

## COMPARISON OF EPIDURAL CATHETER TIP PLACEMENT BETWEEN MEDIAN AND PARAMEDIAN TECHNIQUES WITH FLUOROSCOPY



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### ABSTRACT

**Introduction:** The installation of an epidural catheter can be performed by median or paramedian techniques with the aim of positioning the epidural catheter tip posterior to the epidural space. The goal of this study was to compare the location and position of the epidural catheter tip placed by the median technique compared to the paramedian technique by using fluoroscopy method.

**Patients and Methods:** Fifty patients aged 18-65 years who underwent lower abdominal surgery and lower extremities surgery are classified into two groups by consecutive sampling. The first group consists of those who were inserted epidural catheter by median technique approach, and the second group by paramedian technique

approach. From the fluoroscopy imaging, the catheter position was classified into one of the following: anterior, posterior, and lateral.

**Result:** In median approach, the epidural catheter tip were placed 16% anteriorly, 20% posteriorly, and 64% laterally. In the paramedian approach, the epidural catheter tip were placed 4% anteriorly and 96% posteriorly. The paramedian approach is more superior to median technique in terms of expected epidural catheter tip position ( $p < 0.001$ , RR 4.8, CI95%=2.183-10.556).

**Conclusion:** Placement of the catheter tip in the epidural space using paramedian technique is a better option than the median technique.

**Keywords:** regional anesthesia, median approach, paramedian approach, meningeal ligament, dorsomedial connective tissue

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### INTRODUCTION

Epidural anesthesia has turned into an important breakthrough in neuraxial anesthesia and analgesia, since James Leonard Corning first described the procedure in 1885.<sup>1,2</sup> Epidural anesthesia, which can be administered by a single injection or multiple injections through the use of a catheter, uses local anesthetics that administered into the epidural space to produce a reversible loss of sensory and motoric function. It may be used as a sole anesthetic or combined with general anesthesia to produce the desired effect.

The epidural catheter allows adding local anesthetics during the course of surgery, thus extending the duration of local anesthetics.<sup>3</sup> Epidural anesthesia also plays a role in reducing or eliminating the physiologic stress response to surgery, thus decreasing surgical complications and improving patient outcome.<sup>4-7</sup>

The success rate of epidural block technique varies between reports. Katircioglu et al.<sup>8</sup> reported a success rate of 97% in 20,572 cases of cesarean delivery. Introna et al.<sup>9</sup> reported a higher success rate at 99.79%. Other reports stated higher failure rates ranging from 13-41%, each with its own definition of epidural block failure.<sup>10-20</sup>

Proposed factors influencing epidural block include anatomical catheter location and tip placement, patient position, puncture site, puncture approach technique, localization of epidural space, catheter insertion and fixation, and inadequate equipment.<sup>10-14,16,19-20</sup> A correct positioning of the epidural catheter has always been a challenge even in professional hands due to the blind nature of the procedure.

Two common approaches for epidural puncture are midline (median) and paramedian. By examining the direction of epidural catheter tip Bloomberg concluded that the paramedian technique has several advantages than median technique. The paramedian approach is known to cause less tenting compared to the median. It also passes cephalad more reliably than the midline catheters.<sup>10,21</sup> Less time consuming for catheter insertion was also reported in paramedian approach.<sup>21,22</sup> Other advantages for the paramedian approach include less dependence upon spine flexion and fewer complications in non-pregnant adults.<sup>23</sup> There are only a few studies so far comparing the median and paramedian approach to block success.

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The use of fluoroscopy and contrast after epidural catheter placement allows us to determine the position of the epidural catheter tip: posterior, anterior, lateral, or coiled. This study aims to compare the success rate of epidural catheter placement between the median and paramedian technique by fluoroscopy.

## PATIENTS AND METHODS

This was a prospective single-blinded study about epidural catheter tip placement. The study was conducted from January to March 2018 at Sanglah General Hospital in Bali Island, Indonesia. This study was approved by the Committee of Ethical Research of Udayana University. All subjects provided a written consent to be included in this study.

The subject's inclusion criteria included patients in the age of 18-65 years old who underwent elective lower extremity orthopedic or lower abdomen surgical procedure, body height of 150 -170 cm, and body mass index (BMI) of 18,5 to 29,99 kg/m<sup>2</sup>. Exclusion criteria included a history of allergy to contrast or bupivacaine and the presence of contra-indication to epidural catheter placement. Subjects with failed epidural catheter placement procedure were excluded from the study.

Subjects were divided into two groups. The first group (M group) consisted of subjects with the median technique catheter placement. The second group (P group) consisted of those with the paramedian technique catheter placement. All subjects in both groups received similar treatment of premedications. The subjects were put in a lateral position during the epidural catheter insertion procedure.

The insertions were performed in the lumbar vertebra 2-3 or 3-4 by one similar person to avoid inter-operator variability. The catheter was directed

to the cephalad course for 5 cm. After the catheter was placed, a test dose was administered to ensure the catheter is in the epidural space. We used 3 ml solution of 1.5% lidocaine and 1:200,000 epinephrine as a test dose. After the procedure, all subjects were given 1 ml of fluoroscopy contrast dye to determine the position of the tip and catheter level in the epidural space with C-arm. From the imaging, the catheter position was categorized into one of the following three: anterior, posterior, and lateral.

Data were analyzed by using SPSS 22 for Windows. Chi-square and Mann-Whitney tests were used to analyze the data where a p-value of <0.05 was considered significant.

## RESULTS

A total of 50 patients were enrolled in this study. The characteristics of the eligible subjects are presented in [Table 1](#). No subjects developed allergy reaction to the contrast. No subjects were dropped out during the course of this study.

[Table 2](#) shows a comparison of catheter tip location after epidural catheter insertion between two groups. By interpreting that the posterior position is the correct and desired position, we can see that the paramedian technique is superior to the median technique in achieving the correct epidural catheter position ( $p < 0.001$ ).

While in theory the catheter tip, when inserted for 5 cm, will be expected at around two corpus vertebrae segments from the location where it was inserted, the subjects in the median group had the catheter tip located in poorly expected position compared to the paramedian group ( $0.76 \pm 0.66$  vs.  $1.76 \pm 0.43$  corpus vertebrae segments,  $p < 0.001$ ). The comparison between these results along with its relative risk is displayed in [Table 3](#).

**Table 1** Subjects' characteristics

| Variable                                     | Treatment Group          |                            |
|--|--------------------------|----------------------------|
|  | Median group<br>(N = 25) | Paramedian group<br>(N=25) |
| Sex  |                          |                            |
| -Male, n (%)                                 | 10 (40)                  | 14 (56)                    |
| -Female, n (%)                               | 15 (60)                  | 11 (44)                    |
| Age, years (mean±SD)                         | 42.1±1.39                | 43.7± 1,15                 |
| Weight, kg (median, min-max)                 | 60 (45-80)               | 56.5 (45-75)               |
| Height. cm (median, min-max)                 | 160 (150-170)            | 160 (150-170)              |
| Body mass index, kgm <sup>-2</sup> (mean±SD) | 22.78±2.78               | 21.97±2.34                 |

**Table 2** Comparison of epidural catheter tip position in both groups by fluoroscopy

| Variable   | Median<br>N = 25 | Paramedian<br>N=25 | p-value              |
|--|------------------|--------------------|----------------------|
| Tip position   |                  |                    |                      |
| -Anterior, n (%)   | 4 (16)           | 1(4)               |                      |
| -Posterior, n (%)  | 5 (20)           | 24 (96)            | <0.001 <sup>a</sup>  |
| -Lateral, n (%)  | 16 (64)          | 0 (0)              |                      |
| Distance from insertion point (corpus vertebrae segment) | 0.76±0.66        | 1.76±0.43          | < 0.001 <sup>b</sup> |

<sup>a</sup>Chi-square test, <sup>b</sup>Mann-Whitney test

**Table 3** Comparison of final tip position between the two groups by fluoroscopy

| Variable                               | Median<br>N=25 | Paramedian<br>N=25 | p-value             | RR  | CI 95%       |
|--|----------------|--------------------|---------------------|-----|--------------|
| Expected position <sup>a</sup> , n (%) | 5 (20)         | 24 (96)            | <0.001 <sup>c</sup> | 4.8 | 2.183-10.556 |
| Malposition <sup>b</sup> , n (%)       | 20 (80)        | 1 (4)              |                     |     |              |

<sup>a</sup>Defined as when the catheter tip position is at two corpus vertebrae segments higher than insertion point.

<sup>b</sup>Defined as when the expected position is not reached.

<sup>c</sup>Chi-square test.

## DISCUSSION

Assessment of epidural catheter position in patients receiving epidural anesthesia or epidural analgesia rarely receives special attention and usually confirmed with a test dose to ensure that the epidural catheter is not in the subarachnoid space nor in the blood vessels. The additional methods of assessing the position of the catheter tip and its level in the spine will be helpful in increasing the success of anesthetic or analgesic blocks. A new technique that is easy-to-do, noninvasive, real-time, and with no additional costs may provide better results in assessing the catheter tip location.

Determining the position of the epidural catheter by fluoroscopy can provide qualitative data. By using contrast dye in fluoroscopy we were able to get a better view of the position of the epidural catheter and its level in the corpus vertebrae.

The expected position when placing an epidural catheter is at the posterior of the epidural space and as close as possible to the target dermatomes of the surgical field to optimize its effects in analgesia. In our study, the group who had median technique approach, 16% of the subjects had the catheter tip placed anteriorly, while the other 20% and 64% were placed posteriorly and laterally, respectively. In the paramedian technique approach, 96% of the subjects had it placed posteriorly, while only 4% were placed anteriorly.

This is in accordance with the previous study by Blomberg<sup>21</sup> where 14 catheters installation by median techniques obtained 2 catheters led to expected direction, 1 catheter led to the opposite direction, and 11 catheters led to the lateral direction. The same study also reported that all 14

catheters inserted by the paramedian technique are placed at the expected target.

This result can occur because of the dorsomedial connective tissue is a factor that makes the duramater more rigid so when the catheter tip went through it, this connective tissue may make the catheter direction varied. The paramedian technique has a better result because between the epidural needle tip and the duramater will form an angle of 120-135° so that the catheter tip would not get in touch the duramater and the possibility of knock over dorsomedian connective tissue is also smaller.

This study also showed that the catheter tip in the paramedian group is closer to the target than the median group (1.76±0.43 vs. 0.76±0.66). This may happen because of the chance that the epidural catheter underwent coiling inside the epidural space. The risk factors include the type of catheter material and the catheter tip design. The risk of coiling is increased when the catheter is inserted in the epidural space for >5 cm. This study used polyamide-type catheters which are said to be rigid enough to avoid coiling with a soft-tip catheter design. Uchino<sup>22</sup> reported that the lateral catheter deviation is easy to occur on soft-tip design. Jiang<sup>23</sup> reported his anatomical assessment of epidural lumbar by performing epidural catheter on cadavers. By median technique approach, 50 cadavers were inserted an epidural catheter. Three cadavers had a coiling epidural catheter, 2 had a lateral direction in the intervertebral foramen, and 5 entered the venous plexus. He concluded that inadequate epidural techniques in approaching the targeted

spinal level are due to the presence of meningovertebral ligament or dorsomedian connective tissue.

## CONCLUSION

The paramedian technique is a better option for insertion of epidural catheter compared to the median technique. The paramedian technique also reached the expected level in the medulla spinalis better compared to the median technique.

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