexly in the event of an accidental dural puncture while 48.65% placed the epidural catheter intrathecally as a spinal catheter. Of those respondents who placed the catheter intrathecally, 10.81% used the spinal catheter intraoperatively by giving heavy bupivacaine.

A spinal catheter may also be used to provide postoperative analgesia using intrathecal opioids. Also, the residual hole in the dura created by the large bore epidural needle may lead to a severe Post Dural Puncture Headache (PDPH). If performance of the neuraxial block was technically difficult due to patient positioning, obesity, age, difficult landmarks etc., and if neuraxial block is indicated and has definite advantages in that particular patient it may be wise to thread the catheter intrathecally and provide continuous spinal anaesthesia. This also serves to plug the dural hole preventing leakage of CSF and subsequent PDPH. While placing an epidural catheter intrathecally, it is essential to label the catheter as an intrathecal catheter and manage it accordingly while maintaining complete asepsis [5].

A catheter in the subarachnoid space allows repeated administration of drugs as necessary to maintain the level and prolong the duration of sensory and motor block as is commonly done in epidural anaesthesia. An additional benefit is the use of lower doses of Local Anaesthetic (LA) and hence a lower incidence of LAST (Local Anaesthetic Systemic Toxicity). Earlier microcatheters (27 gauge and smaller) for use in continuous spinal anaesthesia were introduced but were subsequently withdrawn from clinical practice in the United States following reports of Cauda Equina Syndrome (CES) associated with their use [6]. It has been suggested that the injury associated with the use of microcatheters resulted from a combination of maldistribution of drug and the repetitive injection of LA solution. The slow injection of drug through a microcatheter led to a pooling of LA in the dependent sacral sac and an inadequate block height. Repeated injections in an attempt to achieve an adequate block height resulted in neurotoxic concentrations of LA in the caudal region of the subarachnoid space [6]. However, the maldistribution of LA is not restricted to either microcatheters or lidocaine, and similar injuries have been reported with the use of larger bore catheters and other LAs [6]. This may explain the concerns of some of the respondents who although placed the catheter for prevention of PDPH, did not inject any LA through it. However, with appropriate use of drugs and techniques and adequate precautions, CES is now rare.

A recent review from Sweden analyzed severe neurologic complications following neuraxial anaesthesia from 1990 to 1999. During that period an estimated 1,250,000 spinal and 450,000 epidural blocks were performed, including about 200,000 epidurals in labour. CES was reported in 32 cases: 18 of them after spinal block and only 2 after continuous spinal anaesthesia [7]. It may however be wise to exercise certain precautions when using a catheter for continuous spinal anaesthesia. These include insertion of the catheter just far enough to confirm and maintain placement; use of the lowest effective dose of LA and limiting the total dose of LA used; administering of a test dose and assessing the extent of any sensory and motor block; use of maneuvers to increase the spread of LA (change of patient position, alteration of the lumbosacral curvature, switching to a solution with a different

baricity) and if a well-distributed sensory anaesthesia is not achieved before the dose limit is reached it may be sensible to abandon the technique [8].

In a similar way, if accidental dural puncture occurs while threading the epidural catheter, it is important to emphasise that at any point of time, it is not recommended to withdraw the epidural catheter into the needle because this may lead to shearing or transection of the epidural catheter and retention of the sheared tip in situ [8,9].

There have been many studies which studied the intrathecal placement of an epidural catheter in event of unintentional dural puncture and found that placing the catheter for more than 24 hours decreased the incidence of PDPH [9-11]. Ayad S et al., studied 115 parturients for labour analgesia over 5 years duration who were divided into 3 groups [9]. In one group an epidural catheter was placed, the second group had a subarachnoid catheter which was removed immediately after the delivery, and the third group had a subarachnoid catheter that was left in place for 24 hours after delivery. On comparing the incidence of PDPH between the groups, it was found that Intrathecal Catheter Placement (ITCP) after accidental dural puncture in obstetric patients decreases the incidence of PDPH and does so to a greater extent if the catheter is left in situ for 24 hours after its placement.

There are two hypothesis which have been proposed to explain the role of ITCP in preventing PDPH. The first hypothesis proposes that the subarachnoid catheter plugs the dural hole, decreases and stops the leak of CSF thereby helping to maintain the intrathecal CSF volume [10]. The second hypothesis is that the catheter incites an inflammatory reaction in the dura surrounding it which hastens the healing of the dural puncture and prevents the leak of CSF [11]. However in a meta-analysis, Heesen M et al., challenged the inflammatory theory stating that in animal studies the inflammatory response was observed 19-21 days after catheter placement and materials used for manufacturing these catheters are supposedly inert and ideally they should not incite any tissue reaction in the human body [12]. Apfel CC et al., in their meta-analysis suggested that ITCP significantly reduced the need for an epidural blood patch but there was no significant reduction in the incidence of PDPH [13]. In a prospective study over a period of 4 years, Jadon A et al., studied the incidence of PDPH and found a significant decrease in incidence of PDPH when the catheter was left intrathecally for more than 24 hours [14].

Another common problem faced with epidural catheter placement is, inability to advance the catheter to the desired depth, even after the epidural space is located. It is recommended that following identification of the epidural space, the catheter is advanced 3 to 5 cm beyond the tip of the needle positioned in the epidural space. However, at times after locating the epidural space, it is not possible to advance the catheter sufficiently and there is not a sufficient length of catheter in the epidural space so that the anaesthesiologist can withdraw the epidural needle leaving adequate catheter length in situ. In such a scenario, it is likely that the epidural catheter is either hitting a blood vessel, a nerve root or any bony structure. It is recommended that in such a situation one should ask the patient to take a deep breath, thereby increasing the negative pressure in the epidural space and so facilitating the passage of the catheter into the epidural space [15].

At times blood may be seen in the needle/catheter during the procedure. It is important to exclude unintentional intravascular placement of the catheter after epidural cannulation. Commonly an aspiration test is performed to rule this out. However, aspiration may fail to identify a proportion of intravascular catheters. Aspiration with the bacterial filter in situ is likely to fail if both air and liquid are present within the filter [16]. However, removal of the bacterial filter for this purpose increases the risks of bacterial contamination. If the tip of the catheter is lying inside a blood vessel, aspiration using a syringe may lead to a collapse of the vessel and a false negative

test so perhaps holding the catheter tip below the level of insertion and checking for free flow of blood into the catheter may be more reliable to rule out intravascular placement.

The meniscus test described by Shah JL utilises a fluid meniscus in the epidural catheter as a tool for confirmation of correct localization of epidural space [17]. In the event of correct placement of the epidural catheter, raising the distal end of the catheter 30 cm above the point of insertion should make the fluid meniscus fall and when lowered 30 cm below the insertion point, a clear fluid (as opposed to blood) should be visible. The third and final step described by Shah JL [17] involved injecting 1 mL of air prior to the 2 mL of saline to fill the catheter, so that the presence of air bubbles within the fluid in the later step may differentiate it from cerebrospinal fluid. Trojanowski A et al., in their study reported the Shah test or meniscus test to have a sensitivity of 97.4% and specificity of 100%, but no comment was made on the power of the study [18]. The present study also failed to address the effect on the test of differing epidural pressures with changes in posture or of the influence of pregnancy and intrauterine contractions [18].

There is no single optimal way of testing for intravenously placed epidural catheters. No single method is 100% sensitive and there is always the possibility that catheters may migrate from the epidural space. There are many pharmacological test doses using drugs like adrenaline, lidocaine, bupivacaine, 2-chloroprocaine, fentanyl and isoproterenol described in literature to detect intravascular catheter placement but we are discussing procedural problems. Therefore, there is no substitute for continued vigilance and the administration of LA in an incremental fashion.

Shearing of the tip may occur if the catheter is withdrawn into the needle during placement or may occur during removal if excessive pressure is applied and the tip shears off to be left in situ. While 13.51% respondents had experienced difficulty while removing an epidural catheter, this was overcome by asking the patient to relax, take a deep breath and increase spine flexion to widen the intervertebral space and help in removal of the catheter. If shearing of epidural catheter does occur, it should be documented in the records and the patient should also be informed. The catheter material is inert and there does not seem to be any indication for surgical intervention in the absence of symptoms [19-22].

LIMITATION

This audit was conducted in a single tertiary centre. A multicentre audit can provide with more knowledge on the current practices followed by anaesthesiologists in different institutions. In the present, the audit dealt only with the very common technical difficulties and there are many more aspects of epidural anaesthesia which still needs to be discussed in length like test dose and its significance.

CONCLUSION

Epidural catheter placement is routinely practiced. However all anaesthesiologists tend to differ in their approach to manage common technical difficulties experienced during epidural catheter

placement. This audit was conducted to bring to light the practices followed by anaesthesiologists in a tertiary care hospital and to suggest approaches to manage these technical difficulties after reviewing the literature. Certain changes in practice are suggested in order to improve performance and lessen any morbidity associated with placement of an epidural catheter. With growing knowledge and rising incidence of medicolegal issues, one should always be careful and alert and imbibe practices which have a scientific reasoning.

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