Original Article

Incidence of Accidental Dural Perforation, Sanguineous Puncture, and Unsuccessful Catheter Placement and Their Predictors During Epidural Catheterization: A Prospective Observational Study

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ABSTRACT

BACKGROUND

Epidural anaesthesia is widely used for perioperative analgesia, yet immediate complications such as accidental dural perforation (ADP), sanguineous puncture (SP), and unsuccessful catheter placement (UCP) remain clinically significant. This study aimed to determine their incidence and identify associated predictors.

METHODS

This prospective observational study was conducted over one year in a tertiary care centre. Adult patients undergoing epidural catheterization were included. A total of 117 epidural attempts in 100 patients were analysed. Patient- and procedure-related variables were assessed using chi-square test and logistic regression.

RESULTS

The incidence of SP, ADP, and UCP was 3.4%, 2.6%, and 8.5%, respectively. UCP was the most frequent complication. Age ≥50 years ($p < 0.001$) and use of a 16G needle ($p = 0.002$) were significantly associated with complications.

CONCLUSIONS

Immediate complications during epidural catheterization are influenced by patient age and needle size. Use of smaller gauge needles and careful technique in elderly patients may reduce complication rates.

KEY WORDS

Epidural anaesthesia, dural puncture, catheter failure, complications

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INTRODUCTION

Epidural anaesthesia is a cornerstone of modern anaesthetic practice, providing effective intraoperative anaesthesia and postoperative analgesia for a variety of surgical procedures.[1–3] Its benefits include superior pain control, reduced opioid consumption, and improved recovery outcomes.[2,3]

Despite these advantages, epidural catheterization is associated with complications. While serious complications such as epidural hematoma and neurological injury are rare,[4–6] immediate complications during needle insertion and catheter placement occur more frequently and can significantly impact procedural success.[7–9]

Among these, sanguineous puncture (SP), accidental dural perforation (ADP), and unsuccessful catheter placement (UCP) are the most commonly encountered. Their incidence varies widely depending on patient population, operator experience, and procedural techniques.[9–11]

Most existing literature focuses on obstetric populations, with limited data from general surgical patients, particularly in resource-limited settings. Identifying predictors of these complications is essential to improve safety and outcomes.

This study was therefore undertaken to evaluate the incidence of immediate complications during epidural catheterization and to identify associated risk factors.

METHODS

This prospective observational study was conducted over a period of one year after obtaining institutional ethical approval. Written informed consent was obtained from all participants.

Adult patients (≥18 years) undergoing epidural catheterization were included. Patients with contraindications such as coagulopathy, infection at the puncture site, spinal deformity, or refusal to participate were excluded. Obstetric patients were excluded.

Baseline demographic data including age, sex, and body mass index were recorded. Epidural catheterization was performed under standard aseptic precautions using a Tuohy needle. Procedural variables such as needle size, patient positioning, approach, level of insertion, technique, and performer were documented.

Each epidural attempt was considered an independent observation, resulting in 117 observations.

Immediate complications were defined as follows: SP as blood aspiration, ADP as cerebrospinal fluid leakage, and UCP as failure to establish epidural catheterization.

Statistical analysis was performed using chi-square test and logistic regression. A p-value <0.05 was considered statistically significant.

RESULTS

A total of 117 epidural catheterization attempts were analysed. The baseline characteristics of the study population are presented in Table 1. The majority of patients (58.1%) were aged ≥50 years, with males constituting 65.8% of the cohort.

Table 1. Baseline characteristics

Variable	Category	n (%)
Age (years)	<30	22 (18.8)
	30–39	13 (11.1)
	40–49	14 (12.0)
	≥50	68 (58.1)
Sex	Male	77 (65.8)
	Female	40 (34.2)
Body mass index (kg/m²)	<18.5	16 (13.7)
	18.5–24.9	94 (80.3)
	≥25	7 (6.0)

The incidence of immediate complications is summarized in Figure 1. Unsuccessful catheter placement was the most common complication, occurring in 8.5% of attempts. Sanguineous puncture was observed in 3.4% of cases, while accidental dural perforation occurred in 2.6% of cases. No complication was recorded in 85.5% of attempts.

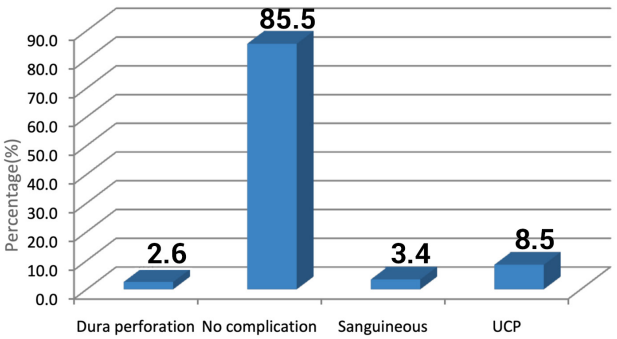

Figure 1: Bar chart showing incidence of Accidental Dural perforation (ADP), Sanguineous puncture (SP), and Unsuccessful Catheter Placement (UCP) during epidural catheterization.

Further analysis demonstrated a significant association between age and complication rates. Patients aged ≥50 years had a markedly higher incidence of complications, with 25% experiencing at least one complication, whereas no

complications were observed in patients aged <50 years. This difference was statistically significant (p < 0.001).

The relationship between patient- and procedure-related variables and complications is presented in Table 2. The use of a 16G needle was associated with a significantly higher incidence of complications compared to an 18G needle (31.3% vs 8.2%, p = 0.002). Logistic regression analysis demonstrated that the use of a 16G needle increased the odds of complications by more than fivefold.

Table 2. Factors associated with complications

Other variables, including sex, BMI, patient position, approach, technique, level of puncture, and performer experience, did not show statistically significant associations with complications.

Variable	Category	Complication Present n (%)	Complication Absent n (%)	p-value
Age	<50 years	0 (0.0)	49 (100.0)	<0.001*
	≥50 years	17 (25.0)	51 (75.0)	
Sex	Female	5 (12.5)	35 (87.5)	0.653
	Male	12 (15.6)	65 (84.4)	
BMI (kg/m²)	<18.5	2 (12.5)	14 (87.5)	1.000
	18.5–24.9	14 (14.9)	80 (85.1)	
	≥25	1 (14.3)	6 (85.7)	
Needle size	16G	10 (31.3)	22 (68.8)	0.002*
	18G	7 (8.2)	78 (91.8)	
Position	Sitting	17 (14.8)	98 (85.2)	1.000
	Lateral	0 (0.0)	2 (100.0)	
Approach	Midline	17 (15.5)	93 (84.5)	0.261
	Paramedian	0 (0.0)	7 (100.0)	
Technique	LOR air	16 (14.2)	97 (85.8)	0.471
	Others	1 (25.0)	3 (75.0)	
Level	Lumbar	9 (17.3)	43 (82.7)	0.446
	Thoracic	8 (12.3)	57 (87.7)	
Performer	Faculty	2 (15.4)	11 (84.6)	0.973
	PG II	9 (13.8)	56 (86.2)	
	PG III	6 (15.4)	33 (84.6)	

DISCUSSION

This study evaluated the incidence and predictors of immediate complications during epidural catheterization in a non-obstetric population. The findings indicate that such complications are relatively common and are influenced by both patient-related and procedural factors.

The incidence of SP and ADP observed in this study is consistent with previously reported literature.[7–9,12] Meyer-Bender et al. reported similar rates of dural puncture, while Tanaka et al. documented comparable rates of vascular puncture.[8,12] These findings support the validity of the present results.

However, the incidence of UCP was higher than that reported in earlier studies.[9,10,13] This may be explained by differences in study population, operator experience, and inclusion of multiple attempts. Pan et al. highlighted that neuraxial block failure is influenced by both anatomical and technical factors.[10]

A key finding of this study is the significant association between increasing age and complication rates. Age-related degenerative changes such as reduced intervertebral space, ligament calcification, and altered anatomy may contribute to increased technical difficulty.[14–16] Similar findings have been reported by Hollister et al. and Connolly et al.[11,17]

The association between larger needle size and increased complications is another important observation. Larger bore needles may increase tissue trauma and risk of dural puncture.[18] This represents a modifiable risk factor with important clinical implications.

The lack of association between BMI and complications in

this study contrasts with some reports suggesting increased difficulty in obese patients.[19] However, other studies have reported similar findings, suggesting that BMI alone may not be a reliable predictor.[7]

Operator experience did not significantly influence complication rates, possibly due to supervision and standardized training. Previous studies have shown mixed results regarding this factor.[20,21]

Emerging evidence suggests that ultrasound guidance may improve success rates and reduce complications, particularly in difficult cases.[22]

CONCLUSION

Immediate complications during epidural catheterization are relatively common. Advanced age and larger needle size are significant predictors. Use of smaller needles and increased vigilance in elderly patients may reduce complication rates.

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