Preventing Post-Lumbar Puncture Headache

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Post-lumbar puncture headache is the main adverse event from lumbar puncture and occurs in 3.5% to 33% of patients, causing functional and socio-professional disability. We searched the post-lumbar puncture headache literature and, based on this review and personal expertise, identified and addressed 19 frequently asked questions regarding post-lumbar puncture headache risk factors and prevention. Among the nonmodifiable factors, older age is associated with a lower incidence of post-lumbar puncture headache, while female sex, lower body mass index, and history of headache might be associated with increased risk. The use of atraumatic, noncutting needles is the most effective intervention for post-lumbar puncture headache prevention. These needles are not more difficult to use than cutting needles. Other commonly recommended measures (eg, fluid supplementation, caffeine) appear unhelpful, and some (eg, bed rest) may worsen post-lumbar puncture headache. [Ann Emerg Med. 2021;78:443-450.]

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INTRODUCTION

Lumbar puncture is a procedure performed to collect cerebrospinal fluid from the subarachnoid space through a puncture between 2 lumbar vertebrae. Although adverse events and failures occur, most can be avoided with proper practices.[1]

Post-lumbar puncture headaches—headaches that appear when a patient is in a standing position, with complete relief upon recumbence—are caused by intracranial hypotension due to persistent leakage of cerebrospinal fluid through a tear in the meninges. It is the most common complication of lumbar puncture, observed in 3.5% to 33% of patients. It may cause severe complications on rare occasions, but it has been demonstrated to be responsible for significant functional and socio-professional disability.

Despite international guidelines,[1–3] lumbar puncture practices vary from setting to setting based on local traditions and experience. The objectives of this review were to provide evidence-based answers to frequently asked questions regarding post-lumbar puncture headache in order to improve knowledge regarding lumbar puncture, decrease the occurrence of adverse events, and homogenize practices.

METHODS

We searched the literature to identify all articles published between January 2000 and January 2020 in Medline and Cochrane databases using the Medical Subject Heading terms "lumbar puncture," "post-lumbar puncture headache," "post-dural puncture headache," "atraumatic needle," "complications," "prevention," "collection," "posture," and "fluids." We only included studies published in English and focused on diagnostic lumbar punctures. Studies and reviews on rachianesthesia (spinal anesthesia) and therapeutic lumbar punctures were discarded except when no data was available on the topic in terms of diagnostic lumbar punctures. Large studies and meta-analyses were considered if they included more than 50% diagnostic lumbar punctures. Papers were screened based on titles and abstracts, and the final selection was made after reading the full text of preselected articles. We also examined papers cited in the selected articles and included additional references based on their originality or relevance regarding the scope of this review. Data extraction was performed by 3 authors (EC, BK, and LD) according to their field of expertise using a standardized extraction form.

Based on review data and personal expertise, we identified 19 frequently asked questions regarding post-lumbar puncture headache risk factors and prevention. For each question, the level of evidence was rated based on the 2011 Oxford Center for Evidence-Based Medicine Levels of Evidence Table.[4]

RESULTS

Questions, answers, and evidence ratings are summarized in the Table.

Table. Summary of frequently asked questions included in the review with answer and evidence rating.

Question	Answer	Rating
Are some patients at increased risk of post-lumbar puncture headache?		
Are women more prone to post-lumbar puncture headache?	Debatable	4
Do thinner patients have a higher risk of post-lumbar puncture headache?	Debatable	3
Does post-lumbar puncture headache occur in newborns and children?	Yes	3
Does aging protect against post-lumbar puncture headache?	Yes	3
Do patients with chronic headaches develop post-lumbar puncture headache more frequently?	Debatable	2
Do underlying diseases and medications increase the risk of post-lumbar puncture headache occurrence?	No	2
Which needle should I choose and how should I handle it to minimize the risk of post-lumbar puncture headache?		
Are atraumatic needles really effective for post-lumbar puncture headache prevention?	Yes	1
Does needle diameter affect post-lumbar puncture headache risk?	Debatable	2
Should the needle be handled in a specific way to minimize post-lumbar puncture headache incidence?	Debatable	2
Is it more difficult to perform lumbar puncture with atraumatic needles?	No	1
Should I perform lumbar puncture in a specific way to prevent post-lumbar puncture headache?		
Does position during lumbar puncture matter?	Yes	2
Is there a preferred intervertebral space?	Yes	4
Are difficult lumbar punctures at higher risk of causing post-lumbar puncture headache?	No	3
Should I limit cerebrospinal fluid volume to lower the risk of post-lumbar puncture headache?	No	3
Is it dangerous to aspirate cerebrospinal fluid with respect to post-lumbar puncture headache risk?	No	3
Is there something to do after lumbar puncture to reduce post-lumbar puncture headache occurrence?		
Should patients rest after lumbar puncture?	No	1
Is fluid supplementation useful to prevent post-lumbar puncture headache?	No	2
Is caffeine efficient for post-lumbar puncture headache prevention?	No	5
Are there other pharmacological agents of interest for post-lumbar puncture headache prevention?	Debatable	4

Levels of evidence were rated based on the 2011 Oxford Center for Evidence-Based Medicine Levels of evidence Evidence 2011 table4 as follows: level 1, systematic review of randomized trials; level 2, randomized trial or observational study with dramatic effect; level 3, non-randomized controlled cohort/follow-up study; level 4, case- series, case-control studies, or historically controlled studies; level 5, mechanism-based reasoning. Level of evidence has been adapted (graded down) on the basis of study quality, imprecision, or indirectness, because of inconsistency between studies, or because the absolute effect size was very small

Are some patients at increased risk of post-lumbar puncture headache?

Are women more prone to post-lumbar puncture headache? Debatable.

One study by Engedal et al[5] identified female sex as a risk factor for post-lumbar puncture headache. In this study, which involved 501 patients, the relative risk (RR) of post-lumbar puncture headache in women compared to men was 2.58 (95% CI, 1.39 to 4.82) (P=.003). Numerous other studies, however, including multicentric, high-quality, and prospective studies, failed to replicate those observations.[6,7] This discrepancy may be due to confounding factors that might not have been corrected for in the study by Engedal et al, such as weight, age, or comorbidities (see below).

Do thinner patients have a higher risk of post-lumbar puncture headache? Debatable.

The same prospective sequential design study by Engedal et al[5] found a significant increase in the risk of post-lumbar puncture headache in patients with body mass indices (BMIs) of less than 20 kg/m^2. These results were corroborated by 2 retrospective studies that found that patients who developed post-lumbar puncture headache had significantly lower BMIs (23.4 and 24.5 for patients with and without post-lumbar puncture headache, respectively; P=.022)[8] and that a BMI of less than 25 kg/m^2 was significantly associated with an increased risk of post-lumbar puncture headache (odds ratio [OR], 3.26 [1.53 to 6.96]; P=.001).[9] This could be linked to the well-known positive relationship between BMI and cerebrospinal fluid opening pressure,[10,11] which may exert a protective effect against cerebrospinal fluid hypotension in patients with higher BMIs. This converging data between BMI or body weight and post-lumbar puncture headache occurrence, however, has not been confirmed by more recent studies,[12,13] and further investigation is needed.

Does post-lumbar puncture headache occur in newborns and children? Yes.

Although clinical diagnosis may be difficult in infants, the prevalence of post-lumbar puncture headache in children seems in line with the prevalence observed in adults (between 12% and 15%),[14–16] with similar clinical presentation: frontal and/or occipital bilateral headache beginning within 24 hours after lumbar puncture, which decreases when lying down and worsens while standing, possibly accompanied by nausea, neck pain, or visual, vestibular, or cochlear symptoms.[14]

It should be noted that the literature regarding the use of atraumatic needles is much less abundant for children than for adults. Thus, most studies included in this review used classic cutting needles. Taking this into account, it has been suggested that for children, the orientation of the bevel parallel to the spine axis, the reinsertion of the stylet before needle removal, and the withdrawal of a low volume of cerebrospinal fluid are associated with a lower risk of post-lumbar puncture headache.[14] Needle gauge and bed rest do not seem to affect the incidence of post-lumbar puncture headache in children.[17,18]

Does aging protect against post-lumbar puncture headache? Yes.

Older age is believed to play a protective role against post-lumbar puncture headache. In an extensive study of more than 10,000 lumbar punctures, the incidence of post-lumbar puncture headache was less than 5% in individuals over 60 years old, while it was up to 15% in younger individuals.[19] Recently, Salzer et al[20] reported a lower risk of post-lumbar puncture headache in older patients who displayed the clearest needle effect. Various mechanisms have been proposed to explain this reduction of post-lumbar puncture headache during the later years of life. Moreover, the prevalence of post-lumbar puncture headache is even lower in patients with cognitive impairment or cerebral atrophy, likely due to the enlargement of cerebrospinal fluid spaces. Indeed, Blennow et al[21,22] reported a strikingly low prevalence of post-lumbar puncture headache (2% to 2.6%) in 2 studies conducted on patients with cognitive disturbance. Furthermore, symptoms were mild in all cases but one, and they usually resolved within 2 days. Notably, the authors acknowledged that some of the participants with severe cognitive impairment might have been unable to report headaches after lumbar puncture, which could have been responsible for the underestimation of the actual prevalence of post-lumbar puncture headache in their studies.

Do patients with chronic headache develop post-lumbar puncture headache more frequently? Debatable.

Reports regarding the association between post-lumbar puncture headache and a history of chronic headaches are conflicting. Indeed, a reduced incidence of post-lumbar puncture headache was reported in migraine sufferers compared to controls (28% and 44.9%, respectively) in a prospective study using classic traumatic needles.[7] In contrast, in a pilot study published in 2012, Kim et al[23] observed that 27.3% of patients who developed post-lumbar puncture headache reported a history of chronic headaches, compared to only 2.1% of patients without post-lumbar puncture headache. These data were confirmed by a prospective multicentric study that enrolled 3,686 participants in 23 memory centers.[7] This study found an OR of 1.76 (1.16 to 2.59) in patients reporting a history of mild headaches and an OR of 2.65 (1.88 to 3.74) in patients with a history of moderate-to-severe headaches. A different study—which had a similar design but a smaller population (689 participants) and did not stratify the analysis based on headache severity—failed to identify a significant increase in the risk of post-lumbar puncture headache in patients with a history of headaches (OR, 1.47 [0.81 to 2.67]).[6]

Interestingly, the study by Kim et al[23] also suggested that a history of post-lumbar puncture headache was associated with an increased risk of post-lumbar puncture headache occurrence.

Do underlying diseases and medications increase the risk of post-lumbar puncture headache occurrence? No.

Diagnostic lumbar punctures are performed in patients presenting various neurological and nonneurological disorders. Post-lumbar puncture headache occurrence has been assessed in some of them. Among patients with cognitive complaints included in the Alzheimer's Disease Neuroimaging Initiative, Vidoni et al[24] reported no significant differences in post-lumbar puncture headache incidence between patients without dementia and patients with mild cognitive impairment or in the subgroup of patients whose cerebrospinal fluid biomarkers were indicative of Alzheimer's disease. Duits et al[7] reported a similar absence of difference in the risk of post-lumbar puncture headache between nondemented patients and patients with mild cognitive impairment. However, they identified dementia as a protective factor against post-lumbar puncture headache development (OR, 0.66 [0.55 to 0.8]) after correction for age. Another prospective study focused on cerebral inflammatory diseases and found no difference in the occurrence rate of post-lumbar puncture headache among patients with clinically isolated syndrome or multiple sclerosis compared to patients with other diagnoses.[12] Similarly, a study performed on HIV patients and controls identified no association between HIV

serological status and post-lumbar puncture headache incidence.[9] Likewise, the rates of post-lumbar puncture headache reported in a noncomparative study related to amyotrophic lateral sclerosis, while high (15% to 28%), remained in the usual ranges for lumbar punctures performed with cutting needles.[25]

Regarding the association between patients' medications and post-lumbar puncture headache, only aspirin has been evaluated in a single monocentric retrospective cohort study of 274 patients who had undergone lumbar puncture over a 2-year period. The study reported a decrease in the relative risk of post-lumbar puncture headache in patients taking aspirin using univariate analysis (RR, 0.17 [0.04 to 0.73]) that no longer existed when multivariate analysis was performed.[13]

Which needle should I choose and how should I handle it to minimize the risk of post-lumbar puncture headache?

Are atraumatic needles really effective for post-lumbar puncture headache prevention? Yes.

Historically, lumbar puncture has been performed with a sharp cutting point ("Quincke") needle. Noncutting—atraumatic—needles with a rounded point (ie, pencil-point "Whiteacre" needles and bullet-point "Sprotte" needles) were developed in the 1980s in order to limit dura mater fiber lesions and, ultimately, cerebrospinal fluid leaking. Indeed, studies performed *in vitro* on postmortem dura maters have shown that wounds caused by the 2 types of needles differ; punctures with cutting needles result in U-shaped lesions, while atraumatic needles produce more rounded holes. Microscopic examination confirmed that the former caused more disruption and compression of the dura fibers, while the latter caused a clean-cut opening of the dural membrane.[26,27] Consequently, cutting point needles resulted in a fivefold increase of fluid leakage compared to noncutting needles of the same diameter.[28]

Many studies have compared cutting and noncutting needles regarding the risk of post-lumbar puncture headache. Most of them reported a highly significant increase in post-lumbar puncture headache when lumbar puncture was performed using cutting needles. This has been confirmed by 2 large meta-analyses (17,067 and 20,241 lumbar punctures); the first found an increase in post-lumbar puncture headache risk by a factor of 2.14 (1.72 to 2.67) when using cutting compared to atraumatic needles, while the second identified a relative risk of post-lumbar puncture headache of 0.4 (0.34 to 0.47) with atraumatic needles compared to cutting needles.[29,30] Importantly, while these meta-analyses included lumbar punctures performed for any purpose (eg, diagnosis, anesthesia, treatment), studies that focused only on diagnostic lumbar punctures found similar reductions in the risk of post-lumbar puncture headache with the use of noncutting needles. For instance, Salzer et al[20] recently reported that the use of atraumatic needles reduced the occurrence of post-lumbar puncture headache with an OR of up to 0.58 (0.4 to 0.82) when standard 22-gauge cutting needles were compared to 25-gauge atraumatic needles in a prospective controlled trial on diagnostic lumbar punctures.

Does needle diameter affect post-lumbar puncture headache risk? Debatable.

Needles of a wide range of diameters—from 19- or 20-gauge to 25- or 27-gauge—are used in daily clinical practice depending on both local habits and the purpose of the lumbar puncture. Consequently, data regarding the impact of needle diameter on the risk of post-lumbar puncture headache are much more heterogeneous than those regarding needle type. Indeed, while 2 studies concluded to a reduced risk of post-lumbar puncture headache when using smaller-caliber needles,[12,24] a large meta-analysis failed to identify a relationship between needle diameter and the occurrence of post-lumbar puncture headache.[29] The meta-analysis separately analyzed the impact of needle gauge on the risk of post-lumbar puncture headache in lumbar punctures performed with cutting and atraumatic needles. It failed to demonstrate any effect in either setup (emphasizing, however, the high heterogeneity and poor global quality of the studies). Importantly, in their monocentric prospective randomized control trial, Salzer et al[20] recently reported a significant decrease in the risk of post-lumbar puncture headache when using a 25-gauge atraumatic needle instead of a 22-gauge atraumatic needle (OR, 0.65 [0.45 to 0.93]).

Should the needle be handled in a specific way to minimize post-lumbar puncture headache occurrence? Debatable.

It has been hypothesized that strands of arachnoid might be trapped in the lateral eye of atraumatic needles, causing the worsening of dura mater injury during needle removal and, eventually, increased cerebrospinal fluid leaking. This issue might be prevented by the reinsertion of the stylet into the canula prior to needle removal. A prospective randomized trial that enrolled 600 patients undergoing diagnostic lumbar puncture showed a highly significant difference favoring stylet reinsertion (5% post-lumbar puncture headache compared to 16.3% when stylet was not reinserted; $P<.005$).[31] A recent prospective randomized trial did not corroborate these results, however, leaving this question unanswered.[20]

When using cutting needles, a meta-analysis of 5 randomized studies demonstrated that the orientation of the bevel parallel to the axis of the spine significantly lowers post-lumbar puncture headache incidence (OR, 0.29 [0.17 to 0.5]).[32]

Is it more difficult to perform lumbar puncture with atraumatic needles? No.

Some clinicians who are used to traditional cutting point needles are reluctant to move to atraumatic needles because the need of an introducer would supposedly increase the technical difficulty of lumbar puncture. Several studies have explored this issue. All showed that use of atraumatic needles for lumbar puncture did not affect the rate of success, success on the first attempt, or duration of the procedure.[20,33,34] Interestingly, Engedal et al[5] performed a study with a sequential design in which they compared indicators of lumbar puncture success and ease in a neurology department during 2 time periods. During the first one (249 lumbar punctures), only cutting point needles were used; they were replaced by atraumatic needles during the second period (252 lumbar punctures). During the atraumatic needle period compared to the first period, the study revealed a significant reduction in both the number of lumbar punctures needing more than one attempt (30% and 44%, respectively; P=.001) and the failure rate of the first operator (17% and 29%, respectively; P=.005). It must be taken into account, however, that experience regarding practice of lumbar puncture acquired by residents during the first period of the study might have positively impacted the rate of success in the second period. Altogether, these results suggest that if operators receive proper training, atraumatic needles should be considered as easy to use as traumatic ones.

Should I perform lumbar puncture in a specific way to prevent post-lumbar puncture headache?

Does position during lumbar puncture matter? Debatable.

In clinical practice, lumbar puncture is usually performed either in the seated or lateral decubitus position. Indeed, both of these positions—especially the seated one—allow for good hip flexion that results in a widening of interspinous space, a key determinant of lumbar puncture success.[35,36] While data regarding purely diagnostic lumbar punctures are scarce, some evidence pleads for a protective effect of the lateral decubitus position toward post-lumbar puncture headache. Four studies showed such a reduction of post-lumbar puncture headache for patients in which lumbar puncture had been performed in lateral decubitus, including the one performed by Duits et al[7] that reported an OR of 0.6 [0.3 to 0.9].[7,8,37,38] These results are in line with those of a meta-analysis of 7 studies (including mainly rachianesthesia but also diagnostic lumbar punctures), which found a RR of post-lumbar puncture headache of 0.61 (0.44 to 0.86) in patients in lateral decubitus during lumbar puncture as compared to those performed in the seated position.[39]

Is there a preferred intervertebral space? Yes.

Lumbar puncture may be performed safely through a wide range of intervertebral spaces (from between L3 and L4 to between L5 and S1).[1] Unfortunately, pertinent data that are truly relevant to clinical practice are lacking. One retrospective study of 724 lumbar punctures using both traumatic and atraumatic needles reported the frequency of post-lumbar puncture headache depending on the punctured interval assessed by fluoroscopy, using blood patch as a surrogate marker. Interestingly, it showed a direct correlation between the punctured level and the incidence of post-lumbar puncture headache, with the lower levels being associated with a higher incidence (ranging from 5.2% between L1 and L2 to 16.2% between L4 and L5).[40]

Are difficult lumbar punctures at higher risk of causing post-lumbar puncture headache? No.

It may be hypothesized that difficult lumbar punctures (multiple attempts, hemorrhagic cerebrospinal fluid, etc) that could cause increased damage to the dura mater confer a higher risk of post-lumbar puncture headache. Data focusing on this issue are scarce, but a few studies counter this suggestion. Indeed, Hammond et al,[41] who analyzed the factors associated with post-lumbar puncture headache in 266 consecutive patients who had undergone lumbar puncture over 1 year in a clinical setting, did not find any association between the number of attempts, the presence of more than 5 red blood cells per μL of cerebrospinal fluid, and post-lumbar puncture headache occurrence. Another indicator of difficult lumbar puncture may be needle deformation. Similarly, measurement of needle deformation did not detect any association between needle bending and post-lumbar puncture headache, even for angles higher than 5°. Of note, however, is that post-lumbar puncture headache was very frequent (6 out of 7 cases) when the needle tip was deformed in a specific "hook" shape.[42]

Should I limit cerebrospinal fluid volume to lower the risk of post-lumbar puncture headache? No.

While about 500 mL of cerebrospinal fluid are produced every day, the central nervous system contains only approximately 125 mL of cerebrospinal fluid at one

time.[43] Thus, clinicians are often reluctant to withdraw more than 10 to 15 mL of fluid per sample. Five studies tried to correlate withdrawn cerebrospinal fluid and post-lumbar puncture headache,[12,25,40,41,44] but only one of them identified such a relationship.[25] Moreover, in a very detailed observational study on 338 lumbar punctures performed in older patients, Monserrate et al[44] identified an inverse association between sample volume and occurrence of post-lumbar puncture headache. Indeed, while immediate postprocedural headaches increased with sample volume, the risk of post-lumbar puncture headache was significantly diminished (RR, 3.07 [1.11 to 8.49]) in sample volumes of more than 17 mL compared to sample volumes of less than 17 mL. Interestingly, in this study, 33 patients had more than 30 mL of cerebrospinal fluid collected. Only 3 of them (9.1%) developed post-lumbar puncture headache (compared to 40.9% in the less than 17 mL group and 16.6% in the 17 to 30 mL group).

Is it dangerous to aspirate cerebrospinal fluid with respect to post-lumbar puncture headache risk? No.

According to Poiseuille's law, flow rate through a needle is highly dependent on the needle's diameter (radius^4 relationship). Consequently, increasing needle gauge may increase collection time by gravity drip, as recently demonstrated by Salzer et al.[20] Thus, alternative collection techniques have been proposed, such as negative pressure and active suction, which dramatically reduce collection times.[45] None of 5 prospective and retrospective cohort studies identified a significant difference in the respective risk of post-lumbar puncture headache after sampling using one method or the other.[9,12,24,44,45] For instance, Vidoni et al[24] analyzed the effects of different needles and sampling methods on the incidence of post-lumbar puncture headache after the first lumbar puncture in patients included in the Alzheimer's Disease Neuroimaging Initiative database. In their study, 20 of 300 patients (6.7%) developed post-lumbar puncture headache after cerebrospinal fluid withdrawal using syringe suction, compared to the 8 of 214 patients (3.7%) whose sampling had been performed by gravity drip (P=.31).

Is there something to do after lumbar puncture to reduce post-lumbar puncture headache occurrence?

Should patients rest after lumbar puncture? No.

It is widely accepted that prolonged decubitus after lumbar puncture is a key measure in reducing the incidence of post-lumbar puncture headache.[46] None of the numerous studies that tried to substantiate this practice, however, demonstrated any protective effect of decubitus (whatever the type and duration of decubitus) on post-lumbar puncture headache.[7,47–52] Conversely, a 2016 Cochrane review[46] that included 2,996 patients from 24 studies showed that decubitus after lumbar puncture was associated with a low, but significant, increase in the relative risk of post-lumbar puncture headache (1.24 [1.05 to 1.48]) compared to immediate mobilization.

Is fluid supplementation useful in preventing post-lumbar puncture headache? No.

Oral or parenteral fluid supplementation is one of the most traditional methods used to prevent post-lumbar puncture headache. The rationale is so logical and simple (the addition of external fluid to replace leaked internal fluid) that its effectiveness has barely been scientifically evaluated. Indeed, only one controlled study, published in 1988 by Dieterich and Brandt, [53] analyzed the effect of oral fluid supplementation (3 L/day and 1.5 L/day) in 100 patients undergoing lumbar puncture. In this study, authors found no difference in the rate of post-lumbar puncture headache between the 2 groups. A Cochrane meta-analysis[46] recently reviewed this study and concluded that there was low-quality evidence of an absence of benefit of fluid supplementation on the incidence of post-lumbar puncture headache. Indeed, this review concluded that there was no benefit of fluid supplementation in the prevention of any headache occurring after lumbar puncture.

Is caffeine efficient for post-lumbar puncture headache prevention? No.

Patients are frequently advised to drink coffee or cola after lumbar puncture, as caffeine is supposed to be an efficient preventive agent for post-lumbar puncture headache.[54] Evidence is lacking, however, as shown by Halker et al[54] in their 2007 review. Indeed, they identified only 5 studies, with small sample sizes, methodological flaws, and inconsistent designs that reported conflicting results. To the best of our knowledge, no additional trials have been conducted since the publication of this paper.

Are there other pharmacological agents of interest for post-lumbar puncture headache prevention? Debatable.

Frovatriptan has been proposed as an option for post-lumbar puncture headache prevention in patients undergoing lumbar puncture in an uncontrolled study that has not been replicated so far.[55] Some evidence supports the effectiveness of morphine, cosyntrophine, or aminophylline in the prevention of post-lumbar puncture headache caused by regional anesthesia (mainly

in obstetric patients).[56] As previously emphasized, those observations might not be extrapolated to patients undergoing diagnostic lumbar puncture due to the major differences between this procedure and rachianesthesia.

CONCLUSION

Among nonmodifiable factors, older age is associated with lower incidence of post-lumbar puncture headache, while female sex, lower body mass index, and history of headache might be associated with increased risk. The use of atraumatic, noncutting needles is the most effective intervention for post-lumbar puncture headache prevention. These needles are not more difficult to use than cutting needles. Other commonly recommended measures (eg, fluid supplementation, caffeine) appear unhelpful, and some (eg, bed rest) may worsen post-lumbar puncture headache.

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