Cerebrospinal fluid loss at lumbar puncture for caesarean section: any effect on post-dural puncture headache?

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Abstract

Background Post dural puncture headache (PDPH) is an unpleasant complication of spinal anaesthesia. Several studies have attempted explanation of its pathophysiology. A widely held view is that it results from loss of cerebrospinal fluid volume resulting from leak following a hole left in the dura after the puncture. The objective of the study was to find out whether this headache results from cerebrospinal fluid lost at induction of spinal anaesthesia.

Methods Ninety parturients of American Society of Anesthetists classes I and II booked for elective Caesarean section were randomised into two groups of forty-five each. In group A, spinal anaesthesia was instituted with 25G Quincke type needle without allowing any cerebrospinal fluid to drop. In group B, five drops of cerebrospinal fluid were allowed before induction. The parturients were followed up for post-dural puncture headache.

Results Eighty seven parturients, 45 in group A (no CSF drop) and forty two in group B (CSF drop), completed the study. Three (6.7%) had PDPH in group A and 3 (7.1%) in group B. The mean incidence was 6.9% (OR=1.077, 0.205 – 5.656).

Conclusion The loss of cerebrospinal fluid volume at institution of spinal anaesthesia may not contribute to the development of post-dural puncture headache.

Keywords Post-dural puncture headache, cerebrospinal fluid loss, spinal anaesthesia

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Introduction

The history of post dural puncture (PDPH) is as old as that of spinal anaesthesia having first been reported by Augustus Bier himself.[1] Since then a lot of studies have been conducted to understand its pathophysiology. It is widely thought to result from a hole created in the dura leading to a leak of cerebrospinal fluid (CSF). The classic explanation is that the leak results in a loss of CSF pressure in the spine and a loss of buoyancy supporting the brain. In the upright position, the brain sags and tension on the meninges and other intracranial structures creates the pain.[2,3] Sechzer in 1979 contended that the pain results from compensatory intracranial vasodilatation secondary to a loss of hydrostatic pressure in the upright position as a consequence of CSF volume loss.[2] This is reversed on assumption of the supine position. Based on this understanding of the pathophysiology many management techniques have been developed to ameliorate the condition. One of these is the use of smaller gauge needles to carry out the dural puncture. This has been found to reduce the incidence of PDPH.[4,5] This is because the smaller gauges allow little or no leakage of CSF as the hole they leave is small. However the incidence of 1-6% reported in studies may still be considered high.

In describing the technique of lumbar puncture, many authors emphasize the identification of the subarachnoid space by the "free flow" of cerebrospinal fluid.[6] The objective of this study was to evaluate whether the loss of cerebrospinal fluid at the institution of spinal anaesthesia has any effect on the incidence of post-dural puncture headache.

Materials and Methods

Settings

The study was conducted at the department of anaesthesia of the Federal Medical Centre, Makurdi, Benue State, North Central of Nigeria from July 15, 2012 to June 20, 2014. This is a tertiary hospital with a bed capacity of 500 and is involved in the Residency Training programme with accreditations in Obstetrics and Gynaecology, Surgery and Family Medicine.

Study Design

This was a case by case analysis conducted at the Federal Medical Centre, Makurdi. Parturients of American Society of Anesthesiologists classes I and II booked for elective Caesarean section under spinal anaesthesia were co-opted into the study after an informed consent. All

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those with contraindication to regional anaesthesia and any history of peri-operative headache or neck pain were excluded from the study. Ninety parturients were divided into two groups of forty-five each. A coin was tossed for each parturient who consented and arrived the theatre for Caesarean section. Those who drew the head were randomised into group A to serve as study group. Those who drew the tail were grouped as B and taken as the control group. None of the patient knew the group they drew. The anaesthetist who performed the spinal was different from the one who went to the ward to review for symptoms of post-dural puncture headache. The anaesthetist who went to the ward to review was blinded as to the group the parturients belonged.

Each parturient who arrived the theatre was prepared for spinal anaesthesia following the standard technique. A 16G intravenous cannula was inserted in the vein through which intravenous 0.9% saline was infused. A comprehensive monitor was made available to monitor the blood pressure, pulse rate, oxygen saturation and respiration. A fully equipped anaesthetic machine was on standby to deliver oxygen and or general anaesthesia if the need arose. The local anaesthetic for the procedure was heavy bupivacaine 0.5%. The dose was 10mg in 2ml of solution. Intravenous ephedrine injection was made available to manage any case of hypotension.

In group A, spinal anaesthesia was done with the patient in sitting position after routine cleaning using a 25G Quincke type spinal needle with a transparent hub. Spinal needle was inserted at the L3/4 interspace. On successful puncture of the dura, the CSF flowing back into the hub was watched closely and the syringe bearing the bupivacaine was attached immediately the CSF got to the hub. No CSF was allowed to be lost. The patient was returned to the modified supine position for the surgery. In group B, all the above procedures in group A were observed. But on dura puncture, the CSF was allowed to "flow freely" out up to five drops before the syringe with bupivacaine was attached and the content administered. Both groups then proceeded to have the surgery and monitoring as was standard.

At the end of surgery the patients were followed up in the ward for any complaint of headache. They were reviewed at 12, 24, 48, 72, 96 and 120 hours post operatively. Any case of PDPH noted was graded as mild, moderate or severe and appropriate treatment was offered.

Data Analysis

The patients' age, height, weight, gestational age, indication for surgery, and presence or absence of PDPH were recorded. The data gathered was analysed using the SPSS version 19.0 for Windows. The statistical tools used were Odd Ratio and Student t test. Accepted level of significance was a p-value less than 0.05.

Ethical Issues

The approval for this study was obtained from the Ethical Review Committee of the Federal Medical Centre, Makurdi, Benue State, Nigeria. Each participant gave informed consent.

Results

Characteristics of study participants

A total of eighty seven parturients completed the study, 42 in the study group (A), and 45 in the control group (B). Three patients withdrew from the study as they were discharged on the second day of operation due to logistics and labour related issues in the hospital. The mean age in the study group was 29±5 years and in the control group was 28±4 years; (p = 0.348) as shown in Table 1. None of the anthropometric indices was statistically different. Table 2 shows the indications for caesarean section.

Table 1. Characteristics of parturients who had spinal anaesthesia

Variable	No CSF Leak	CSF Leak	P value
Mean Age±SD, years	28±4	29±5	0.348
Height±SD; cm	159.8±5.35	161.1±6.14	0.304
Weight±SD; Kg	72.4±12.19	72.6±14.76	0.952
BMI±SD; Kg/m2	28.30±5.05	28.02±4.27	0.647
Gestational age±SD; weeks	39.0±2.3	47.5±8.6	0.329

Table 2: Indications for Caesarean section

Indications	Frequency	Percentage
Previous sections	31	35.6
Abnormal lie	30	34.5
Hypertensive disease of pregnancy	10	11.5
Postdatism/bad obstetric history	7	8.1
Fetal macrosomia/multiple pregnancies	5	5.7

Incidence of PDPH

The incidence of PDPH for the entire study was 6.9%. The incidence of PDPH in Group A (study, no CSF drop) was 7.1% whereas Group B (control, CSF drop) was 6.7%; (OR=1.077, 0.205 – 5.656). The degree of the post dural puncture headache suffered by the patient was mild and did not require any treatment. There was no significant difference in the paremeters of the parturients who suffered headache compared to those that did not as shown in Table 3.

Table 3. Relationship of characteristics of parturients and post-dural puncture headache

Variable	PDPH positive	PDPH negative	P value
Mean Age±SD, years	29.83±2.71	28.59±5.25	0.570
Height±SD; cm	1.61±0.07	1.61±0.06	0.914
Weight±SD; Kg	76.3±11.8	72.2±13.5	0.770
BMI±SD; Kg/m2	29.36±3.66	28.26±5.96	0.659
Gestational age±SD; weeks	39.17±1.47	39.00±2.05	0.846

Discussion

The incidence of post-dural puncture headache of 6.9% in our study was comparable to the 6% found in the study by Fyneface-Ogan[7] in Port Harcourt and Okafor[8] in Enugu, Nigeria. However, while Fyneface-Ogan used a pencil-point needle (Whitacre needle), in their study, we used lancet tipped needle (Quincke) in ours. The needle type may account for the slight but insignificant difference in the incidences found by us. Studies have shown that the pencil-point needles tend to "separate" the fibres of the dura sheath, while the lancet tipped needles tend to "tear" apparently resulting in more leak of cerebrospinal fluid[7].

The size of spinal needle has been found to affect the incidence of post-dural puncture headache.[9] Toutellotte[4] showed that the use of smaller gauge needle could significantly reduce PDPH. As a result, we used 25G needle in the study as this particular size is commonly available at the study centre though 26 and 27G are available in some practice.

However, while studies tended to look at the leaks after the puncture[10] our study concentrated on finding out whether the loss of cerebrospinal fluid at institution of the spinal anaesthesia, a procedure which primarily involves a lumbar puncture, could influence the incidence of the headache. We found that there was no significant difference in the incidence of post-dural puncture headache in the patients whose cerebrospinal fluid was spilled and those whose fluid was not allowed to spill. In view of Seltzer's theory that the headache resulted from the compensatory intracranial vasodilatation secondary to a loss of hydrostatic pressure in the upright position consequent upon cerebrospinal volume loss,[2] it would be expected that those who lost more cerebrospinal fluid at lumbar puncture should have more volume depletion and more loss of hydrostatic pressure and therefore more headache. But our study revealed a non-significant difference in the incidence of the headache. This would imply that volume loss in cerebrospinal fluid may not have a significant role to play in the development of the headache contrary to the theory by Seltzer, at least not at the institution of the procedure. An explanation as to the why the headache still develops despite the preservation of cerebrospinal fluid volume still needs to be sought.

The incidence of PDPH tends to be higher in women, younger patients, parturients and obese patients.[11] In our study, of the six parturients that had headache, none was obese as their mean body mass index was 28kg/m^2. This is in disagreement with the finding of Gultekin[12] that the incidence of PDPH is higher in the obese parturient. The finding however agrees with that of Okafor[8] in South Eastern Nigeria who actually found a lower incidence of PDPH in the obese than in the comparative normal weight parturients using 25G spinal needle. The elderly suffer less PDPH.[12] PDPH can be treated with simple analgesics - paracetamol, non-steroidal anti-inflammatory drugs (NSAIDS), and codeine. However, they may not completely alleviate the headache. Adequate fluid intake is helpful and so is encouraged. The use of caffeine and theophylline in the treatment of PDPH has become controversial.[10] Concerns have been expressed that the incidence of seizures following dural puncture may be increased in the presence of caffeine. The cerebral vasoconstrictor sumatriptan has been found to be of benefit, but it is expensive and may cause coronary artery spasm.[10] Adrenocorticotropic hormone (ACTH) has been reported to effectively alleviate symptoms of PDPH probably by increasing the concentration of β-endorphin and intravascular volume.[13]

Bed rest used to be recommended for patients with the risk of developing PDPH. While bed rest alleviates the symptoms, the incidence of PDPH after 48hours was found to be the same for those who mobilised throughout and those who observed bed rest.[14] Because of the risk of thrombo-embolism, bed rest should not be routinely encouraged in asymptomatic women.[14] Epidural blood patch remains the most effective treatment of PDPH with cure rate at first attempt reported to be 60-90%.[15] Ofoegbu[16] reported a successful management of PDPH in a parturient in Nigeria with an epidural blood patch. Strict asepsis should be observed, as epidural blood patch may be associated with the risk of infection and adhesion formation.[13] In our study, the degree of severity of the headache was mild and therefore did not necessitate any form of aggressive treatment. However, since the patients were receiving simple analgesics as part of the post operative pain management, these may have been sufficient to curtail any need for specialized management of the headache.

Our study is limited by the relatively small sample size. Perhaps a larger sample size may be necessary to draw a more confident conclusion. However, our study does contribute to the body of evidence suggesting that the loss of cerebrospinal fluid at the institution of the subarachnoid block does not appear to contribute to the risk of developing post dural puncture headache despite the fact that volume of CSF is lost in the process. More research may be required to explain the pathophysiology of the headache.

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Conflict Of Interest

No conflict of interest is declared.

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