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## Diagnostic lumbar puncture. Comparative study between 22-gauge pencil point and sharp bevel needle

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**Abstract** Post-lumbar puncture headache is a frequent clinical problem. Needle design is expected to reduce post-puncture headache. In this study, we compared two different lumbar puncture needle designs in diagnostic lumbar puncture and analysed post-dural puncture headache (PDPH) and social and economical harm associated with the diagnostic lumbar puncture procedure. This prospective, controlled study consisted of 80 consecutive adult patients requiring elective diagnostic lumbar puncture due to various neurological symptoms. Lumbar puncture was completed either with Spinocan 22 G sharp bevel needle or Whitacre 22G pencil point needle. Patients were asked about previous headache symptoms and pain provoked by puncture. One week after the lumbar puncture all patients were interviewed by telephone and occurrence and type of headache, headache intensity, medication and frequency of impairment in activities of daily living were

asked. Need for epidural blood patch was also recorded. Thirty-three of 78 (42%) patients experienced headache after diagnostic lumbar puncture and in 26 (33%) the headache could be classified as PDPH. There were no statistically significant differences between needle types in the frequency of common headache, PDPH, puncture pain intensity, need for epidural blood patch or sick leave. Also, there were no other complications except local back pain or headache. In this study, the needle design did not affect the frequency of PDPH. Also, PDPH was common, occurring in 33% cases and caused a considerable amount of disturbance in daily activities. Seeking help for this condition was insufficient and only part of these PDPH patients were treated with epidural blood patch.

**Key words** Post-lumbar puncture headache • Diagnostic lumbar puncture • Puncture needle

### Introduction

Lumbar puncture is a common procedure most frequently performed in administering spinal anaesthesia and in diag-

nosing neurological disease with examination of the cerebrospinal fluid (CSF). Headache is the most common complication, occurring in over 30% of patients when a 20-G bevelled needle is used [1]. Post-dural puncture headache (PDPH) is a typical position-dependent

headache, which occurs or worsens when upright position is assumed and disappears or improves while lying down. PDPH is typically occipital, it starts usually 24–48 h after lumbar puncture and usually lasts one to two days but may be more prolonged to even weeks. The headache is related to low CSF pressure resulting from spinal fluid leaking through the hole cut in the dura by bevelled spinal needles [2–5]. Actions such as bed rest and posture have been used to prevent headache, but have not proven beneficial [6, 7].

In anaesthetics much has been done to reduce the incidence of headache after lumbar puncture. Finer bore spinal needles are used and have succeeded in reducing the incidence of headache to around 14% with a 25-G needle and just over 2% with a 27-G needle [8]. The requirements of diagnostic lumbar puncture differ from those in anaesthetics: CSF must be removed and the pressure measured. Therefore very fine needles are impractical. Needles smaller than 22 G take longer than six minutes to collect 2 ml of fluid [8]. Also, there is still controversy about the significance of the needle design: atraumatic or cutting point, an atraumatic needle theoretically leaving a smaller hole in dura and thus possibly decreasing CSF leakage [9, 10]. However, it has been stated that use of a 22-G blunt needle might reduce the incidence of headache to as low as 5% [11].

In this study, we compared two different lumbar puncture needle designs in diagnostic lumbar puncture and analysed PDPH and social and economical harm associated with the diagnostic lumbar puncture procedure.

study group consisted of 80 consecutive adult patients (Table 1) requiring elective diagnostic lumbar puncture due to various neurological symptoms. Patients received standard information about the procedure and possible complications before consenting.

## Methods

Patients were randomised to two groups for the lumbar puncture procedure, in which 3–10 ml CSF was withdrawn. Lumbar puncture was completed either with Spinocan 22-G sharp bevel needle or Whitacre 22-G pencil point needle (atraumatic). All punctures were performed by neurologists ( $n=4$ ). Only one of them used local anaesthesia before lumbar puncture. All neurologists had a training period with atraumatic needle before participating in the study. All procedures were performed with the patient in the left lateral position. After the procedure, patients were allowed to leave hospital immediately.

Patients were asked about previous headache symptoms and pain provoked by puncture. One week after the lumbar puncture all patients were interviewed by telephone about occurrence and type of headache, headache intensity, medication and frequency of impairment in activities of daily living were asked about. Headache was classified to be PDPH if it was a position-dependent headache, exacerbated on sitting or standing and relieved or reduced by lying down. Intensity of headache and puncture pain were assessed on a scale of 1 to 10, where 1 means no pain and 10 the worst possible pain (1 no, 2–4 mild, 5–7 moderate, 8–10 severe). Need for epidural blood patch was also recorded. Although 80 patients consented and were randomised to the study, one case file in both groups were unfortunately missing when the data were collected and processed, and thus 78 cases were finally analysed.

## Patients and methods

### Patients

This study was carried out in a secondary referral centre at the Department of Neurology in the Päijät-Häme Central Hospital. The

### Statistical methods

Data were expressed as means with standard deviations or frequencies as indicated. Confidence intervals (95%) and contin-

**Table 1** Demographic data

	Spinocan		Whitacre		All ( $n=78$ )
	Male ( $n=16$ )	Female ( $n=23$ )	Male ( $n=8$ )	Female ( $n=31$ )	
Age, years, mean (SD)	45 (10)	44 (12)	48 (12)	44 (17)	45 (13)
Body mass index, mean (SD)	25 (3)	25 (4)	26 (4)	24 (4)	25 (4)
Frequency of headache before diagnostic lumbar puncture					
Daily headache*	1 (6)	3 (13)	1 (13)	4 (13)	9 (12)
Weekly headache*	4 (25)	7 (30)	2 (25)	11 (35)	24 (31)
Once a month*	3 (19)	5 (22)	3 (38)	7 (23)	18 (23)
Less than once a month*	8 (50)	8 (35)	2 (25)	9 (29)	27 (35)

\*Number of patients (percents)

The differences between the groups are not statistically significant

gency table with  $\chi^2$ -test and Mann–Whitney *U*-test were used for statistical comparisons when appropriate.

The study protocol was approved by the Ethical Committee of the Päijät-Häme Hospital District, and written informed consent was obtained from all patients.

## Results

There were 39 patients in each group (Table 1). Frequency of headache before diagnostic lumbar puncture was similar in both groups. Thirty-three out of 78 (42%) patients experienced headache after diagnostic lumbar puncture and in 26 (33%) the headache could be classified as PDPH. There were no statistically significant differences between needle types in the frequency of common headache, PDPH, puncture pain intensity, need for epidural blood patch or sick leave (Table 2). However, there was a slight trend suggesting atraumatic needle might cause headache and need for further therapy less frequently. There were no other complications except local back pain or headache.

Ten out of 78 (13%) patients had to contact a doctor because of symptoms. Epidural blood patch was performed for eight (10%) because of PDPH. Altogether 17 (22%) had pain medication. Activities of daily living were impaired in a total of 26 (33%) patients; and in addition, 18 (69%) of these 26 did not get epidural blood patching and had to spend time in bed rest. The intensity of headache was classified to be moderate ( $5.9 \pm 3.0$ ). Only seven (9%) out of 78 patients were on sick leave because of symptoms provoked with diagnostic lumbar puncture, but in addition to that many of these 78 patients were on sick leave because of neurological symptoms that indicated the need for procedure.

Puncture pain was classified to be mild ( $3.1 \pm 2.1$ ). There were no differences in pain intensity in patients with or without local anaesthesia if the puncture succeeded at the first attempt (2.4 vs. 2.9,  $p=0.25$ ). If more than one puncture attempt was performed, pain was classified to be moderate ( $4.7 \pm 2.3$ ). One of these repeatedly punctured had local anaesthesia and then pain was classified mild in his case [2].

Puncture with atraumatic needle was considered to be more difficult due to the use of an introducer, but success rates were alike. We did not find a statistically significant correlation between success in one or several attempts and body mass index (mean BMI  $24.5 \pm 3.8$  vs.  $26 \pm 4.6$ ,  $p=0.2$ ).

## Discussion

In this study, we compared two different lumbar puncture needle types of similar diameter and analysed the prevalence of PDPH and social harm occurring after diagnostic lumbar puncture. We did not find a statistically significant difference between needle types in the frequency of common headache, PDPH, puncture pain intensity, need for epidural blood patch or sick leave. However, there was a slight trend in favour of the pencil point needle. In previous studies, there has been a discrepancy concerning the significance of needle type for the frequency of PDPH. In one non-systematic meta-analysis there was some evidence that atraumatic needles might be better [10]. Later Kokki et al. [9] reported a study with an adequate number of patients, in which the needle design did not affect the incidence of PDPH. Both of these reports were dealing with spinal anaesthesia, and the patients of Kokki et al. were children. There are also some other studies favouring blunt-tip nee-

**Table 2** Clinical characteristics. Data are *n* (%) except otherwise indicated

	Spinocan needle ( <i>n</i> =39)	Whitacre needle ( <i>n</i> =39)	All ( <i>n</i> =78)
Headache after puncture	19 (49)	14 (36)	33 (42)
Typical post-dural puncture headache (PDPH)	15 (38)	11 (28)	26 (33)
Epidural blood patch	5 (13)	3 (8)	8 (10)
Need for pain medication	10 (26)	7 (18)	17 (22)
Sick-leave*	3 (8)	4 (10)	7 (9)
Puncture pain#	2.8 (2.0)	3.3 (2.1)	3.1 (2.1)
First puncture succeeded	33 (85)	31 (79)	64 (82)
Second puncture succeeded	3 (8)	7 (18)	10 (13)
Three or more punctures	3 (8)	1 (3)	4 (5)
Need to change the needle type	3 (8)	4 (10)	7 (9)

#Estimated from 1 to 10, mean (SD)

\*Solely because of PDPH

The differences between the groups are not statistically significant

dles [18]. The whole question has not had a confirmed answer, especially when diagnostic puncture is concerned [19]. We did not find a significant difference in the present study, but this may be due to the rather small group size.

Most previous studies concerning PDPH were done in spinal anaesthesia with smaller needles [12–15]. Large needle size is definitely associated with more frequent PDPH [10, 11, 16]. In diagnostic lumbar puncture, smaller needles than G22 are not generally used, because time to collect required CSF samples makes it impractical and sometimes CSF is too viscous to come through a small needle. Despite the reliable evidence of larger needles increasing the occurrence of PDPH, in many centres G20 needles are still in regular use. We found the frequency of PDPH to be as high as 33%. In contrast to our results it has been stated that with use of a 22-G blunt needle instead of a 20-G needle, the incidence of headache might be reduced from 30% to as low as 5% [11, 17, 18].

The social harm and disturbance of daily activities associated with this simple diagnostic examination is significant and seems to be often underestimated. There was need for sick leave, pain medication, bed rest, readmission and epidural blood patching. Altogether 42% experienced headache, 33% had typical PDPH and activities of daily living were impaired in 33%. Thirteen percent contacted a doctor and 10% were treated with epidural blood patch. Still there were 69% patients with typical PDPH without blood patch, who had to be in bed because of postural headache. It is possible that these patients did not get enough information concerning treatment of headache or fear of the procedure kept them home. While drugs in treatment of PDPH are usually ineffective [19], epidural blood patching is safe, fast and effective in 90% of

patients; and if repeated in patients showing a poor response the response rate rises up to 98% [20–23]. Despite that, epidural blood patch is underused in the treatment of patients with diagnostic lumbar puncture.

Patients without local anaesthesia did not record remarkable puncture pain and local anaesthesia did not make the procedure painless when the first puncture was successful, as was the case in 82% of all events. We do not recommend local anaesthesia in usual cases. We did not find difference of puncture success rates with Spinocan 22-G sharp bevel needle or Whitacre 22-G pencil point needle. This is in accordance with results of Thomas et al. [16], who found that the use of atraumatic needle was associated with non-significant risk of more than one attempt at lumbar puncture being required. In our study Spinocan was considered to be easier to use, but with Whitacre needle the dural penetration was easier to detect.

## Conclusions

Diagnostic lumbar puncture is safe, but associated with PDPH in one third of cases and only a fraction of patients with PDPH are treated with epidural blood patching. Clinicians should pay more attention in giving better information to the patients in order to increase their knowledge of PDPH and its treatment possibilities. With proper guidance patients should be more ready to contact their doctor when this type of headache appears and more epidural blood patching procedures could be considered to minimise the harm provoked by diagnostic lumbar puncture.

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