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Original

Needle caliber and design are associated with the risk of post-dural puncture headache after diagnostic lumbar puncture

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Abstract

Introduction

Post-dural puncture headache (PDPH) is defined as an orthostatic headache that develops within the first few days after performing a spinal tap and it is related to extravasation of cerebrospinal fluid (CSF) into the epidural space, resulting in CSF hypovolemia and hypotension. The risk factors for PDPH are not yet fully understood.

Objective

To evaluate the risk of spontaneously reported PDPH according to the size and type of spinal tap needle.

Methods

A total of 4589 patients undergoing outpatient lumbar puncture (LP) were included. All CSF collections were performed at Senne Liquor Diagnostico, a laboratory specialized in CSF collection and analysis. Patients were instructed to report by telephone if they had orthostatic headache during the first 7 days after LP to the medical team of the laboratory. Patients with previous headache were instructed to report any change in the headache pattern during the same period. Needle gauge was classified into two groups: 1) 25 G or less and 2) greater than 25 G. Two types of needles were used and compared: 1) Pencil point and 2) Quincke. Comparisons of the percentages of spontaneous reports of PDPH were made using the chi-square test.

Results

141 patients (3.07%) reported PDPH to the laboratory's medical team. Needles of 25G gauge or less were used in 31.8% of cases. The percentage of patients reporting PHD in the group of 25G or less needles was 1.9% versus 3.6% in the group of larger than 25G needles (p=0.003). Pencil point needles were used in 10.6% of cases. The percentage of PHD among pencil point group was 1.4% versus 3.2% in Quincke group (p=0.026).

Conclusion

25 G or finer gauge needles as well as pencil point type needles significantly reduced the risk of spontaneously reported PHD.

Keywords:
Headache
Lumbar puncture
Post-dural puncture headache
CSF leak
Intracranial hypotension

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Introduction

Post-dural puncture headache (PDPH) is defined as an orthostatic headache that develops in the first days after lumbar puncture, whether performed for diagnostic purposes, spinal anesthesia, or accidental, in cases of epidural anesthesia attempt. According to the International Classification of Headache Disorders, the PDPH is characterized by a headache that worsens within 15 minutes of sitting or rising and that improves within 15 minutes of lying down, associated with at least one of the following symptoms: neck stiffness, tinnitus, hypoacusis, photophobia, and nausea, in patients submitted to lumbar puncture (LP), with the onset within 5 days after puncture and headache resolution spontaneously within a week or within 48 hours after effective treatment of cerebrospinal fluid (CSF) drainage.[1,2]

The pathophysiology of this headache is related to the formation of a hole in the dura mater, through the passage of the needle, allowing the extravasation of CSF into the epidural space, resulting in hypovolemia and CSF hypotension.[3,4] PDPH has been reported in 15-40% of lumbar puncture cases in the absence of preventive measures.[5] In most cases the headache is of moderate intensity and resistant to the usual painkillers. This headache will rarely progress to a chronic form.[6] More serious complications, such as persistent PDPH and subdural hematoma, are extremely uncommon.[7]

Risk factors for the development of PDPH include technique, needle, and patient related variables.[8-10] A larger needle diameter has been reported to increase the risk of PDPH, although some studies have not shown this association. Needle design has been considered a relevant variable for PDPH in anesthesiology LP, with lower risk of PDPH when atraumatic needles are used; however, this association is still unclear for diagnostic LP.[11] Therefore, the factors for the development of PDPH in diagnostic LP still need to be better clarified, thus contributing to the development of therapeutic and preventive strategies.

The aim of the present study was to evaluate whether the use of smaller gauge needles and atraumatic needles reduced the risk of the risk of PDPH in patients submitted to diagnostic LP.

Methods

This study was carried among adult patients submitted to outpatient LP performed at *Senne Liquor Diagnóstico*, a laboratory specialized in CSF collection and analysis. The procedures adopted for CSF collection and analysis were those usually adopted by the laboratory, without any modification due to the present work.

The patients were instructed to report by telephone if they developed a new orthostatic headache during the first 7 days after the LP to the medical team of the laboratory. The laboratory has a medical team available by telephone to assist patients after LP whenever it is necessary and these physicians who recorded the information for this study. Besides the presence or not of PDPH, other collected data for this study were age, gender, and needle gauge, and needle type. All needles used in the laboratory are from a single manufacturer (Becton Dickinson Limited, BD®).

The diameter of the needles was classified into two groups: a) 25 G or thinner and b) wider than 25 G. Two types of needles were used and compared: a) pencil point and b) Quincke. The diameter and type of needle were defined by the physician who performed the procedure, based on his evaluation and clinical experience.

Comparisons of the percentages of spontaneous reports of PDPH according to age group, gender, and needle characteristics were made using the chi-square test. The study was approved by ethical board and written informed consent was obtained from each patient.

Results

The data of 4589 patients submitted to diagnostic LP were evaluated and 3.07% of them reported PDPH. The percentages of PDPH according to the age groups were: a) 18-30 years – 3,36%; b) 31-50 years – 4,23%; 51 years or older – 1,52% ($p<0.0001$). PDPH was reported by 3.93% of female patients and 2.07% of male patients ($p=0.0004$).

Needles of with 25 G gauge diameter or less were used in 31.8% of cases. The percentage of patients with PDPH in the group of patients undergoing LP with needles of 25 G or less diameter was 1.9% versus 3.6% in the group of those undergoing LP with needles of a diameter greater than 25 G ($p=0.003$) (Figure 1). Pencil point needles were used in 10.6% of cases. The percentage of patients undergoing LP with pencil point needles that reported PDPH was 1.4% while the percentage of PDPH in those undergoing LP with Quincke needles was 3.2% ($p=0.026$) (Figure 2).

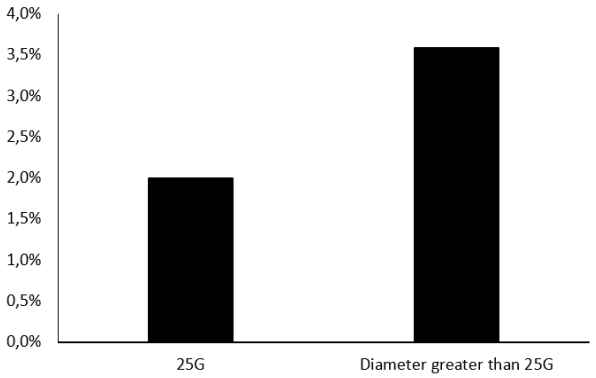

Figure 1. Percentages of post-dural puncture headache according to the diameter of the needle (p=0.003).

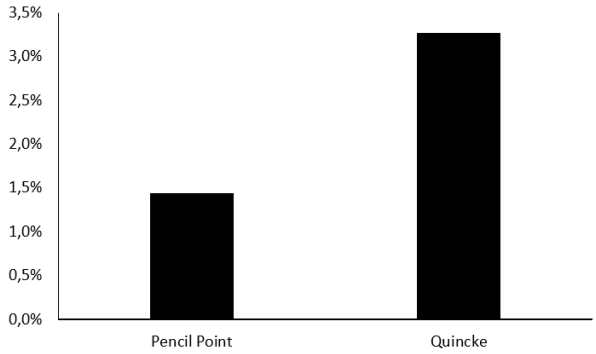

Figure 2. Percentages of post-dural puncture headache with pencil point and Quincke needles (p=0.026).

Discussion

In the present study we have shown that smaller gauge needles are associated with lower risk of PDPH. This finding agrees with previous studies[11-14] but was not verified by others. Amorin et al.[10] did not show a significant difference in the prevalence of PDPH between patients who underwent LP with 25 G and 27 G needles. It is possible that this difference only occurs with larger gauge needles, such as the 22 G, which is widely used in clinical practice.[10] In fact, Ahmed et al.[15] reported a higher incidence of PDPH with 20 G and 22 G needles when compared with 24 G and 27 G needles.[15] Considering that CSF leakage is probably the cause of PDPH it is reasonable to hypothesize that smaller gauge needles produce smaller tears in the dura thus reducing the CSF leakage and the risk of PDPH.[16]

We also showed that needle design is associated with the risk of PDPH with atraumatic pencil point having a lower risk developing this headache when compared with Quincke needles. Although this relationship has been better established for LP in in punctures performed in anesthetic procedures, there is conflicting evidence as to whether pencil point needles reduce the risk of PDPH among patients submitted to LP for diagnostic purposes.[17] Our study suggests that reduced risk of PDPH with atraumatic needles occur in LP performed for diagnostic purposes. This association is probably related to the fact that that pencil point needle produces less damage to dura and consequently less leakage.[11]

Our study confirmed that patient-related factors also interfere with the risk of developing PDPH. Female patients had a significantly higher risk of developing PDPH. This association has been previously demonstrated.[10,18] Although it is not known exactly why women have higher risk of PDPH than men, it is possible that anatomical and physiological differences related to the dura mater and CSF dynamics make women more susceptible to this headache. Like other authors, we also identified a drop in the risk of PDPH after the age of 50.[10,19] Reduced elasticity of the dura mater reducing CSF leak and a reduced extradural space have been postulated as possible explanations, although the precise mechanism for the reduced risk of PDPH with age is still unknown.

Our study has limitations that deserve to be mentioned. We relied on a spontaneous telephone report rather than an accurate clinical assessment. It is possible that patients who have had PDPH have not reported their occurrence to the medical team, therefore underestimating the real number of cases. However, due to the large number of subjects included, this risk is the same in all groups, probably not affecting the comparative results. The option for the type and caliber of the needle was not randomized, however, the choice was made by each of the physicians who performed the procedures, based on their evaluation and clinical experience. The retrospective nature of the study precluded such randomization. Some possible variables related to the LP were not evaluated, such as the reinsertion of the stylet before removing the needle and the direction of the bevel in relation to the fibers of the dura mater. This is justified because in our laboratory routine, the stylet is always reintroduced before removing the needle and the bevel of Quincke needles are always inserted in parallel to the dural fibers, rather than perpendicular. Therefore, it would not be possible to assess the effectiveness of this procedure in reducing the risk of PDPH since it was used in all cases.

In conclusion, our data suggest that atraumatic needles with a diameter of 25 G or thinner should be preferred whenever possible in patients undergoing diagnostic LP.

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