Original Article

A Retrospective Study of Postdural Puncture Headache after Spinal Anesthesia for Cesarean Section Treated by Epidural Blood Patch: Incidence and Associated Factors

Ladda Permpolprasert BNS[1], Phongthara Vichitvejpaisal MD, PHD[1],
Saowapark Chumpathong MD[1], Pattrapun Wongsripuemtet MD[1]

[1] Department of Anesthesiology, Faculty of Medicine Siriraj Hospital, Mahidol University, Bangkok, Thailand

Objective: To investigate the incidence and characteristics of postdural puncture headache [PDPH] requiring epidural blood patch in patients undergoing cesarean section under spinal anesthesia and find out factors associated with early PDPH onset and peak PDPH.

Materials and Methods: This descriptive, retrospective study included patients who received spinal anesthesia for cesarean section and developed PDPH requiring treatment with epidural blood patch during a study period from January 2006 to July 2017. PDPH was diagnosed by an obstetric anesthesiologist. Collected data included demographic characteristics; types and sizes of spinal needles; PDPH features; spinal needle approach techniques (paramedian or midline approach); number of lumbar puncture attempts; operator experience levels; conservative treatment, volume of blood administered through an epidural space, and length of hospital stay.

Results: From a total of 35,290 parturients 77 patients who developed PDPH and required treatment with epidural blood patch were identified. Parturients had a mean age of 30.6±4.7 years, and a mean BMI of 27.8±6.0 kg/m^2. Most patients had the following features: PDPH occurring in both the occipital and frontal area (66.2%); receiving first attempt maneuver (58.1%); using 26 gauge (G) Quincke spinal needle (42.9%); and, being performed by 2nd-year resident (39.0%). Patients undergoing epidural blood patch had a mean length of hospital stay of 5.79±2.5 days, with a mean volume of blood administered through an epidural space of 13.08±3.5 mL. The association between early onset (0 to 1 postoperative day) or early peak (0 to 2 postoperative day) of PDPH and the investigated factors did not reach statistically significant level.

Conclusion: Of 35,290 parturients who underwent spinal anesthesia for cesarean section, 77 patients (0.2%) developed PDPH requiring treatment with epidural blood patch. No investigated factors were found to be significantly associated with PDPH onset or peak PDPH.

Keywords: Postdural puncture headache, Spinal anesthesia, Cesarean section, Epidural blood patch

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Spinal anesthesia is widely accepted as a regional anesthetic technique for cesarean section in many countries. Spinal anesthesia is safe for both mothers and newborns, with high satisfaction reported among obstetricians. Bloom et al surveyed 37,142 women who underwent cesarean section and found that 94% of the procedures were performed under regional anesthesia, as follows: 40% spinal, 42% epidural, and 12% combined spinal and epidural anesthesia[(1)].

Despite being regarded as a safe technique, spinal anesthesia is associated with some adverse events including high spinal block, nerve injury, and postdural puncture headache [PDPH]. PDPH is a complication of subarachnoid anesthesia that is of particular concern to the anesthesiologist, because the

Correspondence to:
Wongsripuemtet P. Department of Anesthesiology, Faculty of Medicine Siriraj Hospital, Mahidol University, 2 Wanglang Road, Bangkoknoi, Bangkok 10700, Thailand.
Phone: +66-2-4197978
E-mail: pattrapun_wong@hotmail.com

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dura puncture can result in continuous cerebrospinal fluid [CSF] leakage and gradual reduction in intracranial pressure. The incidence of PDPH varies according to the type of needle used with an association with cutting beveled spinal needles (Quincke 22g -30%) and larger Tuohy needles (52 to 100% with 16g and 55% with 18g). Smaller gauge pencil point needles have an incidence as low as 0.4 to 0.5%. Other potential risk factors include operator inexperience, needle bevel insertion perpendicular to the dural fiber orientation, multiple needle insertions, pregnancy, age, female gender, previous PDPH and for obese patients that body mass index [BMI] >35 kg/m^2 are less susceptible to PDPH and less likely to receive an epidural blood patch[2]. Chan et al found an incidence of PDPH of 0.26% among 65,348 parturients[3], while Bloom et al reported a rate of 0.18%[1]. Interestingly, a 2003 obstetric meta-analysis reported the risk of PDPH varied amongst spinal needles and ranged from 1.5% to 11.2%[4].

PDPH is characterized by severe headache that appears within 7 days following a lumbar puncture. It may be accompanied by other manifestations, such as tinnitus, hypoacusis, photophobia, nausea, and neck stiffness. PDPH can resolve spontaneously within 1 week after onset, or within 48 hours after treatment with an epidural blood patch. Other treatments include bed rest, analgesics, increased fluid intake, and caffeinated beverages. A few studies and some case reports have recommended oral and intravenous caffeine as a therapeutic option, although the recurrence of headache after caffeine treatment is frequent[5]. Though treatments for PDPH include both pharmacologic and non-pharmacologic regimens, a Cochrane review concluded that epidural blood patch was more effective than any other conservative treatment[6].

The aim of the present study was to investigate the incidence and patient characteristics in PDPH after spinal anesthesia for cesarean section treated by epidural blood patch, and factors that associate with PDPH onset and peak PDPH.

Materials and Methods

This descriptive, retrospective study was approved by the Siriraj Institutional Review Board [SIRB], Faculty of Medicine Siriraj Hospital, Mahidol University, Bangkok, Thailand (Si. 034/2012). Patients who received spinal anesthesia for cesarean section and developed PDPH which required treatment with epidural blood patch during the January 2006 to July 2017 study period were included. Patients with incomplete medical information were excluded.

PDPH was diagnosed by an obstetric anesthesiologist. Conservative treatment, including bed rest, fluid hydration greater than 3,000 ml/day, oral caffeine, and/or oral analgesia (e.g., paracetamol or non-steroidal anti-inflammatory drugs [NSAIDs]) was administered for 72 to 96 hours. In patients with symptoms that persisted after the described course of conservative treatment or that had a pain score (using verbal numerical rating score (VNRS; range 0 to 10) more than 4, a conventional epidural blood patch was applied in the operating theater. Data were obtained from the epidural blood patch record form and epidural blood patch procedure note. If any data were missing, the patient's medical chart was accessed to obtain the missing data.

Collected data included demographic characteristics, such as age, height, body weight, and BMI; type and size of spinal needle(s) used; PDPH features, including location and time of onset of headache, day of peak aching phenomenon, and associated symptoms; spinal needle approach technique (i.e., midline or paramedian approach); number of lumbar puncture attempts; level of operator experience; types of conservative treatment, volume of blood administered through an epidural space, and length of hospital stay.

In the present study, early onset PDPH was defined as the syndrome occurring within day 0 to 1 while the late onset PDPH occurring later beyond this date[5]. The peak of PDPH were defined as the day of the peak pain score of PDPH which classified into 2 groups the early (postoperative day 0 to 2) and the late group (postoperative day 3 to 5).

Statistical analysis

The sample size calculation was based on a previous study[1], which found a 0.18% incidence of PDPH after single-shot spinal anesthesia that required epidural blood patch. We estimated an incidence of epidural blood patch of 0.2%, with a 95% confidence interval [CI] of 0.15% to 0.25%. Our calculation yielded a minimum sample size of 30,671 parturients.

All data analyses were performed using PASW Statistics version 18.0 (SPSS, Inc., Chicago, IL, USA). Data are described as number and percentage or mean $\pm$ standard deviation. Chi-square test was used for categorical data to determine the difference between groups. Variables with a p-value <0.25 in univariate analysis and also interested variables were included into multiple logistic regression analysis. A p-value <0.05 was considered statistically significant.

Results

From a total of 98,374 deliveries, 41,925 (42.6%) women underwent cesarean section during January 2006 to June 2017. Of those, 35,292 parturients underwent cesarean section under spinal anesthesia. Two of those patients had incomplete medical information and were excluded. Of the 35,290 remaining patients, 77 patients (0.2%) who developed PDPH requiring an epidural blood patch were included in our final analysis.

Demographic data, spinal anesthesia details and clinical characteristics of the study population are shown in Table 1, 2. Parturients had a mean age of 30.6±4.7 years, and a mean BMI of 27.8±6.0 kg/m^2. Most patients who developed PDPH requiring epidural blood patch had the following characteristics: PDPH occurring at both the occipital and frontal area (66.2%); receiving first attempt maneuver (58.1%); using 26 gauge [G] Quincke spinal needle (42.9%); and, procedure performed by 2nd-year resident (39.0%). The non-pharmacologic treatment given to most patients consisted of bed rest, hydration, and analgesics. Patients undergoing epidural blood patch had a mean length of hospital stay of 5.79±2.5 days, with a mean volume of blood administered through an epidural space of 13.08±3.5 mL.

Forty-eight patients (61.7%) had onset of PDPH on the first postoperative day, and 94.8% of patients developed symptom by the end of postoperative day 2; however, only 45.5% of patients experienced peak effect of PDPH on the second day. In most cases in this study, epidural blood patch was administered on the third or fourth day after cesarean section. Patients experiencing early onset of PDPH and early peak of painful sensation had more pain than patients who had late onset and late peak (Table 3). After epidural blood patch, 39 patients (50.6%) had complete pain relieve (pain score 0), with the others having a pain score of 1 to 2. The overall success rate of epidural blood patch was 100%, and no second attempts were required.

Table 1. Demographic data of the study population and spinal anesthesia details (n = 77)

Parameters	
Age (year)	30.6±4.7
Weight (kg)	69.3±16.0
Height (cm)	157.9±5.7
BMI (kg/m^2)	27.8±6.0
ASA classification I, II	73 (94.8)
Spinal needle	
25 G Whitacre	2 (2.6)
25 G Quincke	11 (14.3)
26 G Quincke	33 (42.9)
27 G Quincke	31 (40.3)
Operator experience level	
First-year resident	9 (11.7)
Second-year resident	30 (39.0)
Third-year resident	32 (41.6)
Staff	5 (6.5)
Resident and staff	1 (1.3)
Number of lumbar puncture attempts (n = 74)	
1	43 (58.1)
2	14 (18.9)
3	12 (16.2)
4	3 (4.1)
≥5	2 (2.7)
Needle approach (n = 62)	
Midline	50 (80.6)
Paramedian	12 (19.4)

The data are presented as mean ± standard deviation or n (%)
BMI = Body mass index; ASA = American society of anesthesiologists; G = Gauge

Table 2. Clinical characteristics of the study population (n = 77)

Parameters	
Site of headache	
Frontal	11 (14.3)
Occipital	12 (15.6)
Occipital and frontal area	52 (67.5)
Not localized	2 (2.6)
Associated symptoms	
Nausea	15 (19.5)
Vomiting	12 (15.6)
Tinnitus	2 (2.6)
Conservative treatment	
Bed rest	65 (84.4)
Hydration	73 (94.8)
Analgesic drug	72 (93.5)
Caffeine	5 (6.5)
Volume of epidural blood patch (mL) (n = 56)	
<10	2 (3.6)
10 to 14	35 (62.5)
15 to 19	13 (23.2)
20	6 (10.7)
Back pain symptom during or after epidural blood patch (n = 75)	
None	55 (73.3)
Back pain	20 (26.7)

The data are presented as n (%)

Factors that affected early (postoperative day 0 to 1) and late (postoperative day 2 to 3) onset of PDPH are shown in Table 4. There was no correlation between onset of PDPH and patient's BMI, spinal needle size, needle approach, level of operator experience, or number of spinal attempts in univariate analysis. The factors that have been focused, patient's BMI and needle size, found no correlation in multivariate analysis.

Factors that affected early (postoperative day 0 to 2) and late (postoperative day 3 to 5) peak of PDPH are shown in Table 5. Univariate analysis revealed BMI >25 kg/m^2 and needle size 25, 26 G correlated with early peak of PDPH; however, these factors did not remain statistically significant in multivariate analysis.

Table 3. Onset and peak PDPH compared between pain scores

	Pain scores		*p*-value
	≤3 (n = 39)	>3 (n = 21)	
Onset PDPH			0.261
Day 0 to 1	22 (56.4)	15 (71.4)	
Day 2 to 3	17 (43.6)	6 (28.6)	
Peak PDPH			0.422
Day 0 to 2	18 (46.2)	12 (57.1)	
Day 3 to 5	21 (53.8)	9 (42.9)	

The data are presented as n (%)
PDPH = Postdural puncture headache

Discussion

This retrospective study revealed that 0.2% of parturients undergoing spinal anesthesia for cesarean section received epidural blood patch after developing PDPH. No factors were found to be significantly related with PDPH onset or peak PDPH.

Bloom, et al reported an incidence of PDPH after single-shot spinal anesthesia that required epidural blood patch of 0.18%[1], which is consistent with the findings of the present study. It should be noted that the true incidence of PDPH in our study population could not be conclusively determined. The anesthesiologist was notified only if the patient had severe symptom of headache or failed conservative treatment, and the postoperative anesthetic round at 24 hours could be too early to detect PDPH.

Regarding BMI, when there was critical pressure high enough to create CSF leakage, patients with higher BMI ≥25 kg/m^2) seemed to experience early peak PDPH that required epidural blood patch.

Table 4. Factors affect onset PDPH compared between the early and late onset groups

	Onset PDPH		Crude OR (95% CI)	*p*-value	Adjusted OR (95% CI)	*p*-value
	POD 2 to 3 (n = 23)	POD 0 to 1 (n = 37)				
Body mass index (kg/m^2)						
<25	10 (43.5)	13 (56.5)	1		1	
≥25	13 (35.1)	24 (64.9)	1.42 (0.5 to 4.1)	0.521	1.1 (0.4 to 3.5)	0.842
Needle size (gauge)						
27	13 (48.1)	14 (51.9)	1		1	
25, 26	10 (30.3)	23 (69.7)	2.1 (0.7 to 6.2)	0.163	2.1 (0.7 to 6.3)	0.204
Operator experience level						
R_3, staff	14 (45.2)	17 (54.8)	1			
R_1, R_2	9 (31.0)	20 (69.0)	1.8 (0.6 to 5.3)	0.311		
Spinal attempts						
1	15 (39.5)	23 (60.5)	1			
>1	8 (36.4)	14 (63.6)	1.1 (0.4 to 3.4)	0.825		
Needle approach						
Midline	20 (40.8)	29 (59.2)	1			
Paramedian	3 (27.3)	8 (72.7)	1.8 (0.4 to 7.8)	0.442		

The data are presented as n (%)
PDPH = Postdural puncture headache; POD = Postoperative day; OR = Odds ratio; CI = Confidence interval; BMI = Body mass index; R_3 = Third-year resident; R_2 = Second-year resident; R_1 = First-year resident

Table 5. Factors affecting early and late peak PDPH

	Peak PDPH		Crude OR (95% CI)	*p*-value	Adjusted OR (95% CI)	*p*-value
	POD 3 to 5 (n = 30)	POD 0 to 2 (n = 30)				
Body mass index (kg/m^2)						
<25	16 (69.6)	7 (30.4)	1		1	
≥25	14 (37.8)	23 (62.2)	3.8 (1.2 to 11.4)	0.021	2.9 (0.9 to 9.2)	0.072
Needle size (gauge)						
27	18 (66.7)	9 (33.3)	1		1	
25, 26	12 (36.4)	21 (63.6)	3.5 (1.2 to 10.2)	0.022	2.7 (0.9 to 8.3)	0.093
Operator						
R_3, staff	15 (48.4)	16 (51.6)	1			
R_1, R_2	15 (51.7)	14 (48.3)	0.9 (0.3 to 2.4)	0.801		
Spinal attempts						
1	20 (52.6)	18 (47.4)	1			
>1	10 (45.5)	12 (54.5)	1.3 (0.5 to 3.8)	0.592		
Needle approach						
Midline	26 (53.1)	23 (46.9)	1			
Paramedian	4 (36.4)	7 (63.6)	2.0 (0.5 to 7.6)	0.323		

The data are presented as n (%)
PDPH = Postdural puncture headache; OR = Odds ratio; POD = Postoperative day; BMI = Body mass index; R_3 = Third-year resident; R_2 = Second-year resident; R_1 = First-year resident

Birajdar et al found that term parturients with BMI >30 kg/m^2 had lower incidence of PDPH after spinal anesthesia; however, they did not describe in detail the characteristics of patients in their study that developed PDPH[7].

Peralta, et al reported a lower incidence of PDPH in parturients with BMI ≥31.5 kg/m^2 who had unintentional dural puncture after epidural or combined spinal epidural anesthesia[8]. Song et al claimed that obesity had no influence on the development and intensity of headache following accidental dural puncture[9]. Franz et al also found no statistically significant association between BMI >30 kg/m^2 and the development of PDPH after unintentional dural puncture[10]. The mean BMI of patients in the present study was 27.8±6.0 kg/m^2, which may unable to imply for the larger BMI group.

Arevalo-Rodiguez et al reported no positive association between fluid administration and prevention of PDPH[11]. Kuntz et al studied 501 patients and found physician experience relative to performance of administering regional anesthesia to have no relationship with the development of PDPH[12]. A current study by Imarengiaye, et al found no correlation between the number of attempts and the incidence of PDPH[13]. To our knowledge, no previous study has investigated the factors related with PDPH onset or peak PDPH. The present study found that factors, such as operator experience level, number of spinal attempts, and needle approach, had no significant influence on PDPH onset or peak PDPH in patients that required epidural blood patch.

Dieterich et al found that the incidence of PDPH was much lower when using 24 to 27 G needles (5% to 12%), as compared to 20 to 22 G needles (20% to 40%)[14]. Lambert et al reported an incidence of PDPH of 5.2% with 26 G Quincke needle, 2.7% with 27 G Quincke needle, and 1.2% with 25 G Whitacre needle[15]. Since our use of 27 G Quincke and 25 G Whitacre needles was applied after 2011, the incidence of PDPH that required epidural blood patch was decreased. This study found that needle size 25, 26 G tended toward association with early peak of headache that required epidural blood patch.

We also found that patients who had early PDPH onset (postoperative day 0 to 1) or early peak PDPH (postoperative day 0 to 2) had more severe pain (pain score >3) than the late onset and late peak groups, but the differences were not statistically significant. Patients who underwent epidural blood patch had longer hospital stay due to the need for close observation for signs and symptoms of reoccurrence

of PDPH, compared to the normal length of hospital stay, which was approximately 72 hours.

Onset of PDPH usually occurred within day 0 to 3. The patient who discharged earlier than this period should be advised about the symptoms of PDPH. The needle size 25, 26 G tended to associate with early peak of headache that required epidural blood patch so this group of patient should be followed up closely.

The present study has some limitations. First and consistent with this study's retrospective design, some patient data were incomplete or missing such as number of lumbar puncture attempts, needle approach, pain score. Second, some parturients may have been discharged before the symptoms developed. Third, the data were collected from a single center. Fourth, the true incidence of PDPH could not be determined, because the anesthesiologist was notified only if the patient had severe headache or failed conservative treatment, and the postoperative anesthetic round at 24 hours could be too early to detect PDPH.

Conclusion

Of 35,290 parturients who underwent spinal anesthesia for cesarean section, 77 patients (0.2%) developed PDPH that required treatment by epidural blood patch. No investigated factors were found to be significantly associated with PDPH onset or peak PDPH.

What is already known about this topic?

The incidence of PDPH after single-shot spinal anesthesia is about 1.5% to 11.2%. The factors that lead to the development of PDPH after spinal block are known; however, the characteristics of PDPH that require treatment by epidural blood patch, such as time of PDPH onset and peak PDPH, have not been elucidated.

What this study adds?

The incidence of PDPH after single-shot spinal anesthesia that required epidural blood patch at Siriraj Hospital is 0.2%. None of the investigated factors was found to be significantly associated with onset or peak PDPH.

Trial registration

Clinical Trials.gov registration as NCT0308 0610.

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Potential conflicts of interest

The authors declare no conflict of interest.

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