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Critical evaluation of multiple factors for post Dural puncture headache while contemplating subarachnoid block in obstetric patients

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Abstract
Aims: The purpose of the study was to evaluate the occurrence of post dural puncture headache with different design spinal needle with respect to issues pertaining to technique or equipment in lower segment caesarean section.
Settings and Design: Prospective randomized clinical study.
Methods and Material: This study included 268 parturient who were randomized into five groups based on spinal needle used for performing the subarachnoid block and groups were designated as I,II and III where 25G cutting needle was used and IV and V where 25G and 27 G pencil point needle was used respectively. Bevel direction was parallel to longitudinal fibres of dura in group I and II and perpendicular in III. Stylet was replaced in all the groups except I. Response to therapy was adjudged by Corbeys grading score
Statistical analysis used: Data was statistically analyzed using SPSS (Version 23.0). For categorical data, Chi-Square test, numerical data for inter group comparison, one way analysis of variance (ANOVA) test and Z test were applied for comparison of proportion between two groups. p- Value of <0.05 was considered statistically significant
Results: The occurrence of post dural headache was statistically significant among the groups. Group III was recorded to have the highest 14/55(25%) whereas in sequence group I, II and IV with 10/52(19%), 8/54(15%) and 2/54(4%) followed. There was no occurrence in Group V. The response to conservative therapy was adequate except in two patients with severe headache.
Conclusions: Pencil point needles plays a substantial role in decreasing or eliminating PDPH. It would be discreet to substitute them for the cutting type needles. For the cutting needle the stylet should preferably be replaced. The response to therapy can reliably be monitored by Corbeys grading for severity of headache.

Keywords: cutting, pencil point needles, obstetrical spinal anesthesia, PDPH (post dural puncture headache)

Introduction

Subarachnoid block techniques has established its position as an in dispensible technique in obstetric anesthesia because of block reliability although the Intentional rent created in the dura leave patients at risk of an undesirable outcome in the form of PDPH due to continuous leakage of CSF as previously under tension dural fibres tend to retract and increase the longitudinal dimension of the rent which may have many contributing factors [1]. The factors responsible are either related to either needle such as size and design, midline versus lateral approach or even some minor issues such as stylet being replaced before needle withdrawn after instituting the block [2, 3, 4, 5]. Some of these factors have been evaluated but stylet reinsertion after injecting drug need to be investigated in obstetric practice as there is possibility of dragging dura into the port of cutting tip needle which can act as a wick for continuous CSF leak.
Because of high incidence of PDPH, and multiple factors involved in its pathophysiology, we had designed this study with the aim to compare cutting and pencil point tip needle for occurrence of paresthesias and post dural puncture headache. Orientation of bevel and stylet replacement for cutting needles was evaluated for the occurrence of PDPH.

Material and Methods

After approval from the Institutional Ethical Committee and a written informed consent, the present prospective randomized study was carried out on 268 ASA grade I/ II obstetric patients posted for LSCS under subarachnoid block.
Prior to enrollment all patients underwent pre-anesthesia assessment to exclude pre-existing cardiac or pulmonary diseases, pre-eclamptic headache, migraine headache, meningitis or any other chronic headache, neurologic (peripheral neuropathies) or psychological disease, previous spinal surgeries, spinal column deformity (kypho scoliosis) and bleeding or coagulation disorder and patient refusal.
Patients were randomized, according to computer generated number into following groups
Group I: Subarachnoid block performed with 25Gcutting tip spinal needle with bevel direction parallel to long axis of spine (longitudinal fibers of dura) with no stylet re-insertion.
Group II: Subarachnoid block performed with 25G cutting tip spinal needle with bevel direction parallel to long axis of spine (longitudinal fibers of dura) with re-insertion of stylet.
Group III: Subarachnoid block performed with 25G cutting tip spinal needle with bevel direction perpendicular to long axis of spine (longitudinal fibers of dura) with re-insertion of stylet.
Group IV: Subarachnoid block was performed with 25G pencil point spinal needle.
Group V: Subarachnoid block was performed with 27G pencil point spinal needle.
The orientation of the bevel/distal eye was guided by stylet

hub with LUG which indicated the position of the distal eye once needle crosses skin level.

As the technique cannot be blinded due to color coding of the needles, however a second anesthesiologist was blinded to the occurrence of headache and recording of various other parameters.

Standard monitors for heart rate (HR), electrocardiogram (ECG), pulse oximetry (SpO2) and non-invasive arterial blood pressure (NIBP) were attached. Intravenous line with 18 G intracath was secured in the non-dominant forearm and preloaded with lactated Ringer solution at rate of 10 mL/kg over 15 minutes before subarachnoid block.

The subarachnoid block was performed under strict aseptic precaution in sitting position. The skin of back was cleaned with aseptic 40 % cetrimide solution followed by alcohol and 5% povidone iodine solution. Patients were draped with sterile sheets and lumbar intervertebral space (L3-L4 or L4-L5) was identified using Tuffier's line (Corresponding to L4-L5 space for identification) as a bony land mark. Before insertion of the spinal needle, a subcutaneous infiltration of 2ml 2% lignocaine was done using 25G insulin needle followed by insertion of needle introducer 20G x 13/8th"(B Braun) spinal needle insertion as per group was followed through midline approach with puncture at 90 degrees to the skin.

Post operatively headache was diagnosed as PDPH if it fulfilled the criteria of International Classification of Headache Disorders (ICHD) third edition (beta version) as following and the headache that is not better accounted for another ICHD- III beta version diagnosis[6] : Occurs after dural puncture, develops within five days of dural puncture, worsens or improves within 15 minutes of sitting or standing/lying with at least one of the following five: Neck stiffness, tinnitus, hypoacusia, photophobia, nausea and headache that resolves either spontaneously within one week or within 48 hours after effective treatment.

The following parameters were used to assess PDPH: Occurrence, Location (frontal/occipital/ or generalized), Severity (Grade I/II/III as per Corbey grades [7].

Grade I: FG1 + VAS 1-3 (FG1: Headache will not interfere with normal activity)

Grade II: FG2 + VAS 4-7 (FG2: Periodic bed rest necessary to relieve headache)

Grade III: FG3 + VAS 8-10 (FG3: Headache so intense that it is not possible to sit up)(FG: Functional Grading)

When patients responded to VAS, they specified their level of agreement to a statement by indicating a position along a continuous line between two endpoints of 0 -10, where 0 meant no pain and 10 as worst possible pain.

Paresthesia: abnormal excruciating sensation in which patient experiences tingling, itching, pricking, pins and needle or electric shock.

Treatment options were recorded: conservative treatment (recumbency position, abdominal binder, stool softner, paracetamol 1gm i.v TDS), Invasive treatment (epidural blood patch therapy was kept as an option with 15 ml of autologous blood planned which was to be injected into epidural space, one level below with Touhys 18 G needle if patient opted for it.

Statistical analysis

The results in the study are presented in a tabulated manner as Mean ± Standard Deviation (SD). Data was statistically analyzed using SPSS (Version 23.0). For categorical data, Chi-Square test, for numerical data for inter group comparison, one way analysis of variance (ANOVA) test and Z test was applied for comparison of proportion between two groups. p- value of <0.05 was considered statistically significant.

Results

Of 275 patients 7 were excluded from the study on count of refusal to participate in the study. The groups were comparable for various demographic and needle insertion parameters including spine examination, needle redirection/attempts and paresthesia (Table 1)

Table 1: Demographic profile and insertion parameters

Groups(N)	I(52)	II(54)	III(55)	IV(54)	V(53)	P value
Age(years)	26.8 ± 4.9	27.1 ± 4.7	24.2 ± 4.2	26.9 ± 5.0	24.7 ± 4.1	0.73
BMI(Kg/m2)	23.7 ± 3.8	24.7 ± 1.6	25.6 ± 2.9	26.6 ± 2.5	25.0 ± 2.0	0.68
Previous PDPH	6(12%)	6(11%)	2(4%)	4(7%)	6(11%)	0.53
LSP(P/O)	44/8	50/4	51/4	46/8	47/6	0.62
NR(1/2/3)	5/2/0(9)	5/2/0(9)	8/0/1(11)	6/2/1(13)	8/2/1(15)	0.66
Attempts(1/2/3)	45/7/0(59)	47/7/0(61)	47/8/0(63)	42/10/1(65)	42/10/2(68)	0.68
Paresthesias	3(6%)	4(7.4%)	3(5%)	4(7.4%)	1(1.8%)	0.71

LSP (P/O) Lumber spine (palpable/obscured), NR Needle Redirections. Data as mean±SD and percentage frequency, P<0.05 as statistical significance

The incidence of PDPH was statistically significant with the most cases in the cutting needle group(I,II,III) while lower incidence was recorded with 25G pencil point needles(IV) and eliminated with 27 G pencil point needle(V). On comparing the groups for needle design(I,II,III vs IV) and bevel direction(II vs III) keeping other determinants constant it was found to be statistically significant but for stylet replacement into needle(I vs II) was insignificant though it was higher for group I. (Table 2)

Orientation of bevel with respect to dural fibres had significant role for cutting type needle whereas it had nothing to be of concern in pencil point design needles as the port is placed slight away from the tip which significantly reduce or eliminates PDPH from the count. Frontal location was commonest followed by occipital. No patient had generalised headache (table 3).

Table 2: Incidence of PDPH

Groups	Patients with PDPH	P Value	Group vs Group	P value
I	10/52(19%)	0.005	II vs IV	0.04
II	8/54(15%)		III VS IV	0.002
III	14/55(25%)		I vs II	0.64
IV	2/54(4%)		II vs III	0.03
V	0			

Data as percentage and frequency, P< 0.05 as significant. II, III vs IV: Needle design, I vs II: stylet reinsertion, II vs III Bevel orientation.

Table 3: Location of headache

Location of headache	No of patients
Frontal	20
Occipital	14
Generalized	0

Table 4: Corbeys grading for severity of headache

Groups	I	II	III
I	8(3)	1 (0)	1(1)
II	5(3)	3(1)	0
III	9(5)	4(2)	1(1)
IV	1(0)	1(0)	0
V	0	0	

Data as numerical value. Bracketed values represent incidence after 48 hours of treatment

Most patients responded to conservative treatment for PDPH as evident 48 hours after initiation of therapy. There was shift from higher grades to lower ones except two who continued to remain in the same grade III one each in group I and III (Table 4). They were offered epidural blood patch but they refrained from any further invasive procedure. They however responded to steroid therapy which was used to control their symptoms to which the response was evident and where symptom free after 12 days. The steroids were tapered off.

Associated symptoms were also recorded in all the groups except V. (Table 5) Nausea was the commonest associated symptom which bothered most patients with PDPH followed by hypoacusis, tinnitus, neck stiffness and photophobia in the decreasing order. Most symptoms resolved with the control of PDPH there was no long term complain by any patient for its persistence.

Table 5: Symptoms associated with PDPH

Symptoms	I	II	III	IV	V
Nausea	7	8	12	2	0
Neck stiffness	3	0	1	0	0
Photophobia	1	0	1	0	0
Tinnitus	2	1	1	0	0
Hypoacusis	2	0	3	0	0

Discussion

The present study has been based on the evidence that there is CSF leak after intentional dural rent which has been confirmed by various diagnostic techniques such as Radionucleotide cisternography, radionucleotide myelography, mannometric studies, epiduroscopy, and even direct visualization at laminectomy [8]. Gaddolium enhanced MRI in the presence of PDPH validates sagging of intracranial structures and meningeal enhancement which attributes to adenosine mediated vasodilatation [9].

The incidence of PDPH in the present study was found to be 12.7%. Shutt *et al.*, have reported wide range of PDPH which varies from 0-37% [10]. The incidence and severity is related to size and shape of the rent and duration on rate at which it heals. The occurrence of PDPH was high in the present study when bevel was perpendicular to long axis of longitudinal fibres of dura which cut the fibers, previously under tension and tend to retract and increase the longitudinal dimension of the dura perforation increasing the likelihood of PDPH [11, 12]. Incidence was much lower or eliminated with pencil point needle. The location of bevel in pencil point needles away from the tip ensures free flow of CSF while its round edges prevents coring and minimize damage to dura [13]. However Reina *et al.*, reported that more attempts at dural puncture with pencil point needle damage the multiple dural layers that start to close individually while with cutting type bevel dural lesions are V or half-moon shaped clean opening formed as can opener on both external and internal surface. This study postulated that whitaker needle produce more traumatic opening with tearing and severe disruption of the collagen fibres thereby inflicting an inflammatory reaction with edema which may act as a plug limiting the leakage of CSF [14].

Tanveer Baig compared 25 G cutting with non-cutting needle for PDPH in obstetric patients, in this study the incidence of PDPH was 36.7 percent for cutting needle and only 6.7 percent for pencil non cutting needle [15]. The result of this study supports the present study where it was observed that the incidence was much higher with cutting type compared to pencil point needle. There has been an overwhelming evidence to support the use of pencil point needles to decrease the incidence of PDPH [14]. Hong Xu reported PDPH incidence of just 2 percent with pencil point needle [16]. The present study has a 4% incidence with 25 G while not observed with 27G pencil point needle.

In our study when group I was compared to group II with same gauge size needle (25g) and parallel bevel direction to longitudinal direction to dural fibers or long axis of spine, the only difference with group I being that stylet was not reinserted before needle removal whereas, it was re inserted in group II. In our study there was no significant difference in the incidence of PDPH on comparing the two groups although slight higher frequency was observed in group I. There are few research literature which describe the influence of reinsertion of stylet on the incidence of PDPH. Sinikoglu, Nadir & Yeter studied 630 patients undergoing elective surgery with spinal anesthesia and randomized into group based upon stylet replacement before needle removal(group A) and stylet not replaced in group B[17]. There was no significant difference between the groups with incidence of 10.5% for group A and 11.1 for group B. The conclusion from this study was that re insertion of stylet after spinal anesthesia did not reduce the incidence of PDPH. However, Strupp *et al.*, study had a conflicting results on the incidence of PDPH, with replacement of the stylet before withdrawing 25 G sprotte needle after lumbar puncture [18]. In this study the incidence dropped from 16.3 to 5 percent. It was hypothesized that leakage of CSF may drag arachnoid matter into open needle that on removal may act as a wick for CSF leakage or prevent closure of the dura. The wick theory of Strupp needs to be further evaluation in larger size obstetrical population.

Most patients in the present study responded to the conservative therapy, Two patients were exception with severe PDPH Corbey grade III, continued to remain in that grade. They were offered epidural blood patch, to which they refused and remained in grade III and they had to be managed finally with caffeine containing beverages and steroids to which they responded and there grades dropped and were finally relieved of their symptoms. Alam *et al*., evaluated the use of intravenous hydrocortisone 100mg eight hourly, for 48 hours on PDPH and observed that 6 hours after starting the steroid therapy the mean headache intensity was 2.66 ± 1.98 compared to 6.02 ± 2.46 in patients treated conventionally [19]. After 24 hours the intensity recorded was 0.94±2.67 (hydrocortisone group)

and 3.77±1.85 in conventional group. The mechanism behind this steroid effectiveness on PDPH has been hypothesized to be suppression of arachnoid acid production through lipoprotein induced phosphokinase inhibition which ultimately inhibits algogenic prostaglandins (prostaglandin E2 and I2) and leukotrienes (LTB4). Steroid block production of pro inflammatory cytokine (IL1, 2 and TNF-alpha). During healing process of dural puncture site, inflammatory mediators secreted from immune cells, spread to CSF, stimulate pain receptors and cause headache.

The strength of our prospective randomized comparative study was that we kept the number of factors in each group constant for comparison among the groups such as needle size, orientation of bevel of cutting needle, stylet reinsertion and needle design, However there were a few limitations to our study. The anesthesiologist who performed the block could not be blinded to the type of needle used in this study. However one who assessed post-operative outcome was blinded to the group assignment in order to mitigate that limitation. We struck to midline approach and sitting position in this study and did not include Paramedian approach and lateral position which may have different incidence on PDPH.

We conclude by saying that use of cutting needle has remained gold standard for long, but it is time to substitute traumatic needles by atraumatic ones which seems quite justifiable particularly in obstetric patients keeping in view a very high incidence of PDPH and associated symptoms. If cutting needle is the only option due to non-availability of pencil point needle then it would be wise to keep bevel parallel to longitudinal fibres of dura and until authenticated by further studies stylet should be replaced before needle is finally withdrawn.

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