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Factors associated with post-dural puncture headache following spinal anesthesia at HU PZAGA Mahajanga (Madagascar)

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Abstract

Introduction: Post-dural puncture headache is a common complication of spinal anesthesia and may impair postoperative recovery. This study aimed to evaluate the frequency of this headache and identify associated factors among patients undergoing spinal anesthesia at University Hospital Professor ZAFISAONA Gabriel Mahajanga.

Methods: This was a prospective case-control study conducted over a ten-month period from June 1, 2023, to March 31, 2024. All patients older than 15 years who underwent surgery under spinal anesthesia were included. Cases were defined as patients who developed post-dural puncture headache within seven postoperative days, whereas controls were patients without headache. Associations were assessed using odds ratios (OR) with 95% confidence intervals.

Results: Among the 427 patients who underwent spinal anesthesia, 34 (7.96%) developed post-dural puncture headache. The mean age was 26.82 ± 6.01 years, with a female predominance. Emergency obstetric and trauma surgeries were the most frequently performed. Headaches were mainly frontal, of early onset, and mild to moderate intensity. The use of Quincke® needles (OR = 4.40; 95% CI: 1.62–12.10; $p < 0.01$), G22 needles (OR = 4.64; 95% CI: 1.08–19.39; $p = 0.026$), and two or more puncture attempts (OR = 3.12; 95% CI: 1.10–8.87; $p = 0.027$) were significantly associated with the occurrence of PDPH.

Conclusion: Post-dural puncture headache was a frequent complication of spinal anesthesia. The use of atraumatic needles and reduction in the number of puncture attempts could help decrease its incidence.

Keywords: Headache, Pain, Post-Dural Puncture, Spinal Anesthesia

Introduction

Spinal anesthesia is a widely used anesthetic technique in surgery because of its simplicity, effective analgesia, and low cost. Despite its many advantages, it may be associated with certain complications, among which post-dural puncture headache (PDPH) is one of the most common [1]. PDPH usually occurs within days following dural puncture and can significantly impair patient comfort [2]. Several factors influence the occurrence of PDPH [1, 3]. However, data regarding this complication remain limited, particularly in Madagascar. The aim of this study was to evaluate the frequency of PDPH and identify associated factors among patients undergoing surgery under spinal anesthesia in our university hospital.

Methods

Study Setting and Design

The study was conducted at the HUPZaGa in Mahajanga, Madagascar, which includes a surgical intensive care unit. This was a prospective case-control study based on individual interviews.

Study Period
The study was carried out over a ten-month period from June 1, 2023, to March 31, 2024.

Study Population
All postoperative patients who received spinal anesthesia and were admitted to surgical wards during the study period were eligible.

Inclusion Criteria
All patients aged over 15 years who underwent surgery under spinal anesthesia with bupivacaine 12.5 mg and fentanyl 25 µg were included. "Cases" were defined as patients who developed PDPH within seven postoperative days, while "controls" were patients without headache.

Exclusion Criteria
Patients who refused consent or were non-cooperative during postoperative follow-up were excluded.

Sampling Method
Exhaustive sampling was used for cases through structured individual questionnaires administered to postoperative patients who developed headaches after spinal anesthesia. Controls were selected using simple random sampling among patients without post-dural puncture headache (PDPH) during the same study period.

Sample Size
The sample consisted of all patients who developed headaches during the study period, totaling thirty-four cases (n = 34), and sixty-eight controls (n = 68), with a case-to-control ratio of 1:2.

Study Variables
- Epidemiological and clinical variables: age, sex.
- Surgery-related variables: elective or emergency surgery, type of surgery.
- Spinal anesthesia-related variables: number of puncture attempts, type of needle used, needle gauge.
- Headache-related variables: occurrence (yes/no), onset pattern (sudden or gradual), location, time of onset, intensity (assessed using a numerical scale or NRS: mild 1–3, moderate 4–6, severe >6), and impact on immediate postoperative recovery.

Data Entry and Analysis
Data entry and analysis were performed using IBM SPSS® Statistics version 26. Microsoft Word® and Excel® 2013 were used for text processing and graph preparation. Bivariate analyses were conducted between the dependent variable (PDPH) and independent variables. Associations were assessed using crude odds ratios (OR) with 95% confidence intervals. No multivariate analysis or logistic regression was performed. An odds ratio (OR) was interpreted as follows: OR > 1 indicates a risk factor, OR = 1 indicates no association, and OR < 1 indicates a protective factor.

Ethical Considerations
Prior to interviews, informed consent was obtained from each patient, while ensuring anonymity and confidentiality. All procedures respected human rights, freedom of opinion, and expression.

Study Limitations
This was a single-center study and therefore may not be fully generalizable to the broader Malagasy population.

Results
Among the 427 patients who underwent spinal anesthesia, 34 (7.96%) developed PDPH. Sixty-eight patients without PDPH were selected as controls. The mean age was 26.82 ± 6.01 years, with a minimum age of 17 and a maximum of 40 years. The male-to-female sex ratio was was 0.17 (Table 1).

Table 1: Patients characteristics

	Cases n (%)	Controls n (%)	OR [IC95 %]	P
Age				
15 à 35 years	30 (94,1)	45 (77,9)	3,83 [1,30–10,50]	0,04
Over 35 years	4 (5,9)	23 (22,1)		
Gender				
Female	32 (94,2)	55 (80,9)	3,78 [0,30–17,94]	0,07
Male	2 (5,8)	13 (19,1)		

Operative characteristics were comparable between cases and controls. Emergency procedures accounted for 52.9% of cases versus 51.4% of controls (OR = 1.06; 95% CI: 0.46–2.41; p = 0.88). Most surgical procedures lasted less than two hours in both groups (91.2% vs. 92.7%; OR = 1.21; 95% CI: 0.27–5.43; p = 0.79). Moreover, obstetric and trauma procedures were the most frequent surgical indication in both groups, with no significant difference in the distribution of surgical types (p = 0.95).
Headache onset was predominantly sudden, observed in 88.2% of patients. Frontal localization was the most frequent (50%), followed by fronto-occipital pain (41.2%). Regarding intensity, headaches were mainly mild according to the numerical rating scale (76.5%), while no patient reported severe pain (Table 2).

Table 2: Headache characteristics

	Number (n)	Percentage (%)
Mode of onset		
Sudden	30	88,2
Progressive	4	11,8
Time of onset		
Postoperative day 0 – 2	24	70,6
Postoperative day 3 – 5	10	29,4
Location		
Frontal	17	50
Occipital	3	8,8
Fronto-occipital	14	41,1
Intensity		
Mild (NRS < 3)	26	76,5
Moderate (NRS: 4–6)	8	23,5
Severe (NRS > 6)	–	–

The use of Quincke® needles (OR = 4.40; 95% CI: 1.62–12.10; p < 0.001), G22 needle gauge (OR = 4.64; 95% CI: 1.08–19.39; p = 0.026), and having two or more puncture attempts (OR = 3.12; 95% CI: 1.10–8.87; p = 0.027) were significantly associated with the occurrence of PDPH (Table 3).

Table 3: Données liées à la ponction rachidienne

	Cases n = 34 (%)	Controls n = 68 (%)	OR [IC95 %]	P
Needle type				
Quincke®	28 (82,3)	35 (51,4)	4,40 [1,62–12,10]	<0,01
Whitacre®	6 (17,6)	33 (48,5)		
Gauge				
G22	6 (17,6)	3 (4,4)	4,64 [1,08–19,39]	0,026
G25	28 (82,4)	65 (95,6)		
Number of puncture attempts				
Two or more	10 (29,4)	8 (11,7)	3,12 [1,10–8,87]	0,027
One attempt	24 (70,6)	60 (88,2)		

Discussion

The incidence of PDPH in our study was 7.96%. This rate is comparable to that reported in several international series, where the incidence of PDPH after spinal anesthesia generally ranges between 4% and 11%, but may be higher depending on the type of needle used and patient characteristics [4, 5]. This variability may be explained by methodological differences between studies, including the study population, needle gauge, and operator experience. In our setting, the predominant use of traumatic Quincke® needles may have contributed to the observed incidence.

In our study, patients who developed PDPH were predominantly young, with most being between 15 and 35 years of age. This finding is consistent with the literature showing that younger patients are at higher risk of PDPH (4–6). This increased susceptibility may be related to greater dural elasticity in younger individuals, leading to persistent cerebrospinal fluid leakage after puncture. Conversely, reduced dural elasticity in older patients may explain the lower incidence in this population.

A female predominance was observed in our series. This trend is frequently reported in the literature, particularly in studies involving a high proportion of obstetric patients [4, 6, 7]. Several physiological hypotheses have been proposed, including hormonal variations and increased sensitivity to cerebrospinal fluid pressure changes in women. However, in our study, female sex was not statistically associated with PDPH, possibly due to the limited sample size.

Obstetric procedures accounted for the majority of surgical interventions in our series, which may explain the high proportion of female patients. The literature indicates that obstetric patients are particularly exposed to PDPH due to the frequent use of spinal anesthesia for cesarean delivery [8, 9].

Regarding clinical characteristics, sudden onset of headache was observed in most patients, and symptoms occurred mainly between postoperative day 0 and day 2. These findings are consistent with international diagnostic criteria for PDPH, which describe symptom onset within five days after dural puncture, most commonly within 48 hours [4, 5, 10]. The frontal or fronto-occipital localization observed in our study is also typical of PDPH and may be explained by intracranial hypotension secondary to cerebrospinal fluid leakage [5, 6].

Most patients experienced mild to moderate headaches, and no severe cases were observed. This may partly be explained by the predominance of smaller-gauge needles in our series. However, several authors have reported that PDPH can significantly impair quality of life and delay postoperative recovery, particularly in postpartum patients [6, 11].

The use of Quincke® needles was significantly associated with PDPH in our study. This finding is consistent with the literature showing that cutting bevel (traumatic) needles increase cerebrospinal fluid leakage compared with atraumatic needles such as Whitacre® or Sprotte® (4–6). Atraumatic needles separate rather than cut dural fibers, thereby reducing the size of the dural defect and the incidence of PDPH.

Needle gauge was also significantly associated with PDPH. Patients who received a G22 needle had a higher risk compared with those who received a G25 needle. This is consistent with previous studies showing that larger needle diameters increase dural defect size and cerebrospinal fluid leakage (4-6). Current international recommendations encourage the use of fine and atraumatic needles to reduce PDPH incidence [10, 12].

In our series, two or more puncture attempts were also associated with PDPH. Multiple punctures increase dural trauma and may promote persistent cerebrospinal fluid leakage [5, 6]. This finding may also reflect technical difficulty or limited operator experience during spinal anesthesia.

This study has some limitations. It was a single-center study conducted in one hospital, which may limit the generalizability of the findings to the wider Malagasy population. Furthermore, the absence of multivariate analysis does not allow identification of independent risk factors for PDPH. Because only bivariate analysis was performed, potential confounding factors could not be controlled. However, this study provides valuable local data on a frequent complication of spinal anesthesia that remains underreported in our setting.

Conclusion

Post-dural puncture headache was a frequent complication of spinal anesthesia in our study. Young age, use of traumatic Quincke® needles, G22 needle gauge, and multiple puncture attempts were significantly associated with its occurrence. The use of atraumatic needles and minimization of puncture attempts may help reduce the incidence of PDPH in our setting.

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