Original Research Article

A comparative study of 27 G Quincke and Whitacre spinal needle for evaluation of postdural puncture headache

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Abstract

Background: Postdural puncture headache (PDPH) is a well-known complication of spinal anaesthesia. Two strategies have evolved to reduce the incidence of PDPH: First, to reduce the gauge of needle and second, to change the design of needle tip. Needle size might be the most significant factor in the development of PDPH. **Aim:** To compare the incidence of post-dural puncture headache and technical difficulties in lower abdomen surgeries under subarachnoid block between 27-G Whitacre spinal needle and 27-G Quincke spinal needle. **Materials and Method:** The present study was conducted at Tertiary Care Hospital and patients who were posted for lower abdomen surgeries including caesarean section, pelvis/perineum and lower limb surgeries under subarachnoid block and ASA physical status I and II were included in the study. A study proforma was formulated and details of demographic characteristics, baseline vitals, failure to produce spinal anaesthesia, time in seconds to the first appearance of cerebrospinal fluid (CSF) at the hub of the spinal needle, number of attempts to obtain CSF intraoperatively and patients were interviewed postoperatively. **Results:** The mean duration PDPH in the study was 33.84±25.14 hours in Quincke group as compare to 21±10.52 hours in Whitacre group and appearance of no significant difference between groups. Duration of headache lasted <24 hours and 24-48 hours (6 vs 3 & 4 vs 1 patient) among Quincke and Whitacre group respectively. **Conclusion:** The use of a 27-G Whitacre spinal needle was associated with a significantly lower incidence of PDPH than a 27-G Quincke spinal needle used for spinal anaesthesia.

Key Word:27 G Quincke and Whitacre spinal needle

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INTRODUCTION

Spinal Anaesthesia has been widely practiced for surgery below the umbilicus since its invention by August Bier in 1898.[1] The history of the development of spinal needles, and in particular of the tip of the spinal needle, began with the understanding of the anatomy and physiology of the central nervous system. Early developments were often based on incomplete or incorrect information and, as understanding improved, the equipment was modified to improve safety and decrease the severity and frequency of the complications of spinal anesthesia. Spinal

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anaesthesia involves injection of small amounts of local anaesthetic in the cerebrospinal fluid (CSF). This anaesthetic should not only be able to block the nervous pathways, but also be nontoxic in nature, thereby preventing any delay in mechanism of bulbar centers or interference with the vital metabolic processes of the body. Spinal anaesthesia should be done below the surface where the spinal cord ends (L2) and therefore, is usually performed in the L3-L4 region.[2]The Postdural puncture headache (PDPH), a well-known complication of spinal anaesthesia, is especially troublesome in young patients.[3]It was first reported by Bier and Hildebrnadt in 1898(incidence being 100%), while performing spinal anaesthesia on each other.[4]PDPH is an iatrogenic complication of neuraxial anaesthesia and results from the puncture of the dura-mater. The signs and symptoms of PDPH result from loss of cerebrospinal fluid, traction on the cranial contents and reflex cerebral vasodilatation.[5]PDPH is defined as any headache after a lumbar puncture that worsens within 15 minutes of sitting or standing and is relieved within15 minutes of the patient lying down.[6] Most PDPH occur within three days of the procedure and more than 50%start within the first 48 hours.[7] It can result in the patient's distress, longer hospital stay and more expenses.Risk factors for PDPH have been exhaustively researched and includes patients characteristics like pregnancy, youth and female sex or intra operative variables such as patient position, bevel orientation, type and size of needle, type and baracity of anaesthetic agent, addition of opioid and intra operative sedation.[8]The characteristics of PDPH are often variable. It may be accompanied by neck stiffness, tinnitus, hearing loss, photophobia and nausea, among other symptoms. Other characteristics such as the location and duration of the headache are also unpredictable.[9] Although PDPH is not a life-threatening condition, physical activity is often restricted. Patients are usually required to stay in bed for the entire day, and length of hospital stay and use of medical services are increased.[10] The variability in symptom profiles makes PDPH a diagnosis of exclusion. Alternative diagnoses (e.g. viral meningitis, sinus headache, intracranial haemorrhage) should be ruled out first.[7]Once PDPH is diagnosed, initial treatment involves conservative measures such as bed rest, fluid intake(adequate hydration) and analgesics. If PDPH continues for longer than 72 hours,more specific treatment is indicated.[(11)] Severe PDPH may respond to some therapeutic drugs and to an epidural blood patch.[12]Two strategies have evolved to reduce the incidence of PDPH: First, to reduce the gauge of the needle and second, to change the design of the needle tip. Studies have indicated that decreasing the needle gauge reduces the incidence of PDPH; however, it increases the technical difficulty, leading to an increase in the failure rate.[(13-17)]According to tip design, needles can be divided into traumatic and atraumatic types. Atraumatic needles include Whitacre, Atraucan, Sprotte, Cappe and Deutsch, among others. Traumatic needles include Quincke, Greene, Hingson Ferguson, Lutz, Brace and Rovenstine, among others. Traumatic needles are characterized bya bevelled tip that cuts the dura mater. In contrast, atraumatic needles are characterized by a pencil-point design. It has been stated that non-cutting or atraumatic needles produce a separation of the tissue fibres that heals easily after removal of the needle. Cutting or traumatic needles, on the other hand, favour loss of tissue and trigger a large inflammatory reaction that requires a long time to heal.[(18)]Research aimed at altering the needle design was done as early as 1926, when Greene proposed 'rounding off' of the needle tip, which would separate rather than cut the longitudinal dural fibres,[19]This idea was rediscovered and modified in 1952 by Hart and Whitacre, who developed a pencil-point needle that led to the current availability of smaller gauge pencil-point needles.[20]Pencil-point needles were thought to penetrate and then separate dura mater fibres, resulting in less trauma and subsequently less loss of CSF and a lower incidence of PDPH. A large inflammatory reaction caused by larger lesions can lead to faster closing of the injury through rapid migration of the cells involved in scar formation. Microscopic analyses of corpses have revealed that injuries produced by pencil-point needles are more complex than those produced by cutting needles.[21]Some studies have argued that the incidence of PDPH was not significantly different between cutting-point and pencil-point needles[22,23] while some opposed, arguing non cutting needle lead to lower rate of headache.[22,24]A meta-analysis published in 2000 has compared the frequency of PDPH between Quincke (a cutting point spinal needle) and pencil-point spinal needles which suggested that pencil-point spinal needle will significantly reduce PDPH rate compared to Quincke spinal needles.[25]The previous meta-analysis showed that Whitacre spinal needle was better than Quincke spinal needle.[26]Needle size might be the most significant factor in the development of PDPH. Spinal needles generally used today are 22 to 27G, but sizes ranging from19 to 30G are available. The incidence of PDPH after spinal anaesthesia performed with Quincke, a cutting needle, is 36% with 22G needle, 25% with 25G needle, 2% to 12% with 26G needle and less than 2% for smaller than 26G needles. The smaller needle diameter reduces the incidence of PDPH. However, even the use of 29G needles will reduce the complication, they are too thin to use. Spinal needle, which is extremely thin (29G or smaller), would increase the rate of failure for spinal

anaesthesia. And multiple dural punctures caused by unsuccessful puncture would increase the rate of PDPH. And sometimes CSF is too viscous to come through a small needle.[27]The Whitacre and Quincke 27-gauge needles may offer the best compromise between the low incidence of PDPH associated with fine-gauge needles and the low rate of failed spinal anaesthesia seen with larger spinal needles.[27] The aim of this prospective randomized clinical study was to compare the incidence of failed spinal anaesthesia, PDPH, and the handling characteristics of 27-gauge Whitacre and27-gauge Quincke needle.

METHODOLOGY

Study Area

Fortis Escorts Hospital, Jaipur

Study Population

Patients aged 16 to 40 years, who were posted for lower abdomen surgeries including caesarean section, pelvis/perineum and lower limb surgeries under subarachnoid block and ASA physical status I and II.

Sample Size and Sample Technique

Assuming the pooled incidence of PDPH as 4% from previous studies[3] and difference of incidence in PDPH among the groups as 6.5%. We need to recruit 197 patients in each group to detect significant difference between the groups at 5% alpha error and 80% power.

The sample size is calculated with the following formula:

$$N = 2 \times \left(\frac{Z_{1-\alpha/2}+Z_{\beta}}{d-\delta_{\circ}}\right)^2 \times p\,(1\text{-}p)$$

$$= 2\times \left(\frac{1.96+0.84}{0.065-\ .01}\right)^2 \times 0.04\,(1-0.04)$$

$$= 2 \times \left(\frac{2.8}{0.055}\right)^2 \times 0.04\times 0.96$$

$$= 2\times (50.09)^2 \times 0.038$$

$$= 2\times 2590 \times 0.038$$

$$= 197 \text{ per group}$$

Where N= required sample size

$Z_{1-\frac{\alpha}{2}}$=1.96 for α =0.05 and 95% CI

Z_{β} = 0.84 for β =80%

d = real difference of incidence of PDPH among group.

$\delta_{\circ}$= margin of error is considered as 1%

P=Polled incidence of PDPH in 27 G Quincke needle.

Study Design

A prospective double- blind, randomized comparative study. Randomization was done using random number table method. Double blinding ("The outcome assessor that is Anaesthesia resident doctor and the patient was blinded for the study. The anaesthesia was given by Anaesthesia specialist who was aware of the treatment arm.") was done to avoid bias.

Data Collection Technique and Tools

A study proforma was formulated and details of demographic characteristics, baseline vitals, failure to produce spinal anaesthesia , time in seconds to the first appearance of cerebrospinal fluid (CSF) at the hub of the spinal needle, number of attempts to obtain CSF intraoperatively and patients was interviewed by Anaesthesia DNB resident unaware of the needle type used at 0hr,4hr and then every 6 hourly upto 72 hours postoperatively regarding headache its onset, location, severity, effect of position, character, duration, associated symptoms like nausea, vomiting, auditory and ocular symptoms were recorded.

Data Analysis

All the statistical analysis was performed by statistical software STATA 12(STATA CORP, TEXAS, USA). Quantitative variables were presented as mean and SD and Qualitative variables were presented as number, percentage. Student 't' test and Mann Whitney U test was applied to find out the significant difference between the groups for continuous variables where as Chi-square test was applied for categorical variables. P value <0.05 was considered statistically significant.

RESULTS AND DISCUSSION

Demographic variables

Both the groups were homogenous in terms of Age, Sex, Weight, Height, BMI, ASA physical status and duration of surgery. Therefore, their demographic profile was comparable. No significant difference was noted in any of these parameters. (P value > 0.05)

Haemodynamic variables

There was no significant difference in the mean Heart Rate, Systolic blood pressure, Diastolic blood pressure and Respiratory rate between 27G Whitacre spinal needle and 27G Quincke spinal needle (p value >0.05). Attempts and Failure: Two and more than 2 attempts were required by significantly more number of times for Quincke needle group(16.24% and 2.54%) in comparison to Whitacre needle group(9.64% and 0%).p value <0.05 .Failure rate was more among Quincke needle group (3.05%) as compare to Whitacre needle group (1.52%) but the difference was insignificant. p value >0.05

Time to CSF detection

The mean time in seconds to detect CSF did not differ significantly between 27G Quincke spinal needle (12.68±3.95) and 27G Whitacre spinal needle (12.46±3.90) groups (p value > 0.05).

Post dural Puncture Headache: The frequency of Post dural Puncture Headache had a significant difference(p value < 0.05) between 27G Quincke spinal needle (6.09%) and 27G Whitacre spinal needle (2.03%).Most of the patients complaining of PDPH had mild PDPH and

only one patient in the Quincke group reported PDPH to be of severe grade in the entire study. Also the frequency of mild, moderate and severe PDPH (7 vs 3, 4 vs 1 and 1 vs 0 patients) was reported more among Quincke group as compare to Whitacre group. The distribution of severity of PDPH among the two groups was insignificant. (p value >0.05) While complaining onset of PDPH in both the groups we found that during 0-8 hours and 9-24 hours, 2and1 patients from Quincke group complained of PDPH whereas, there was no such incidence in Whitacre group. During 25-36 hours and 37-48 hours incidence was more in Quincke group when compare with Whitacre group (3 vs 2 and 4 vs 2 respectively).After 48 hours only 2 patients in Quincke group reported onset of PDPH. No significant difference was found in the distribution of onset of Post dural Puncture Headache between 27G Whitacre spinal needle and 27G Quincke spinal needle. The site of PDPH was Occipital among both Quincke and Whitacre needle groups followed by Frontal and Occipitofrontal (6 vs 3, 4 vs 0 and 2 vs 1 respectively). p value >0.05. The mean duration PDPH in our study was 33.84±25.14 hours in Quincke group as compare to 21±10.52 hours in Whitacre group and no significant difference between the groups. Duration of headache lasted <24 hours and 24-48 hours (6 vs 3 and 4 vs 1 patient) among Quincke and Whitacre group respectively. Only 2 patients in Quincke group and no patient in Whitacre group headache lasted more than 48 hours.

Non Postdural Puncture Headache

The non postdural puncture headache occurred more frequently among 27G Quincke spinal needle (13.20%) in comparison to 27G Whitacre spinal needle (10.66%).p value >0.05 Most of NPDPH was mild in nature among both the groups with no significant difference in severity (p-value>0.05). The onset and duration of non postdural puncture headache did not differ significantly (p-value>0.05) between both the groups though the duration was longer among 27G Quincke spinal needle group.

CONCLUSION

The present study showed that the use of a 27-G Whitacre spinal needle was associated with a significantly lower incidence of PDPH than a 27-G Quincke spinal needle when used for spinal anaesthesia. Therefore, the routine use of the 27-G Whitacre spinal needle is recommended when performing spinal anaesthesia. The incidence of non-PDPH following spinal anaesthesia is high and may reduce patient satisfaction.One of the most important preventive measures for PDPH include the use of smaller gauge pencil-point needles for spinal blocks as the results in the present study also support these findings.

RECOMMENDATIONS

1. Whitacre spinal needle can be of future interest for use in paediatric age group due to less incidence of PDPH, less technical difficulty and few multiple punctures.
2. For more precise study of NPDPH, we can have a control group of subjects under spinal and general anaesthesia.
3. Larger sample size would improve the accuracy of results.
4. Larger randomized controlled trials are needed to confirm our findings.

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