

Effect of reinsertion of the spinal needle stylet after spinal anaesthesia procedure on post dural puncture headache in women undergoing caesarean delivery

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ABSTRACT

Background and Aims: Post dural puncture headache (PDPH) following caesarean delivery (CD) is a cause for concern for anaesthesiologists. We aimed to study the effect of reinsertion of the stylet after spinal anaesthesia procedure, prior to spinal needle removal, on the incidence of PDPH in women undergoing CD. We also evaluated the risk factors associated with PDPH. **Methods:** In this randomised, double-blind study in a tertiary care hospital, 870 American Society of Anesthesiologists (ASA) II/III women undergoing CD under spinal anaesthesia were randomly divided into-Group A (n = 435): stylet reinsertion before spinal needle removal and Group B (n = 435): spinal needle removal without stylet reinsertion. All patients were questioned for occurrence of PDPH at various time-points. Statistical calculations were done using Statistical Package for the Social Sciences (SPSS) 17 version program for Windows. **Results:** Sixty-two (7.1%) patients developed PDPH; 27 (6.2%) patients with stylet reinsertion and 35 (8.0%) patients in those with no stylet reinsertion; $P = 0.389$. The onset of headache was significantly delayed in patients with stylet reinsertion (16.2 ± 6.7 and 13.2 ± 4.3 h, respectively); $P = 0.041$ and they had greater severity of PDPH compared with those with no stylet reinsertion; $P = 0.002$. Factors significantly associated with PDPH were hypothyroidism, tea habituation, number of skin punctures and needle redirections, first pass success rate, occurrence of paraesthesia and contact with bone, intraoperative hypotension and time to ambulation. **Conclusions:** Reinsertion of the stylet before spinal needle removal did not influence the incidence of PDPH. The onset of PDPH was delayed and the severity of headache was greater in women in whom reinsertion of the stylet was done.

Key words: Anaesthesia, caesarean section, post dural puncture headache, spinal

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INTRODUCTION

Neuraxial anaesthesia is the preferred technique for caesarean delivery (CD). However, it is associated with post-dural puncture headache (PDPH), the incidence varying between 6% and 36%.^[1] The incidence is higher in obstetric patients because of pregnancy-related increased cerebrospinal fluid (CSF) pressure, dehydration, blood loss, postpartum diuresis, high serum oestrogen levels, gender predisposition and younger age.^[1-3] PDPH may result in increased morbidity, prolonged hospital stay, increased cost and patient dissatisfaction.^[4] Reinsertion of the stylet into the spinal needle after a diagnostic lumbar puncture (LP) has been found to reduce the incidence of PDPH compared with removal of the spinal needle without stylet

reinsertion (5% and 16.3%, respectively).^[5] However, Sinikoglu *et al.* could not demonstrate a beneficial effect of stylet reinsertion in decreasing PDPH in surgical patients receiving spinal anaesthesia.^[6]

The effect of stylet reinsertion, prior to spinal needle removal, on the occurrence of PDPH has been

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investigated previously in the non-surgical and in non-obstetric population.^[5,6] We investigated the effect of spinal needle stylet reinsertion on PDPH incidence in the obstetric population. The study hypothesis was that reinsertion of the stylet will decrease the incidence of PDPH. We aimed to study the effect of reinsertion of the stylet, prior to spinal needle removal, on the incidence of PDPH (primary outcome) in women undergoing CD. We also evaluated the risk factors associated with PDPH (secondary outcome) in the obstetric population.

METHODS

After obtaining Institute Ethics Committee approval and written informed consent from patients, this randomised, interventional, double-blind study was conducted between March 2018 and December 2018. The study was registered with Clinical Trials Registry India (CTRI/2017/12/010828). The study included 870 American Society of Anesthesiologists physical status II/III term pregnant women, aged 18–44 years, undergoing elective or emergency CD under spinal anaesthesia. Patients with severe pregnancy induced hypertension (PIH), eclampsia, haemodynamic instability, raised intracranial pressure, bleeding diathesis or coagulopathy, chronic headache, use of analgesics or with any contraindication to spinal anaesthesia were excluded.

History of headache and previous PDPH was recorded. All patients scheduled for elective CD were fasted for 8 hours. The fasting status of emergency cases was noted. Patients received gastric aspiration prophylaxis. In the operating room, standard monitoring was instituted. The patients were positioned supine with left uterine displacement. Co-hydration with 1000 ml of Ringer's lactate was commenced.

Patients were assigned randomly to two groups using computer-generated random sequence numbers. Sealed envelopes were used to conceal allocation sequence. Group A (n = 435): stylet reinsertion before spinal needle removal and Group B (n = 435): spinal needle removal without stylet reinsertion.

Subarachnoid block was performed with the patient seated using a midline approach at the L3–L4 or L4–L5 space with 1.8–2 ml of heavy bupivacaine 0.5% with fentanyl 10 µg using 25-gauge Quincke needle. The spinal needle was introduced with the bevel parallel to long axis of the spine.^[7] After intrathecal

injection, the stylet was reinserted into the spinal needle before withdrawal of the spinal needle (group A) or the spinal needle was removed without stylet reinsertion (group B). Surgery commenced when T5 sensory block was obtained.

The number of attempts (skin punctures, needle passes and needle redirections) for successful dural puncture and the provider experience were noted. First pass success (successful identification of subarachnoid space with one skin puncture and no needle redirection) was noted. Adequacy of spinal block for CD (requirement for intraoperative analgesic supplement or failed spinal block requiring general anaesthesia) was noted. Hypotension (fall in SBP \leq 20% from baseline) was treated with rapid administration of intravenous (IV) fluids and ephedrine 6 mg IV. Bradycardia (HR < 60 beats/min) with hypotension or heart rate (HR) < 45 beats/min was treated with atropine 0.6 mg IV. Occurrence of nausea and vomiting was recorded. Duration of surgery was noted.

Postoperatively, paracetamol 1 g IV 8-hourly was given for analgesia. Diclofenac 50 mg intramuscularly 12-hourly was used to supplement analgesia, if required. Patients were mobilised after haemodynamic stability and return of sensation and motor power. Time to sitting and ambulation were recorded. Postoperative analgesic consumption and perioperative fluid administered was recorded.

Patients were classified as having PDPH if they had headache that developed within 5 days after spinal puncture and disappeared within 14 days, radiated to the neck and shoulders, exacerbated within 15 min of standing or sitting, aggravated by coughing or straining and was alleviated within 30 min of recumbency, and more so by lying prone.^[8] Patients were questioned about onset, severity, location, character and duration of headache. Associated symptoms (nausea or vomiting, hearing loss, tinnitus, vertigo, dizziness, paraesthesia, photophobia, diplopia or blindness) were noted.

Severity of PDPH was graded by a score described by Lybecker *et al.* as mild PDPH (Score 1): postural headache with slight restriction of daily activities, not bedridden, no associated symptoms, responded well to non-opiate analgesics (paracetamol, NSAID, caffeine); moderate PDPH (Score 2): postural headache with significant restriction of daily activities, bed ridden part of the day, associated symptoms were either

present or absent, required the addition of opiate derivatives; severe PDPH (Score 3): postural headache with complete restriction of daily activities, bedridden all day, associated symptoms present (photophobia, diplopia, tinnitus, nausea, vomiting), not responsive to conservative management.^[9] Severity of headache was assessed using a visual analogue scale (VAS 0-10); 0 = no headache, 1-3 = mild headache, 4-7 = moderate headache, >7 = severe headache.^[10]

Patients were assessed for PDPH on days 1, 2 and 3 by personal visit (twice a day) and on days 5 and 7 by telephone interview using questionnaire. Patient satisfaction was assessed by their willingness to have spinal anaesthesia in the future by VAS 0-10 score (0 = complete dissatisfaction, 10 = complete satisfaction). The investigators responsible for data acquisition were unaware of group allocation.

PDPH was treated with bed-rest, avoidance of straining, additional fluid intake (oral or IV), drinking coffee, oral or IV analgesics (non steroidal anti inflammatory drugs, paracetamol or opioids), corticosteroids or gabapentin, as required. Patients with severe PDPH refractory to treatment would be offered an epidural blood patch. Patients with PDPH were not discharged till they became symptom free.

Statistical analysis was performed by the Statistical Package for the Social Sciences program for Windows, version 17.0 (SPSS, Chicago, Illinois). Continuous variables are presented as mean \pm SD, and categorical variables are presented as absolute numbers and percentage. Data were checked for normality before

statistical analysis. Normally distributed continuous variables were compared using the unpaired t test, whereas the Mann-Whitney U test was used for those variables that were not normally distributed. Categorical variables were analysed using either the Chi square test or Fisher's exact test. For all statistical tests, a *P* value <0.05 was taken to indicate a significant difference.

Sample size was determined based on the effect of reinsertion of the stylet after a spinal anaesthesia procedure on PDPH incidence. We chose a 10% baseline ratio of incidence of PDPH based on previous studies.^[6,11] With a sample size of 435 patients in each group, there was 80% power at an alpha 0.05 to detect a 5% difference in the incidence of PDPH between the two groups.

RESULTS

The study included 870 parturients. Figure 1 shows the flow of participants in the randomised trial. Patient characteristics and surgical data are presented in Table 1. The two groups were comparable with regard to past history of spinal anaesthesia, CD or PDPH, tension headache, migraine, sinusitis and motion sickness; all *P* > 0.05. The two groups were comparable with regard to baseline haemodynamic data (all *P* > 0.05), body habitus (*P* = 0.340), quality of landmarks (*P* = 0.072) and presence of spinal bony deformity (*P* = 1.000). Spine flexion was adequate in all women.

Data on spinal anaesthesia procedure are shown in Table 2. Provider experience was comparable in the

Table 1: Patient characteristics, personal habits, co-morbidities and surgical data

Parameter	Stylet reinsertion (n=435)	No stylet reinsertion (n=435)	<i>P</i>
Age (yr)	24.9 \pm 4.1	25.8 \pm 4.5	0.002
Height (cm)	154.5 \pm 6.3	154.3 \pm 6.6	0.618
Weight (kg)	58.9 \pm 7.7	59.0 \pm 6.2	0.923
Body mass index (kg/m ²)	24.7 \pm 2.8	24.8 \pm 2.6	0.648
Smoker	0 (0)	0 (0)	-
Alcoholic	0 (0)	0 (0)	-
Habitual tea drinker	22 (5.1)	18 (4.1)	0.517
Habitual coffee drinker	6 (1.4)	5 (1.1)	0.762
Hypertension	4 (0.9)	5 (1.1)	1.000
PIH	64 (14.7)	63 (14.5)	0.924
Diabetes	16 (3.7)	11 (2.5)	0.328
Hypothyroidism	36 (8.3)	28 (6.4)	0.299
Elective/Emergency	83/352	91/344	0.476
Patients in labour	164 (37.7)	167 (38.4)	0.834
Fasting period (h)	11.2 \pm 2.7	11.5 \pm 2.7	0.235
Duration of surgery (min)	57.7 \pm 7.1	57.6 \pm 7.1	0.708

Values are mean \pm SD or numbers (%), as appropriate. PIH - Pregnancy induced hypertension

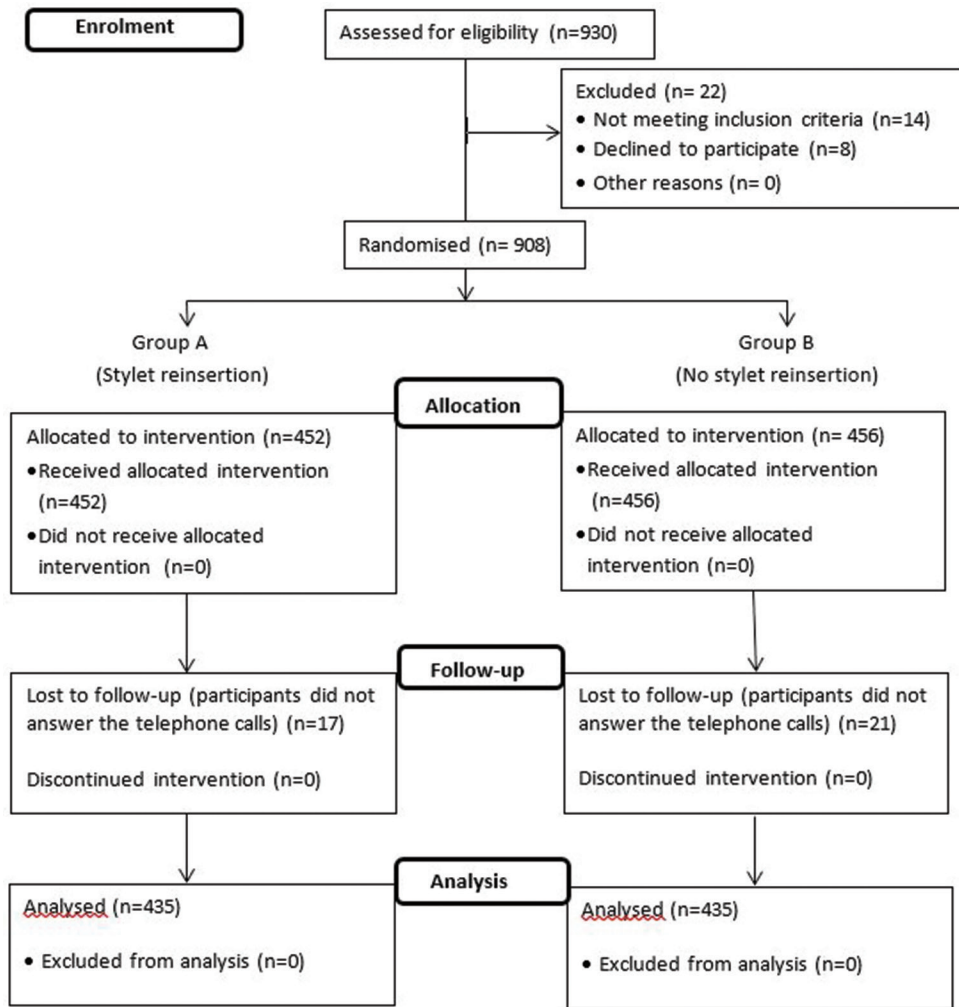


Figure 1: CONSORT flow diagram

two groups; $P = 0.150$. The incidence of intraoperative hypotension ($P = 0.245$) and bradycardia ($P = 1.000$), requirement for ephedrine ($P = 0.288$), atropine ($P = 0.687$), intravenous fluid ($P = 0.757$) and colloid ($P = 1.000$) and occurrence of nausea ($P = 0.604$) and vomiting ($P = 1.000$) was comparable between the groups. No patient required blood transfusion. Patient satisfaction VAS score was 9.7 ± 0.5 and 9.8 ± 0.4 in patients with and without stylet reinsertion, respectively; $P = 0.022$. The incidence of headache (non-PDPH) was 36 (8.3%) and 42 (9.7%) in groups A and B, respectively; $P = 0.476$.

Sixty-two (7.1%) patients developed PDPH; 27 (6.2%) patients in group A (stylet reinsertion) and 35 (8.0%) patients in group B (no stylet reinsertion); $P = 0.389$. The characteristics of headache, aggravating and relieving factors are presented in Table 3. All patients with PDPH had nausea. No patient experienced vomiting,

dizziness, vertigo, musculoskeletal, cochlear or ocular symptoms. The onset of PDPH was significantly delayed in patients with stylet reinsertion (16.2 ± 6.7 and 13.2 ± 4.3 h, respectively; $P = 0.041$) and had greater severity ($P = 0.002$) compared with those with no stylet reinsertion [Table 3]. Patients in both the groups responded to bed rest, avoidance of straining, additional oral and intravenous fluids, coffee intake, paracetamol and diclofenac. No patient required treatment with corticosteroids, gabapentin or epidural blood patch.

Factors affecting the incidence of PDPH are tabulated in Table 4. The following factors did not affect the incidence of PDPH: age ($P = 0.771$), body mass index ($P = 0.420$), elective or emergency CD ($P = 0.605$) or parturient in labour ($P = 0.873$), fasting status ($P = 0.113$), hypertension ($P = 0.130$) or PIH ($P = 0.723$), body habitus ($P = 0.051$) or quality of landmarks ($P = 0.808$), experience of the

provider ($P = 0.073$), bloody CSF tap ($P = 0.136$) or quality of the block ($P = 0.062$).

DISCUSSION

Our results indicate that reinsertion of stylet before removing the spinal needle after spinal anaesthesia procedure has no impact on the incidence of PDPH. The overall incidence for PDPH was 7.1%. The following factors were associated with PDPH: hypothyroidism, tea habituation, previous spinal anaesthesia or CD,

number of skin punctures and needle passes, first pass success rate, occurrence of paraesthesia, contact with bone, intraoperative hypotension and time to sitting and ambulation.

The effect of reinsertion of the stylet has been evaluated in two previous studies.^[5,6] Strupp *et al.* evaluated the effect of reinsertion of stylet on incidence of PDPH in 600 neurological patients undergoing diagnostic LP in sitting position using 21-gauge Sprotte's needle.^[5] They found that 49/300 patients (16%) without stylet reinsertion and 15/300 patients (5%) with stylet reinsertion developed PDPH.^[5] They concluded that reinsertion of stylet reduces PDPH and recommended reinserting the stylet during LP procedure. The rationale for replacing stylet is that CSF flow may drag an arachnoid fibre into the spinal needle, which when withdrawn, 'threads' the fibre through the dural hole to form a 'wick' from which CSF continues to leak and cause PDPH.^[12] Reinsertion of stylet presumably pushes out these arachnoid fibres and prevents them from interfering with dural hole closure.^[12]

Sinikoglu *et al.* studied 630 non-obstetric patients undergoing elective surgery under spinal anaesthesia using 25-gauge Quincke spinal needle in sitting position and found no significant difference in PDPH incidence between patients with stylet reinsertion (10.5%) and without stylet reinsertion (11.1%).^[6] The incidence of PDPH after spinal anaesthesia is much lower than that after diagnostic LP.^[5] Spinal anaesthesia differs from diagnostic LP as needle gauges are smaller than those used in the latter, smaller volumes of CSF are

Table 2: Spinal procedure data

	Group A stylet reinsertion (n=435)	Group B No stylet reinsertion (n=435)	P
Skin Punctures	1.12±0.41	1.13±0.52	0.611
Needle redirections	0.39±0.97	0.37±1.03	0.684
Needle passes	1.51±1.32	1.52±1.53	0.943
First pass success	352 (80.9)	359 (82.5)	0.539
Contact with bone	79 (18.2)	72 (16.6)	0.531
Space level change	6 (1.4)	8 (1.8)	0.590
Paraesthesia	47 (10.8)	41 (9.4)	0.500
CSF bloody/clear	18/417	23/412	0.381
Bupivacaine (ml) 1.8/2.0	22/413	25/410	0.107
Sensory level 5 min	6 (6-8)	6 (6-8)	0.227
Sensory level 15 min	5 (5-6)	5 (5-6)	0.107
Bromage score 5 min	3 (3-3)	3 (3-3)	-
Bromage score 15 min	3 (3-3)	3 (3-3)	-
Block quality 1/2/3	428/6/1	430/4/1	0.310
General anaesthesia	0 (0)	1 (0.2)	1.000
Repeat spinal block	1 (0.2)	0 (0)	1.000
Time to sitting (h)	19.56±4.41	20.25±4.52	0.022
Time to ambulation (h)	31.02±5.81	31.68±6.15	0.106

Values are mean±SD, numbers (per cent) or numbers (range), as appropriate. CSF - Cerebrospinal fluid; Spinal block quality 1-adequate/2-minor supplements/3-failed; VAS - Visual analogue scale

Table 3: Post dural puncture headache data

Parameters		Stylet reinsertion (n=27)	No stylet reinsertion (n=35)	P
Incidence		27 (6.2)	35 (8.0)	0.389
Site of PDPH	Frontal	6 (22.2)	9 (25.7)	0.866
	Occipital	1 (3.7)	1 (2.9)	
	Occipitofrontal	6 (22.2)	5 (14.3)	
	Generalised	14 (51.9)	20 (57.1)	
Aggravating factors	Upright position	27 (100)	35 (100)	0.355
	Coughing	27 (100)	35 (100)	
	Sneezing	26 (96.2)	34 (97.1)	
	Straining	26 (96.2)	34 (97.1)	
Relieved in lying position		27 (100)	35 (100)	-
Nausea		27 (100)	35 (100)	-
Vomiting		0 (0)	0 (0)	-
Onset of PDPH (h)		16.2±6.7	13.2±4.3	0.041
Severity of PDPH	VAS score 4	0 (0)	13 (37.1)	0.002
	VAS score 5	22 (81.5)	19 (54.3)	
	VAS score 6	5 (18.5)	3 (8.6)	
Lybecker class 1		27 (100)	35 (100)	-
Duration of PDPH (h)		11.7±3.4	11.9±2.6	0.968

Values are numbers (percent) or mean±SD, as appropriate. PDPH - Post dural puncture headache; VAS - Visual analogue scale

Table 4: Factors affecting the incidence of post dural puncture headache

Factors	PDPH (n=62)	No PDPH (n=808)	Mean difference	95% CI	P
Hypothyroidism	9 (14.5)	55 (6.8)			0.025
Habitual to tea	7 (11.3)	33 (4.1)			0.009
Previous spinal anaesthesia	27 (43.5)	253 (31.3)			0.000
Previous Caesarean delivery	28 (45.2)	251 (31.3)			0.022
Total drug volume	2.17±0.77	2.19±0.34	0.0295	0.0098-0.0492	0.004
Skin punctures	1.29±0.66	1.11±0.45	-0.178	-0.349-(-.007)	0.042
Needle redirections	0.92±1.59	0.34±0.93	-0.581	-0.991-(-.172)	0.006
Needle passes	2.21±2.17	1.46±1.34	-0.749	-1.307-(-.192)	0.009
First pass success	39 (62.9)	672 (83.2)			0.000
Paraesthesia	15 (24.2)	73 (9.0)			0.000
Contact with bone	20 (32.3)	131 (16.7)			0.001
Intraop hypotension	16 (25.8)	108 (13.4)			0.007
Ephedrine	16 (25.8)	109 (13.5)			0.008
Duration of surgery (min)	59.7±7.2	57.5±7.1	-2.200	-4.092-(-.309)	0.023
Satisfaction VAS score	9.6±0.6	9.8±0.4	0.156	0.008-0.304	0.039
Time to sitting (h)	23.5±4.9	19.6±4.3	-3.82	-4.950-(-2.690)	0.000
Time to ambulation (h)	34.9±5.2	31.1±6.0	-3.848	-5.376-(-2.321)	0.000
Postop analgesia requirement	62 (100)	571 (70.7)			0.000

Values are number (%) or mean±SD, as appropriate. CI - Confidence interval; Intraop - Intraoperative; Postop - Postoperative

withdrawn and small volumes of anaesthetics are injected. Local anaesthetic solution pushed through the needle during spinal anaesthesia could push back the strand of arachnoid which may enter the spinal needle during dural puncture, thereby decreasing the incidence of PDPH.^[6] Our results in the obstetric population are in accordance with those reported by Sinikoglu *et al.*^[6] In their study and in our study, a 25-gauge Quincke spinal needle was used and the needle bevel direction was kept parallel to dural fibres in the sitting position. The cells of dura-mater are oriented parallel to the long axis of spinal cord.^[13] Orientation of needle bevel parallel to the dura-mater fibres separates the fibres rather than cutting them, thereby facilitating closure of the hole upon needle withdrawal and, consequently, a lower incidence of PDPH.^[13,14] However, electron microscopic studies show that although the layers forming the dura mater are concentric and parallel to the surface, the orientation of the fibre layers are different in each sub-lamina, contesting the classical description of dura mater anatomy.^[15]

Reinsertion of the stylet was associated with a delayed onset and greater severity of PDPH, though the duration of PDPH was not affected. The reason for this is unclear. In both the groups, patients experiencing PDPH were categorised under Lybecker class 1.

Literature suggests that hypothyroidism exacerbates headache.^[16] Our results indicate that patients with hypothyroidism had a significantly higher incidence

of PDPH. We also found a significant effect of tea consumption habit on PDPH occurrence. In contrast, Etezadi *et al.* found no association between habitual tea or coffee consumption and PDPH.^[11]

The role of past history of PDPH on occurrence of PDPH is conflicting.^[11,17-20] An increased incidence of PDPH was reported in patients with a history of PDPH (19%) compared with no such history (6.9%).^[17] No relationship was found between history of past PDPH and occurrence of PDPH.^[11,18] In our study, past PDPH was not associated with occurrence of PDPH. However, we found that previous spinal anaesthesia or previous CD increased the incidence of PDPH. The reason for this is unclear. Intraoperative hypotension and ephedrine requirement were associated with PDPH. The low-flow state, induced by post-spinal hypotension, can result in compensatory dilatation of cerebral vessels to maintain adequate cerebral blood flow that may play a role in PDPH development.^[21]

Our results indicate that there is a relation between the incidence of PDPH and the number of skin punctures, needle redirections, needle passes and first pass success. Contact of spinal needle with bone and occurrence of paraesthesia was associated with an increased PDPH incidence. Contact with bone during insertion may lead to spinal needle tip deformation. The damaged needle tips could lead to an increase in the size of the subsequent dural tear.^[22,23] Manggala *et al.* did not find any association of needle contact with bone and PDPH.^[24]

Time to ambulation has not been found to be a factor affecting the incidence of PDPH.^[25] A meta-analysis of the effectiveness of bed rest after dural puncture on PDPH concluded that PDPH prevalence did not differ between the groups assigned to 24 hours of bed rest or early ambulation.^[26] A Cochrane review found that bed rest increased PDPH compared to early ambulation.^[27] Our results also indicate that a longer time to sitting and ambulation was associated with PDPH.

Body mass index (BMI) is a predisposing factor for PDPH.^[10,28] The higher intra-abdominal pressure in obese patients reduces CSF leakage from the dural puncture point and thus decreases PDPH. In our study, there was no association between BMI and PDPH probably because only 3.2% patients had a BMI >30 kg/m².

Our study has limitations. Quincke spinal needle of 25-gauge was used in this study. Our results cannot be extrapolated to use of pencil-point needles or needles of different sizes.

CONCLUSIONS

To conclude, the overall incidence of PDPH was 7.1% in patients undergoing CD under spinal anaesthesia using 25-gauge Quincke spinal needle. Reinsertion of the stylet before spinal needle removal did not influence the incidence of PDPH. Although the onset of PDPH was delayed and the severity of headache was greater in women in whom reinsertion of stylet was done, the duration of PDPH was similar. Factors increasing the incidence of PDPH were hypothyroidism, tea consumption habit, greater number of skin punctures and spinal needle redirections, lower first pass success, occurrence of paraesthesia and contact of spinal needle with bone, intraoperative hypotension and longer time to ambulation.

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Conflicts of interest

There are no conflicts of interest.

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