Post-Dural Puncture Headache is Uncommon in Young Ambulatory Surgery Patients

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Abstract *Background:* The incidence of post-dural puncture headache (PDPH) arising from spinal anesthesia in the general population is low. However, patients under 45 years have been shown to exhibit a higher incidence of PDPH, even with small needles. *Questions/Purposes:* This study aimed to estimate the incidence of PDPH from a 27G pencil-point needle in ambulatory surgery patients between the ages of 15–45 years and compare incidence of PDPH by age group, sex, and history of headache. *Methods:* In this prospective cohort study, 300 patients (15–45 years old) who underwent simple knee arthroscopy under spinal anesthesia with a 27G pencil-point needle were enrolled. Verbal consent was obtained during the initial phone conversation between post-operative days (PODs) 2–5. A PDPH questionnaire was administered during this conversation and between PODs 7–10. Patients who reported a positional headache were contacted by a physician co-investigator, who determined PDPH diagnosis. *Results:* Five patients were excluded from analysis due to complicated operative procedures or spinal needle size. The overall PDPH incidence was 2.0% (95% CI 0.9–4.4; 6/295). PDPH incidence

in 15–19-year-old patients was 16.7% (95% CI 4.7–44.8; 2/12). The crude relative risk of PDPH was 15.4 (95% CI 2.8–114.4) for patients with and without history of headache and 2.5 (95% CI 0.5–14.8) for females vs. males. Overall, 16.3% (95% CI 12.5–20.9) of patients reported post-operative, non-positional headaches. *Conclusions:* There was a low overall incidence of PDPH among patients aged 15–45. Pre-planned subgroup analyses of PDPH incidence by age group revealed a high risk of PDPH among a small sample of 15–19-year-olds.

Keywords spinal anesthesia · post-dural puncture headache · knee arthroscopy · complications

Introduction

PDPH occurs after a needle is passed through the dura mater, causing leakage of cerebral-spinal fluid and a low pressure headache. The first case of post-dural puncture headache (PDPH) following spinal anesthesia was documented by August Bier in 1898 [17]. In the last 70 years, many studies have investigated PDPH in various patient populations, including obstetric patients and patients undergoing evaluation and treatment for oncological or neurological diseases [11, 14]. In all populations, the characteristic that defines PDPH from other headaches is the exacerbation of pain when the individual assumes an upright position from a supine position [1]. According to the International Headache Society, diagnostic criteria of PDPH include the following [8]:

- A. Headache that worsens within 15 min after sitting or standing and improves within 15 min after lying, with at least one of the following: (1) neck stiffness, (2) tinnitus, (3) hypacusia, (4) photophobia, and (5) nausea and fulfilling criteria C and D
- B. Dural puncture has been performed
- C. Headache develops within 5 days of dural puncture

Level of Evidence: Prognostic study, Level II

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- D. Headache resolves either spontaneously within 1 week or within 48 h after effective treatment of the spinal fluid leak (usually by epidural blood patch)

One of the well-studied risk factors for the development of PDPH is age [1], but there are limited articles describing PDPH in younger patients. The literature involving patients <20 years of age is mixed, in terms of needle sizes and incidence. Dittman et al. used 29G needles and found a total PDPH incidence of 1.2% in all patients over 10 years of age, with a maximum incidence of 2.5% in patients aged 30–39 years [6]. Similar patterns were observed by Lybecker et al., albeit with larger needles [12]. At an orthopedics-only institution, the PDPH incidence was found to be 1.2%, with no relationship to age [18].

Currently, practitioners have a general idea of a patient's chance of developing PDPH based on their age, but this is based on anecdotal evidence and the literature of others' work at institutions that have different surgical specialties. This study was carried out to determine the incidence of PDPH from a 27G pencil-point needle in ambulatory surgery patients. The primary aim was to obtain the overall incidence of PDPH in patients aged 15–45 receiving spinal anesthesia with a 27G pencil-point needle for a simple knee arthroscopy. Also, we aimed to assess the incidence of PDPH by age group, sex, and history of headache.

Patients and Methods

This prospective observational cohort study was approved by the Institutional Review Board. All procedures followed were in accordance with the ethical standards of the responsible committee on human experimentation (institutional and national) and with the Helsinki Declaration of 1975, as revised in 2000. This single-center trial was conducted at the Hospital for Special Surgery.

Patients aged 15–45 who underwent a simple knee arthroscopy with spinal anesthesia between August 2013 and April 2014 were potentially eligible to participate in the study. Exclusion criteria included non-English speakers, procedure(s) involving bone or tendon, and previous enrollment in the study. Eligible patients were telephoned daily on post-operative day (POD) 2–14 until contact was made. When this occurred, verbal consent was obtained from the patient (for patients aged 18 and over) or the patient's legal guardians (for patients aged 15–17). Additionally, assent was obtained from patients aged 15–17 once consent was obtained from the legal guardian. During both consent and assent, patients and/or legal guardians were told that the purpose of the study was “to see how often certain symptoms occur (after spinal anesthesia) and whether or not males versus females or people of different ages get particular symptoms more often than others.” This intentional lack of precision in the description of the study purpose was to avoid potential bias in the patient responses that may occur if “headaches” were mentioned in describing the study.

The PDPH questionnaire was administered to the patient by a research team member twice: once during the first

telephone call and again between POD 7–14, in case the onset of symptoms was missed during the first contact. The only exception was if the patient was diagnosed with PDPH on the first phone call. The questionnaire included the following questions:

- (1) Have you experienced a headache since surgery?
- (2) When did it start?
- (3) How long did it last?
- (4) What did it feel like? Where was it located? Was/is it mild, moderate, or severe?
- (5) Did changing position affect your headache?
- (6) Did you contact a provider about your headache?
- (7) Was treatment given for your headache?

An attending anesthesiologist (principal investigator, KD, or co-investigator, RLK) contacted each patient who reported a positional headache. A diagnosis of PDPH was either confirmed or denied based on the investigators' clinical judgment, which followed the International Headache Society's diagnostic criteria of PDPH. At the end of the second telephone call (or only call, if reached after POD 7), patients were debriefed as to the true nature of the study and given the option to have their responses included in the study data or expunged from the database.

Patients whose first contact was after POD 7 were administered the questionnaire only once. Patients who were contacted on POD 2–5 but could not be reached on POD 7–14 were included in the data analysis based on the information given during the first contact. Eligible patients who could not be reached despite daily telephone calls from POD 2–14 were deemed unreachable, and no further attempts were made. However, if a patient returned the telephone call after POD 14, the questionnaire was administered, and the data were included.

History of previous headache information was gathered during the first phone call, before the PDPH questionnaire was administered. In addition to history of previous headache and questionnaire results obtained directly from the patient, patient demographics (age, sex) were collected from medical records. All study data were collected and managed using REDCap electronic data capture tools. The mean age of the 295 patients included in the study was 35 ± 8 years, and 12 of those patients (4.1%) were in the 15–19 age group category (Table 1). Eighty-five females (28.8%) and 45 patients with a history of headaches (11.5%) participated in the study.

Table 1 Baseline characteristics

	All (N = 295)
Age, years, mean (standard deviation)	34.8 (7.95)
Age group, years, n (%)	
15–19	12 (4.1)
20–29	69 (23.4)
30–39	110 (37.3)
40–45	104 (35.3)
Female, n (%)	85 (28.8)
History of headaches, n (%)	45 (11.5)

Fig. 1. Patient flow chart. The numbers of eligible, excluded, and enrolled patients are shown in the flow chart. Details regarding telephone calls are provided.

The primary aim was to determine the overall incidence of PDPH from a 27G pencil-point needle in simple knee arthroscopy patients. Based on previous literature, a 1.2% incidence of PDPH was estimated [18]. It was determined that enrollment of 300 patients would provide a

sufficiently precise estimate of PDPH incidence. Specifically, a sample size of 300 patients would allow for a 95% Wilson score confidence interval (CI) less than 6 percentage points wide, even if the observed incidence was as high as 6.0%. Pre-planned exploratory analyses included

Table 2 Incidence of post-dural puncture headache (PDPH)

	Count/total	Incidence, % (95% CI)	Risk difference, % (95% CI)	Relative risk, % (95% CI)
PDPH (entire cohort)	6/295	2.0 (0.9–4.4)	–	–
PDPH by age group				
15–19	2/12	16.7 (4.7–44.8)	15.3 (3.1–43.4)	15.3 (3.1–43.4)
20–45	1/69	1.5 (0.3–7.8)	–0.5 (–5.4–6.0)	0.8 (0–8.3)
30–39	1/110	0.9 (0.2–5.0)	–1.0 (–5.9–3.3)	0.5 (0–5.2)
40–45	2/104	1.9 (0.5–6.7)	–	–
PDPH by sex				
Female	3/85	3.5 (1.2–9.9)	2.1 (–1.5–8.5)	2.5 (0.5–14.8)
Male	3/210	1.4 (0.5–4.1)	–	–
PDPH by history of headache				
Yes	4/34	11.8 (4.7–26.6)	11.0 (3.6–25.9)	15.4 (2.8–114.4)
No	2/261	0.8 (0.2–2.8)	–	–

CI confidence interval

calculation of PDPH incidence by age group (15–19, 20–29, 30–39, and 40–45), sex, and history of headache and calculation of crude risk difference and relative risk of PDPH for younger age groups vs. the 40–45 age group, females vs. males, and patients with vs. without known history of headache. Incidence and crude risk difference estimates are reported along with 95% Wilson score CIs and crude relative risk estimates are reported along with 95% Farrington-Manning score CIs. Categorical variables are presented as counts and percentages, and continuous variables are presented as mean $\pm$ standard deviation. No *P* values are reported given the descriptive nature of the study. All analyses were performed with SAS Version 9.3 (SAS Institute, Cary, NC).

Results

A total of 405 patients were eligible to participate in the study. One hundred and five patients were excluded from the study. Of those excluded, 7 patients met the exclusion criteria (5 non-English speaking and 2 previously enrolled), 53 patients were unreachable after daily telephone call attempts on POD 2–14, and 45 patients declined to participate. Therefore, verbal consent was obtained from 300 patients. After consent, five patients were excluded from analysis due to either operative procedures that were more complicated than originally noted or the use of non-27G needles during spinal administration. Of the remaining 295 patients, 93 were administered the questionnaire only once (Fig. 1).

Overall, 16.3% (95% CI 12.5, 20.9) of patients reported post-operative, non-positional headaches. Six patients were determined to have PDPH. This resulted in an incidence of 2.0% (95% CI 0.9–4.4) (Table 2). Four of these six patients had a known history of headaches. Blood patches were not required for any of the patients.

There was an increased risk of PDPH in the 15–19 age group (relative risk (95% CI); 15.3% (3.1–43.4)) (Table 2). There was a stark difference in the incidence and risk of PDPH between the 15–19 age group and all

other age groups; as age group increased, the relative risk of PDPH decreased. The unadjusted relative risk of PDPH for females versus males was 2.5% (0.5–14.8). Additionally, there was an increased risk of PDPH among patients who reported a history of headaches (15.4 (2.8–114.4)). Subgroups with the highest incidence of PDPH were the 15–19 age group, females, and patients with a history of headache.

Discussion

In this study of patients receiving spinal anesthesia via a 27G needle and undergoing simple knee arthroscopic procedures, the incidence of PDPH in patients between the ages of 15 and 45 was 2.0% (95% CI 0.9–4.4). The secondary outcomes showed higher risk of PDPH among patients aged 15 to 19 and patients with a history of headache.

Similar percentages on the incidence of PDPH have been reported in the literature. YaDeau et al. reported a 1.2% incidence in ambulatory patients who received spinal or combined spinal-epidural anesthesia [18]. Dittman et al. reported a 1.2% incidence in patients who received spinal anesthesia with 29G needles [6]. A study from 1990 showed a 7.3% incidence in patients who underwent different types of surgery below the diaphragm and received spinal anesthesia using 22G, 25G, or 26G needles [12]. Variations in incidence could be due to needle type; larger needles have been shown to contribute to the likelihood of developing PDPH [7].

The incidence of PDPH with regard to age was also assessed. Of the six patients who were diagnosed with PDPH, two patients were aged 15–19 (16.7% incidence). Patients under the age of 45 years have been shown to have a higher incidence of PDPH, in comparison with older patients [5, 6, 12, 15]. In patients aged 30–39 who received spinal anesthesia with 29G point needles, the incidence of PDPH was 2.5%, although the overall incidence regardless of age was lower at 1.2% [6]. There are limited studies comparing the incidence of PDPH between children and adults,

although several studies show that PDPH is rare in children [9].

Furthermore, the incidence of PDPH with regard to sex was determined. In an unadjusted analysis, females had 2.5 (95% CI 0.5–14.8) times the risk of developing PDPH compared to males. This notably large risk agrees with previous studies on PDPH in females. In a systematic review, Wu et al. found that females are twice as likely to develop PDPH [16]. Similarly, Mosaffa et al. reported a significant difference in PDPH incidence between females and males, in which PDPH was more common in females [13]. However, other studies have shown that sex is not related to the incidence of PDPH [3, 12] and more studies need to be done to find the association between sex and PDPH, regardless of age.

Also, this study found that patients with a self-reported history of previous headache had a 15.4 (95% CI 2.8–114.4) times higher risk of developing PDPH than patients who did not report a history of previous headache. Clark et al. reported that patients with chronic or recurrent headaches were three times as likely to develop PDPH [4]. This is not surprising, given that patients with chronic headaches are predisposed to developing headaches [2].

This study has several limitations. First, there were significantly more patients aged 20–45 than those aged 15–19. Only 4% of patients (12/295) were aged 15–19. Second, not all patients were administered the questionnaire twice, as there were difficulties in reaching some patients by telephone. Thirty-two percent of patients were administered the questionnaire once, but only 4.7% of patients were administered the questionnaire before POD 5, the time by which PDPH would present. Third, only simple, ambulatory orthopedic procedures were included in the study. Fourth, there was potential for recall bias, as patients were questioned about headache symptoms after they may have occurred. Finally, generalizability was limited by the patient population's age, spinal needle size used, and procedures included.

In summary, there was a low overall incidence of PDPH among patients aged 15 to 45 who underwent simple knee arthroscopy under spinal anesthesia with a 27G pencil-point needle. Pre-planned subgroup analyses of PDPH incidence by age group revealed an unexpectedly high risk of PDPH among a small sample of 15–19-year-olds. The covariate-adjusted association between age and risk of PDPH is currently being explored in a study looking at a larger patient population and wider variety of lower extremity procedures. This is important because the number of teenagers undergoing lower extremity ambulatory surgery is increasing [10] and spinal anesthesia offers benefits over general anesthesia such as less nausea and vomiting, preemptive analgesia, and quicker return of GI function. It is not the authors' intention to deter providers from performing spinals in this age group, as the sample size was very small, and all headaches were treated non-invasively (no one received an epidural blood patch). However, providers may use this knowledge to better educate teenagers and their parents during the consent process, especially if the patients have history of previous headaches.

Compliance with Ethical Standards

Conflict of Interest: Kathryn DelPizzo, MD; Jennifer Cheng, PhD; Naomi Dong, MD; Chris R. Edmonds, MD; Richard L. Kahn, MD; Kara G. Fields, MS; Jodie Curren, BSN, RN; Valeria Rotundo; and Victor M. Zayas, MD have declared that they have no conflict of interest.

Human/Animal Rights: All procedures followed were in accordance with the ethical standards of the responsible committee on human experimentation (institutional and national) and with the Helsinki Declaration of 1975, as revised in 2008 (5).

Informed Consent: Informed consent was obtained from all patients for being included in the study.

Required Author Forms Disclosure forms provided by the authors are available with the online version of this article.

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