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Review

Impact of spinal needle size and design on post-dural puncture headache: A narrative review of literature

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Abstract

Background: **Post-dural puncture headache (PDPH) is a well-known iatrogenic complication of lumbar puncture. The main modifiable risk factors of PDPH appear to be needle size and design, which have been extensively modified in an effort to lower the incidence of PDPH. Currently, there is no consensus on the ideal needle tip for lumbar puncture. Therefore, we have conducted this narrative review of literature to provide a more definite answer regarding the impact of spinal needle size and design on PDPH.**
Methods: **Relevant literature was obtained by searching the scientific literature using PubMed, EMBASE, ISI Web of Knowledge, and Google Scholar for from 1990 to July 2022.**
Results: **Both size and design have been extensively researched in numerous randomized controlled trials. A total of seven systematic reviews published since 2016 were reviewed: Five combined with meta-analyses of which two also with a meta-regression analysis, one combined with a network meta-analysis, and one Cochrane review.**
Discussion and Conclusion: **The evidence presented in this review consistently shows that the atraumatic design is less likely to cause PDPH than the traumatic design. There is no simple linear correlation between smaller needle size and lower incidence of PDPH in either needle type. In lumbar puncture for spinal anesthesia we advise the 26G atraumatic spinal needle as the preferred choice, as it is the least likely to cause PDPH and the most likely to enable successful insertion. If unavailable, the 27-gauge atraumatic needle is the next best choice.**

Keywords: Anesthesia, spinal / Adverse effects, Needles / Adverse effects, Post-dural puncture headache, Spinal puncture / Adverse effects.

Introduction

Lumbar puncture is a procedure in which the dura mater is intentionally punctured with a spinal needle for both diagnostic and therapeutic purposes, the latter of which mostly for spinal anesthesia[1,2]. Generally, lumbar puncture is well tolerated and rarely complicated by significant morbidity[3]. The most common iatrogenic complication of this procedure is PDPH (Post-dural puncture headache), which has been reported in the range of <1% to 36% of patients[1,3-8]. PDPH itself can be associated with lower back pain, cranial nerve palsy, subdural hematoma, cerebral venous thrombosis, and bacterial meningitis[3,9-11]. The pathophysiology behind PDPH is complex, but it mainly results from sustained leakage of CSF (Cerebrospinal fluid) through the punctured hole in the dura mater[5-8,12]. The 3rd edition of the International Classification of Headache Disorder defined PDPH as an orthostatic headache occurring within 5 days of a lumbar puncture, being aggravated when standing or sitting and relieved when lying flat[1,8,13]. Although the headache usually remits spontaneously within 2 weeks, this becomes increasingly unlikely after 2 weeks thus requiring sealing of the puncture site with an autologous EBP (Epidural blood patch), which remains the golden standard therapy[13-16]. The headache may be accompanied by nausea, vomiting, neck stiffness, photophobia, dizziness, tinnitus, hearing loss, or blurred vision[1,8,17,18]. While PDPH is mostly

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resolved within a few days, it can be a debilitating complication. A significant number of patients can experience at least one week of disability. Others require treatment and thus prolonged or recurrent hospitalizations for intravenous fluids, controlled analgesia, or new invasive therapy, i.e. the EBP[6,7]. As some patients might even chronically suffer from symptoms for months or even years, lumbar punctures can be associated with long-term morbidity[8,14].

Prevention of PDPH is preferred over its treatment7. Many strategies for prevention of PDPH have not proven to be beneficial, such as different body postures after lumbar puncture, bedrest, supplementary intravenous fluids, caffeine, and the use of a prophylactic EBP[7,19,20]. Actually, the incidence of PDPH is mainly influenced by its risk factors[1,8,21]. Non-modifiable risk factors are: Female gender, younger age, lower body mass index, pregnancy, vaginal delivery, non-smoker, known chronic headache or previous PDPH, and low concentration of substance P in CSF[12,14,22-26]. Modifiable risk factors are: Needle tip size, needle tip design, patient positioning during lumbar puncture, and experience of the physic ian[1,7,8,12,14,21-23,27-29]. Over the years, there has been an increasing amount of literature in the field of lumbar puncture on these modifiable risk factors[14].

The most significant modifiable risk factor in the development of PDPH is needle tip size[1,7,8,15,20,27,30,31]. Needle tip size is categorized by the gauge system, where for each gauge both inner and outer diameters in millimeter are available in the guidelines for the dimensions of needles by the IOS (International Organization for Standardization). However, spinal needles from different manufacturers appear to always have some variability in both inner and outer diameter to the IOS guidelines, and the real value can only be found in specific needle's catalog[32]. The size of spinal needles used today ranges generally from 22 to 27G (gauge), but sizes from 19 to 30G are available8,33. There is a direct relationship between the size of the dural perforation and the risk of developing PDPH[20,27,34]. Larger needle diameter (smaller gauge) will cause larger holes in the dura mater, allowing an increased rate of CSF leakage with a lower probability of spontaneous healing and thereby increasing the incidence of PDPH[1,3,7,12]. Consequently, it was thought effective to keep reducing the needle diameter[8,21,35]. However, extremely thin spinal needles increase the difficulty of the procedure and the rate of failure, as they may cause multiple unrecognized dural punctures due to slower CSF flow and possible mechanical plugging of the needle lumen[1,3,8,30,36-38]. Thus, smaller spinal needles may increase the incidence of PDPH[1,8,30,36-38].

The second most important modifiable risk factor of PDPH might be needle tip design[1,7,8,15,20,27]. Spinal needles can be classified according to tip configuration as pencil-point and cutting-bevel types[1,6,39]. Cutting-bevel needles are the most frequently used in clinical practice, hence its synonym conventional needles. They are considered traumatic needles, as they have a sharp cutting tip design with a distal opening for collection of CSF and the injection of therapeutics[6]. Traumatic needles include Atraucan, Bainbridge, Barker, Brace, Greene, Hingson-Ferguson, Labat, Lemmon, Lutz, Quincke, Rovenstine, and Spinocan, among others[1,6-8]. In comparison, atraumatic needles are blunt with a closed pencil-point tip design and an opening on the side for collection and injection[6,7]. Atraumatic needles include the Cappe, Deutsch, Eldor, Gertie-Marx, Microtip, Sprotte, and Whitacre, among others[1,7,40]. For the atraumatic needle, the technique of insertion differs from that of a traumatic needle in that an introducer needle is used at the start of the procedure in order to puncture the skin[41]. The choice for the atraumatic design seems to be another effective way to reduce the incidence of PDPH, since post-mortem and in-vitro studies have shown that the rate of CSF leakage is reduced compared with the traumatic needles[6,8,42,43]. Atraumatic needles were believed to separate and dilate dural fibers, leaving only pinpoint cuts after removal of the needle[6,42]. However, Reina et al.[44] showed that neither needle type can separate the dural fibers because the size of the needle is 5000 times larger than the fiber[34,44]. In truth, neither needle type is truly atraumatic[34]. The underlying reason why needle tip design is influencing the incidence of PDPH remains hypothetical[34,44].

Accordingly, there is not yet reached a consensus on the ideal needle for lumbar puncture[3,6]. It is put forward that modification of needle tip and size reduces the incidence of PDPH[6,7]. Canonical literature gives a simplistic answer, pointing towards an atraumatic needle of higher gauge that has the perfect balance between ease of insertion and risk of PDPH[3]. In the past decades, however, research on lumbar puncture has progressed greatly. Therefore, to provide a more definite answer regarding the impact of spinal needle size and design on PDPH, we have performed this narrative review of literature.

Methods

PubMed was used to browse the MEDLINE database and further studies were searched using Embase, Google Scholar and ISI Web of Science. The MeSH and Emtree database were used to find relevant terms applicable to this narrative review of literature. As search terms we used "Post-dural puncture headache"; "Spinal puncture/adverse effects"; "Spinal puncture/instrumentation"; "Anesthesia, Spinal/adverse effects"; "Anesthesia, Spinal/ instrumentation", "Lumbar puncture"; "Pencil-point needles"; "Cutting needles" and "Needles/adverse effects". Search results were limited from the year 1990 to July 2022. Only the following languages were allowed: English, French, German, or Dutch. A total of 1837 relevant references were identified through the initial selected database searches, of which 494 were removed due to duplication. In screening the titles and abstracts, 1272 references were excluded. Full text assessment was done on the 71 remaining. Articles were excluded for any of the following reasons: The article was a case report, the article was a randomized controlled trial or cohort study, the article was not about therapeutic or diagnostic lumbar puncture, the article was not about needle size or design, the article was not about PDPH. Finally, 29 references made it to this review of literature following the PRISMA flowchart (Figure 1).

Results

Numerous randomized controlled trials (RCTs) have compared different sizes and shapes of traumatic with atraumatic needles[7]. At the end of 20th century, two meta-analyses were published on this subject during spinal anesthesia. Unfortunately, these authors produced meta-analyses of poor quality by today's standards[27,45]. From 2016 to present seven systematic reviews were published, five combined with meta-analyses[1,6,8,24,46,47] of which two also with a meta-regression analysis[24,46,47], one combined with a network meta-analysis3, and one Cochrane review[7] (Table I). Fortunately, these reviews have much stronger designs and are worthwhile of a more extensive review.

The oldest of these reviews, the systematic review and meta-analysis by Zhang et al.[1], compared Whitacre (atraumatic type) with Quincke (traumatic type) needles for spinal anesthesia. The primary outcome, frequency of PDPH, was significantly reduced by the Whitacre needle (RR 0.34; 95% CI (0.22, 0.52); P<.00001). The atraumatic type was also superior for the secondary outcomes, as the severity of PDPH and frequency of an EBP were both significantly lower. However, this meta-analysis comes with its limitations as only nine RCTs with 2463 patients were included and these lacked long-term follow-up as patients were only followed one week after the procedure. In addition, only spinal anesthesia was studied and only two types of needles were compared, the Whitacre and Quincke spinal needles[1].

One year later, the same authors opposed these limitations in a new systematic review and meta-analysis by Xu et al.[8]. They included 25 RCTs comparing traumatic versus atraumatic needles for all types of spinal needles and in patients given both elective spinal anesthesia and diagnostic lumbar puncture. Based on their analysis of a total of 6539 patients, the incidence rate of PDPH in the traumatic group was significantly higher than in the traumatic group (RR 2.50; 95% CI (1.96, 3.19); P<.00001). Furthermore, the traumatic group resulted in significantly more severe PDPH (2.3 times higher) and more use of an EBP (4.6 times higher). It is important to note that needle size was not taken into account. Therefore bias was introduced, as needle size widely varied from 22 to 27G while comparing

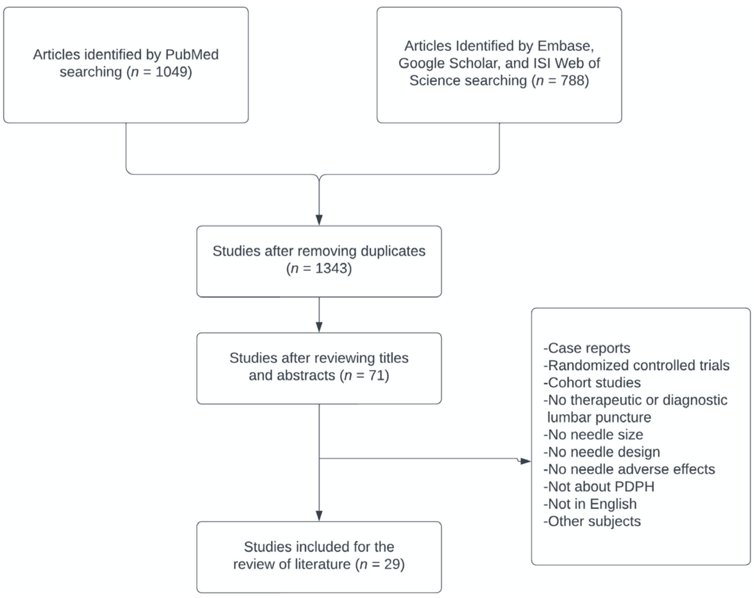

Fig. 1 — Methodology PRISMA Flowchart.

Table I. — Summary table of the selected literature.

Authors	Year	Type	Size	RCTs	Type of lumbar puncture	Outcome
Zhang et al.[1]	2016	Systematic review + Meta-analysis	2463	9	Therapeutic (Spinale anesthesia)	Effect of design
Xu et al.[8]	2017	Systematic review + Meta-analysis	6539	25	Therapeutic (Spinale anesthesia) + Diagnostic	Effect of design
Arevalo-Rodriguez et al.[7]	2017	Cochrane review	17067	66	Therapeutic (Spinale anesthesia) + Diagnostic	Effect of size and design
Zorilla-Vaca et al.[46]	2018	Systematic review + Meta-analysis + Meta-regression analysis	16416	57	Therapeutic (Spinale anesthesia)	Effect of size and design
Lee et al.[24]	2018	Systematic review + Meta-analysis + Meta-regression analysis	4936	20	Therapeutic (Spinale anesthesia, only caesarian section)	Effect of size and design
Nath et al.[6]	2018	Systematic review + Meta-analysis	31412	110	Therapeutic (Spinale anesthesia) + Diagnostic	Effect of design
Maranhao et al.[3]	2021	Systematic review + Network meta-analysis	14961	59	Therapeutic (Spinale anesthesia)	Effect of size and design

different needle tips. Nonetheless, this meta-analysis was the first comparing all types of spinal needles that recommended the use of atraumatic spinal needles in both therapeutic (spinal anesthesia) and diagnostic lumbar punctures[8].

These findings were confirmed in a Cochrane systematic review in 2017 by Arevalo-Rodriguez et al.[7]. This review aimed to assess the effects of needle design (traumatic vs atraumatic) and tip size (gauge) on the prevention of PDPH for lumbar puncture in neurological, anesthesia or myelography settings. A total of 66 trials with 17067 participants were included, however only 36 trials with 9378 participants compared traumatic and atraumatic needles. The authors found that the risk of PDPH was almost doubled when a traumatic needle was used (RR 2.14; 95% CI (1.72, 2.67); $I^2 = 9\%$). Also, atraumatic needles did not increase development of adverse effects such as backache and paresthesia. Note that this review concluded that the overall quality of evidence supporting atraumatic needles was only moderate-quality evidence. The authors themselves lowered the quality of evidence from high to moderate due to lack of reporting on randomization in the included studies, making it difficult to interpret the risk of bias[7]. Subsequently, using large or small gauges in both traumatic and atraumatic needles showed no significant overall difference in terms of risk of PDPH[7,48]. As only 10 trials with 2288 participants compared gauge, the quality of evidence for needle size was lowered even further to low-quality evidence due to imprecision. In their conclusion, the researchers suggest a strong need for further research in an effort to increase the quality of evidence[7].

Zorilla-Vaca et al.[46,47] investigated the impact of needle design and size on the incidence of PDPH among patients undergoing spinal anesthesia through a systematic review with meta-analysis and meta-regression analysis. Originally published in July 2016[47], the article got republished in July 2018 by the same author[46]. The reworked version upgraded its inclusion of RCTs from 34 to 57, hereby almost doubling the included patients to a total of 16416. The meta-analysis concluded that the atraumatic design is associated with a statistically significant reduction in incidence of PDPH (RR 0.41; 95% CI (0.31, 0.54); P<.001; I2 = 29%) in RCTs assessing both needle designs. As previous reviews did not systematically adjust for potential covariates, several subgroup analysis were performed. First, a subgroup analysis among obstetric and non-obstetric procedures resulted in the same conclusion. Second, upon adjustment for two patient-related variables (i.e. age and sex), the meta-regression analysis showed a statistically significant inverse correlation between needle gauge and rate of PDPH for traumatic needle design ($\beta = -2.65\%$; P<.001), but not atraumatic design ($\beta = -0.01\%$; P=0.819)46. Keep in mind that pooling accumulative incidences from different studies in a meta-regression produces bias as it loses the benefit of randomized comparisons[3,46]. Also, bias by underpowered sample sizes is possible. These results suggest that whereas needle gauge significantly impacts the incidence of PDPH in traumatic needle design, gauge does not show a similar relationship in atraumatic needle design. In other words, when choosing an atraumatic needle design for spinal anesthesia, smaller-caliber needles may not lead to a significantly lower incidence of PDPH[46].

Subsequently, Lee et al.[24] confirmed these results in a systematic review with meta-analysis and meta-regression analysis limited to patients undergoing Cesarean section with spinal anesthesia. Similarly, the meta-regression for atraumatic needles found no correlation between gauge and incidence of PDPH (P = 0.167), whereas for traumatic needles finer gauges were associated with lower PDPH incidence (P < 0.001). The meta-analysis, including 20 RCTs with 4936 patients overall, only had 5 RCTs favoring atraumatic needles for reducing PDPH as 15 RCTs were inconclusive. However, the pooled estimate clearly showed reduced PDPH with atraumatic (RR 0.33; 95% CI (0.25, 0.45); I2 = 0%) compared to traumatic needles.

Requirement of EBP was also vastly lowered in atraumatic spinal needles (RR 0.21; 95% CI (0.09, 0.51); I2 = 0%). However, the included studies come with high selection bias as only 15% (3/20) of studies adequately report method of allocation concealment and method employed for generation of randomization sequence. Also, 40% (8/20) of studies were not blinded, thus raising performance and detection bias. Overall, the quality of evidence according to the GRADE criteria for quality across the outcomes was only moderate to low[24].

In March 2018, a thorough systematic review and meta-analysis by Nath et al.[6] was published in The Lancet that vastly distinguished itself from all previous meta-analyses in several aspects. They included 110 RCTs from 29 countries over a 28-year period (1989 to 2017) for a total of 31412 patients of whom 61.7% were women[6]. To acquire statistical power, the review included both diagnostic and therapeutic lumbar puncture[2,6]. The incidence of PDPH was 11.0% (95% CI 9.1-13.3) in the traumatic versus 4.2% (95% CI 3.3-5.2) in the atraumatic group, in essence a significant reduction of PDPH by about 60% in the atraumatic group compared to the traumatic group (RR 0.40; 95% CI (0.34, 0.47); P<0.0001) with an absolute risk difference of 6.8% and a number needed to treat to prevent harm of 5. Moreover, atraumatic spinal needles showed a significant reduction in the need for EBP (RR 0.50; 95% CI (0.33, 0.75); P=0.001), with overall 1.1% of patients in the atraumatic group required EBP compared with 3.0% in the traumatic group. Similarly, the need for intravenous fluid or controlled analgesia, mild PDPH, severe PDPH, any headache, nerve root irritation, and hearing disturbance were all reduced significantly by atraumatic spinal needles. Heterogeneity was moderate between included studies (I2 = 45.4%), calling into question the validity of the results. Therefore, subgroup analyses were performed, showing that atraumatic needles reduced PDPH in each subgroup of sex, needle gauge (20-22 vs 23-26 vs >26), patient position, indication for lumbar puncture, and clinical specialty. This observation shows a true effect of atraumatic needles, rather than an artefact of heterogeneity or specific patient or procedural characteristics. Nath and colleagues do not only show the true benefit of atraumatic needles on safety, but also report no significant differences on efficacy. The rate of success on first attempt, the rate of failure, and the mean number of attempts were all similar between the two needles groups. Using the GRADE approach, the quality of evidence of both efficacy and safety of atraumatic needles was rated as high6. In May 2018, Rochwerg et al.[49] published a BMJ Rapid Recommendation clinical practice guideline on traumatic vs atraumatic needles for lumbar puncture. It has a strong recommendation for the use of atraumatic needles for lumbar puncture in all patients regardless of age or indication and was mainly based on the meta-analysis of Nath et al[6,49].

Recently, Maranhao et al.3 published a systematic review with network meta-analysis in an attempt to provide an unbiased comparison of individual needles varying in size and design. In total 11 distinct spinal needles were analyzed from 59 RCTs with 14961 participants who underwent spinal anesthesia. The network had a high degree of connectivity with a beta index of three and a diameter of two. The 26G atraumatic (26A) needle had the lowest cumulative incidence of PDPH at 2.19% (95% CI (1.11, 4.25)), with the 26G traumatic (26T) needle having the highest at 7.85 (95% CI (6.53, 9.40)). The probability order of the needle least likely to cause PDPH was 26A>27A >29T>24A>22A>25A>23T>22T>25T>27T=26T. Meta-regression by participant position (sitting versus lateral) or type of surgery (obstetric versus non-obstetric) did not significantly alter this rank order. The 26A needle also topped the rank order for lowest likelihood of failure, with a cumulative incidence of 0.55% (95% CI (0.15, 1.97)). The smallest caliber needles (29T>27A>27T) were the worst in this parameter, with the 27T needle having a cumulative incidence of 0.83% (95% CI (0.54-1.28)). These last results clearly show the inherent deficiencies of the Bayesian network, as it produces often wide credible intervals that compromise the precision. As such, the results should be interpreted as a probability of a rank order rather than an absolute rank order. The results of this study put forward the 26G atraumatic spinal needle as the best needle for spinal anesthesia, as it is the least likely to cause PDPH and has the highest probability of successful insertion. Moreover, they provided evidence that there is no linear correlation in the ranking of spinal needles. This is demonstrated since the 29G traumatic needle ranks better than three atraumatic needles (29T>24A>22A>25A respectively) for the probability of having the lowest associated incidence of PDPH. Hereby, they show there are no simplistic linear ‘rules’ in choosing the best needle[3].

Discussion

The evidence presented in this review consistently shows that atraumatic needles are less likely than traumatic needles to cause PDPH[1,3,6,7,8,24,46,47]. Since this iatrogenic complication can be debilitating with long-term morbidity requiring recurrent hospitalizations, prevention is of utmost importance[6,7,8,14]. The most robust and broad analysis to date on needle tip design, both in diagnostic and therapeutic procedures, is the study by Nath et al.[6]. They found, with a high grading quality of evidence, that atraumatic needles were associated with a significant risk reduction of PDPH. Additionally, there was significantly less return to hospital for additional medical therapy or for EBP. They also report a similar efficacy between traumatic and atraumatic needles with no significant differences on the success and failure rates of lumbar punctures. In conclusion, their findings suggest the use of an atraumatic needle design with its favorable balance between safety and efficacy. However, the relationship between needle size and incidence of PDPH was not assessed[6].

Four systematic reviews attempted to assess the effect of needle size[3,7,24,46]. The meta-analysis of Arevalo-Rodriguez et al.[7] found no significant difference between 'small' and 'large' caliber in terms of risk of PDPH[3,7,48]. These results are strongly biased as the same needle gauge could have been marked as 'small' in one comparison and 'large' in another[3,7]. Both Zorilla-Vaca et al.[46] and Lee et al.[24] improved upon this by also performing a meta-regression analysis showing a statistically significant linear correlation between smaller needle size and a lower incidence of PDPH for the traumatic, but not the atraumatic design[24,46]. However, such analyses are biased by the loss of randomization since summing the odds from different studies does not account for the specific experimental conditions in the primary studies[3,46]. In order to preserve this strength of randomized comparisons and to provide an unbiased comparison of individual needles, Maranhao et al.3 pooled the odds using both direct and indirect estimates via a network of randomized comparisons. Their network meta-analysis on spinal anesthesia did not support a linear correlation between needle size and incidence of PDPH in either traumatic or atraumatic design. In addition, the analysis suggests that the 26 and 27G atraumatic needles are the least likely to cause PDPH[3].

The systematic reviews discussed above have several other limitations, primarily the inclusion of multiple small and low-quality RCTs[1,3,7,8,24,46]. Arevalo-Rodriguez et al.7 were the first to point at the imprecise reporting on randomization in the designs of these RCTs, therefore lowering the quality of their evidence from high to moderate. Secondly, the field of RCTs is vast thus introducing nonuniformity in the definitions of PDPH, the treatment of PDPH, and the length of follow-up[3,6,7,24,46]. Finally, often times important clinical outcomes are not being adequately reported such as severity of PDPH, and patient return to hospital for intravenous fluid, analgesia, or EBP administration[6,7]. Although the need for EBP is an obvious outcome of interest, Maranhao et al.3 did not consider it since the decision-making for administration of an EBP was rarely reported as well. Nath et al.6 did show a significant reduction in the need for EBP with atraumatic needles. Backed by their robust and broad assessment, they were able to rate the overall quality of their evidence on both safety and efficacy of atraumatic needles as high. Therefore they state that future research will not likely alter these findings. Consequently, we could change our focus to improving clinical decision making and raising awareness[6].

Informing health-care policy makers on the importance of switching needles could be done from the standpoint of cost[21,50]. Atraumatic needles tend to be up to three times as expensive, however they may prove to be cost-effective in the long run with fewer adverse effects[6,7,51-53]. Sadly none of the afore mentioned systematic reviews preformed a cost-effectiveness analysis[3,6,7,24,46]. However, Rochwerg et al.[49] reviewed three published cost-effectiveness studies, showing that reducing PDPH results in cost savings due to less additional patient care and less lost working hours for patients[21,50,54,55]. To alter the widespread use of traumatic needles, additional and more recent studies evaluating the costs associated with switching to atraumatic needles are warranted[7,56]. New studies are also needed comparing atraumatic needles with different tip in the same size, as well as their link with severe PDPH as it provides the largest burden for extra healthcare costs[7].

Although literature highlights the importance of switching to atraumatic needles from the standpoint of patient care, they are currently still underused[6,26,51,52]. Even though the anesthesia community has changed their practice to atraumatic needles for decades, other physicians are still reluctant to adopt atraumatic needles, particularly in Europe[26,51,53,57-62]. Davis et al.[51] argued this is due to the lack of awareness of the morbidity associated with PDPH. They highlight the discrepancy between those who perform lumbar punctures and those who treat PDPH[51]. Also, there is a common perception that atraumatic needles are technically more complex than traumatic needles[51,61]. Current evidence suggests that this is a misperception, recently undoubtably marked by Nath et al.[6] reporting a similar efficacy with no difference in success rate on the first attempt, overall failure rate, and mean number of attempts[1,6,8,27,41,63,64]. However, the main reason for non-adopting to atraumatic needles may be because the studied literature mainly comprises anesthesia as the indication for lumbar puncture[3,6,62]. In the last 10 years only a couple of RCTs were published on diagnostic lumbar puncture[62,65,66]. Therefore, the literature on needle size and design may indeed be biased from the anesthesiologist's point of view[67].

When choosing the ideal needle, PDPH and EBP are not the only factors to consider[67]. In haemato-oncology, the success of the first diagnostic lumbar puncture is crucial as intrathecal chemotherapy has not yet protected the central nervous system, and so a traumatic puncture that causes blood leakage can contaminate the CSF with blasts. Although these traumatic lumbar punctures or 'traumatic taps' can thus greatly compromise patient health, they are seldom researched[68]. Also, comparative studies on the intrathecal administration of chemotherapy with different spinal needles are unavailable[53]. In the elderly, the incidence of PDPH is lower cause of lower CSF pressure[69,70]. Even though this population may gain the most benefits from it, there is a lack of literature to support the overall safety of spinal anesthesia in elderly and consequently there is a scarcity of research on different needle tips[69]. In neurology, the measurement of intracranial pressure is important in clinical management and diagnosis of several neurological diseases[71]. In other words, this is the needle's ability to measure spinal canal opening pressure and the time to obtain this opening pressure[67]. All needles seem to reliably measure opening pressures in experimental settings[67,72,73]. Of note, the 25G needles take several more minutes than the 20 or 22G needles, due to a difference in flow rate of CSF[67]. Spinal needles and flow rates of CSF have been both experimentally and clinically assessed, with two clinical studies investigating CSF collection times[53,72-74]. Reducing size of the atraumatic needle from 20 to 22G increased CSF collection time with 3 to 4 minutes for 10mL of CSF, however this did not lead to additional discomfort with participants reporting similar stress and pain scores[74]. Further, the median time spend for collection with 25G atraumatic needles was 7 to 15 minutes, this being due to the need for CSF aspiration with a syringe thus requiring higher level of skill[72]. Mostly, smaller size spinal needles are less practical and the current literature leaves many questions unresolved[53,67,68,70-74].

Conclusion

Our review consistently shows that we need to discard the conventional traumatic needle tip design because of favorable safety and similar efficacy of the atraumatic needle tip design. However, we found many unresolved questions on needle tip size. Of note, there is no simple linear correlation between smaller needle size and lower incidence of PDPH in either needle type. In lumbar puncture for spinal anesthesia we advise the 26G atraumatic spinal needle as the preferred choice, as it is the least likely to cause PDPH and the most likely to enable successful insertion. If unavailable, the 27G atraumatic needle is the next best choice. The healthcare providers in charge of lumbar punctures should change practice now and adopt both atraumatic needles.

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