Post-Lumbar Puncture Headache: A Review of Issues for Nursing Practice

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ABSTRACT

Headache is the most common complication after lumbar puncture. This narrative review explores the literature to determine strategies for preventing headache and provide evidence-based nursing care to adults with post-lumbar puncture headache. Multiple findings regarding prevention and relieving of post-lumbar puncture headache were identified and summarized under the headings ''Needle Design and LP Technical Procedure,'' ''Bed Rest and Early Mobilization,'' ''Posture and Head Position,'' ''Cerebral Vasoconstriction,'' ''Hydration and Seal of the Puncture Site,'' and ''Patient Characteristics.'' Despite the amount of articles, no widely accessible nursing practice guidelines were found. It has been shown that several treatments with insufficient or low levels of evidence supporting their efficacy are still being used (e.g., prolonged bed rest, special postures in bed, additional fluid intake, and caffeine intake). A clear recommendation regarding using atraumatic, small-sized needles. Further research is needed to support nursing with stronger evidence.

Keywords: epidural patch, evidence-based nursing, nursing, post-lumbar puncture headache

Lumbar puncture (LP) is a procedure commonly performed to assess neurological diseases such as meningitis and multiple sclerosis, measure brain enzymes and metabolite levels, administrate intrathecal chemotherapy, and measure the cerebrospinal fluid (CSF) pressure (Kluge et al., 2001).

Headache is the most common complication after LP: some authors report an incidence of 10%–30% (Sun-Edelstein & Lay, 2012), whereas others state that it can occur in 70% of the cases (Kessler & Wulf, 2008). The variable incidence of post-LP headache (PLPH) is based on several factors such as the needle gauge and orientation, operators' skills, and presence of risk factors such as history of PLPH (Turnbull & Shepherd, 2003). The incidence of headache after diagnostic LP, on which this article is focused, reaches 36% according to some authors (Lavi, Rowe, & Avivi, 2010). Headache after diagnostic puncture occurs twice as often as after spinal anesthesia, because of the less traumatic needles used in anesthesia (Alstadhaug, Odeh, Baloch, Berg, & Salvesen, 2012; Ghaleb, 2010).

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The authors declare no conflicts of interest.

DOI: 10.1097/JNN.0000000000000052

The International Headache Society (IHS) defined PLPH as a position-dependent headache, frequently associated with nausea, vomiting, dizziness, tinnitus, and visual disturbances (Dakka, Warra, Albadareen, Jankowski, & Silver, 2011; Rodriques & Roy, 2007). The PLPH appears or worsens significantly upon assuming the upright position and resolves or improves in supine position. The PLPH can cause considerable pain and disability; according to the World Health Organization (2004), the impact of headache is a major problem for individual patients and society.

The headache is usually located in the frontal or occipital area, but it can radiate to the neck and shoulders. Less commonly reported sites are the temporal, vertex, and nuchal areas. Symptoms potentially associated with PLPH are nausea, vomiting, hearing loss and tinnitus, vertigo, diplopia, dizziness, limb pain, cranial nerve palsies, and paresthesia of the scalp (Lavi et al., 2010).

In the past few years, some authors (Luostarinen, Heinonen, Luostarinen, & Salmivaara, 2005) analyzed the social and economic costs of PLPH: even with a small sample size ($n = 78$), they showed that activities of daily living were impaired in 33% of patients. Generally, headaches lead to difficulties in performing work activities, and patients often have to give up sports and hobbies. Their learning ability is at risk, and the impact on family life should not be underrated (Stovner & Andrée, 2008). In accordance with the IHS diagnostic criteria, headache usually begins within 48 hours from the puncture and spontaneously disappears within 1 week (Rodriques & Roy, 2007). Nevertheless, some authors suggest that the IHS diagnostic criteria for PLPH should not contain any strict rules

regarding time and that PLPH could be diagnosed in patients who experience headache that worsens within 15 minutes after sitting or standing and improves within 15 minutes after lying down, with at least one symptom among neck stiffness, tinnitus, hypoacusia, photophobia, and nausea (Dakka et al., 2011). These criteria allow to differentiate PLPH from other types of headache. Generally, PLPH is believed to be a consequence of CSF leakage through the dural rent created by LP. However, some studies have identified a vascular regulation problem as a possible cause (Halker et al., 2007).

Nursing care before and during LP is generally unambiguous; the management criteria regarding punctures, patients' recumbent position, and preparation of the necessary equipment are the same almost everywhere (Farley & McLafferty, 2008; Rushing, 2007). However, the criteria of treatment adopted in clinical settings vary considerably and are often incompatible with current evidence (Williams, Lye, & Umapathi, 2008). Moreover, practical information for nursing sometimes needs to be retrieved from a number of different articles. These facts account for the need of a comprehensive review of the literature, aimed at presenting strong evidences. This article presents a narrative review of the literature related to LP, to explore the available evidence regarding prevention, causes, and therapies for PLPH in adult patients as well as discussing its implications for nursing.

Method

We accessed four databases (the American Academy of Neurology, The Cochrane Library, PubMed, CINAHL) and used several search strings: "spinal puncture, post lumbar, dural, postdural, puncture, needle"; "headache, back pain, backache"; "bed rest, posture, immobilization, early ambulation"; and "caffeine/therapeutic use." We reviewed articles from 2005 to 2012 and examined some references of selected studies to deeply investigate some aspects. We also included an older reference (Strupp, Brandt, & Muller, 1998) to provide evidence that could not be found elsewhere. We included clinical trials, both randomized and nonrandomized, as well as secondary literature; we had to include a few descriptive studies, because some data were unavailable in clinical trials. Articles regarding LP for anesthesiological purposes were excluded, to eliminate the possible confounding aspects related to drug administration (e.g., headache as a possible collateral effect of drugs).

Results

The articles we examined can be classified in a few broad categories: needle design and LP technical procedure, bed rest and early mobilization, posture and head position, cerebral vasoconstriction by means of caffeine, hydration, closure of the puncture site, and patient characteristics. The discussion of our findings will be based on these categories.

Post-LP nursing care varies widely and is not consistently linked to current evidence for best practice.

Needle Design and LP Technical Procedure

The shape and dimension of the edge are related to PLPH (Frank, 2008). Smaller needles could significantly reduce headache incidence rates, because they create a smaller dural hole with less CSF leakage (Lavi et al., 2006). In literature, small needle size is associated with reduced frequencies of PLPH (Armon & Evans, 2005), therefore minimizing morbidity (Peskind et al., 2005). According to some authors (Stendell, Fomsgaard, & Olsen, 2012), using an atraumatic needle size of 24 gauge (0.56 mm) instead of a traumatic 27 gauge (0.70 mm) can reduce the incidence of PLPH from 36% to 0%–9%. Others suggest using 20-gauge atraumatic needles (Ahmed, Jayawarna, & Jude, 2006). The shape of the edge plays a crucial role: noncutting needles produce a small hole in the dura by separating the elastic meningeal fibers rather than cutting them. Cutting needles reduce the frequency of PLPH (Arendt, Demaerschalk, Wingerchuk, & Camann, 2009; Ghaleb, 2010) and favor the healing of the dural lesion, ensuring that the bevel direction is parallel to the dural fibers. Finally, data show that, when using noncutting needles, the replacement of the stylet before the needle is withdrawn reduces the frequency of PLPH (Armon & Evans, 2005) and the severity of PLPH in diagnostic LP (Strupp et al., 1998). The incidence of PLPH decreases if the needle is inserted with the bevel parallel to the dural fibers, which in the dura mater, are parallel to the vertical axis of the spine. Maintaining the bevel parallel separates the fibers instead of cutting them; this allows quicker repair of the dural hole after the procedure, with less leakage of CSF and probability of onset of PLPH (Ahmed et al., 2006). This method of inserting the needle is also supported by a meta-analysis (Richman et al., 2006).

There is conflicting evidence in literature regarding the relationship between operator experience and incidence of PLPH: some authors point out that variables like fatigue, night work, and sleep deprivation could be

confounding factors and increase the number of inadvertent puncture (Turnbull & Shepherd, 2003).

The volume of the spinal fluid removed is not a typical risk factor for headache (Ahmed et al., 2006).

Bed Rest and Early Mobilization

On the basis of PLPH pathogenesis, a short period of bed rest plays a role in relieving headache, by decreasing the hydrostatic CSF pressure on the dural rent, thus accelerating the spontaneous closure of the dural defect. This limits CSF leakage into the subarachnoid space (Tejavanija, Sithinamsuwan, Sithinamsuwan, Nidhinandana, & Suwantamee, 2006), thus potentially preventing the onset of subdural hematoma, which according to some authors, has an incidence of 37% (Gaucher & Perez, 2002). These authors did not find any significant difference in the incidence of PLPH between patients undergoing 1-hour and 6-hour bed rest.

Secondary literature suggests that prolonged bed rest may even increase the risk of postural headache (Sudlow & Warlow, 2010). Moreover, long routine bed rest generates considerable costs and health problems, related to both longer recovery times and venous stasis, which may increase the risk of thromboembolism in patients at risk (Sudlow & Warlow, 2010). Other authors also agree that routinary bed rest is not supported by evidence (Williams et al., 2008).

Posture and Head Position

As to the prevention on PLPH, the potential role of different positions during bed rest has often been debated. While taking care of patients after LP, nurses should allow them to assume the position they prefer. There is no need for special postures after LP, because horizontal and supine positions are as good as others. If patients develop headache, they should be encouraged to lie in positions they feel comfortable in (Sudlow & Warlow, 2010).

Cerebral Vasoconstriction and Drug Therapy

In the literature we analyzed, PLPH management is generally aimed at limiting cerebral vasodilatation, reconstituting the lost CSF and sealing the puncture site. A considerable decrease of cerebral blood flow velocity has been observed in patients with PLPH. For this reason, caffeine, a methylxanthine derivate, has been proposed as a therapeutic option for PLPH. Caffeine seems to block adenosine receptors in the central nervous system, constrict cerebral arteries, and decrease cerebral blood flow and CSF pressure as a consequence. The dose currently recommended is 300 ± 500 mg once or twice daily, in consideration of the long half-life of this substance. Caffeine can cross the blood-brain barrier; the oral form is well absorbed, and the levels reach their peak in 30 minutes. However, therapeutic dosages have been associated with central nervous system toxicity and atrial fibrillation (Turnbull & Shepherd, 2003). Although this intervention is frequently used in these patients (Lee, Lin, Hsu, Chu, & Tsai, 2009), some authors argue that there is no valid pharmacological rationale for caffeine as an antinociceptive agent for PLPH, because the available clinical trials are small in sample size and show either no effectiveness or conflicting results (Halker et al., 2007).

A recent systematic review, on the contrary, pointed out the effectiveness of caffeine, if compared with placebo, in reducing the persistence of pain (BasurtoOna, Martínez García, Solà, & Bonfill Cosp, 2011). The authors of this review, however, suggest to interpret their results with caution, in consideration of the small sample size of the studies. As regard to the patients requiring analgesia for headache after LP, according to some authors, non-opioid analgesics such as non-steroidal anti-inflammatory drugs are the first choice for treatment (Kleine-Bruggeney, Kranke, & Stamer, 2011). Others also suggest acetaminophen as the first choice and weak opioids in case of failure of the above-mentioned treatments (Candido & Stevens, 2003). The dosage of these drugs depends on the characteristics of patients, such as weight, age, and respiratory conditions. The effects of opioids, such as epidural morphine, have been studied in anesthesia for preventive purposes (Apfel et al., 2010). The most recent Cochrane review (BasurtoOna et al., 2011) does not include evidence regarding opioid. Several other drugs have been studied for PLPH: in particular, oral gabapentin, oral theophylline, and intravenous hydrocortisone showed decrease on pain scores (visual analog scale), if compared with placebo. Intramuscular adrenocorticotropic hormone and subcutaneous sumatriptane did not lead to significant pain reduction, if compared with placebo (BasurtoOna et al., 2011). Some authors (Ahmed et al., 2006) suggest that, overall, PLPH management should be aimed at replacing the lost CSF, sealing the puncture site, and controlling the cerebral vasodilatation.

Hydration

Hydration therapy is based on the assumption that CSF leakage should be compensated by fluid intake to reestablish the balance of volume in the subarachnoid space (Sudlow & Warlow, 2010). However, nurses should keep in mind that an increase in fluid volume only supports the dynamic and physiology of CSF, with no effects in healing the dural breakthrough. No strong evidence exists in literature regarding the need for additional fluid intake (Stendell et al., 2012; Sudlow & Warlow, 2010).

Closure of the Puncture Site: Epidural Saline and Epidural Blood Patching

An epidural injection of saline could produce a mass effect and restore normal CSF dynamics; moreover, the saline fluid could induce an inflammatory reaction within the epidural space, promoting closure of the dural perforation. Finally, leak reduction would allow the dura to repair (Abdulla, Abdulla, & Eckhardt, 2011). Epidural blood patching (EBP) is a procedure performed by slowly injecting 10–20 ml of the patient's blood into the lumbar epidural space, in the same interspace used during the previous puncture, or in the space located immediately below. There is little consensus in literature regarding this procedure. Some authors favor it as a safe and effective treatment for PLPH (Lavi et al., 2010; Stendell et al., 2012). An RCT has shown that the EBP is useful to close the dural hole through a mass effect (Boonmak & Boonmak, 2010; van Kooten, Oedit, Bakker, & Dippel, 2008). Some authors suggest that headache tends to resolve spontaneously within 48 hours from patching (Rodriques & Roy, 2007). In other articles, EBP is considered as the last chance when dealing with an intractable PLPH ranging from moderate to severe for more than 24 hours (van Kooten et al., 2008).

Patient Characteristics

Some authors have shown that the risk of developing a PLPH might be related to characteristics like age, gender, pregnancy status, and body mass index (BMI; Bezov, Lipton, & Ashina, 2010). The prevalence of PLPH is higher among women (Wu et al., 2006); age of <50 years and postpartum periods seem to be additional risk factors in women (Alstadhaug et al., 2012; Ghaleb, 2010). In a recent study, BMI values of ≤25 were associated with increased risk of headache, whereas CSF volumes were not (de Almeida et al., 2011).

Conclusions and Nursing Implications

LPs are frequently performed for both diagnostic and therapeutic purposes. Nurses often play a role in caring for patients who have undergone this procedure. It is necessary for nurses to have a good knowledge of all factors that could potentially influence the onset of PLPH and to apply evidence-based intervention to prevent, promptly recognize, and manage headache. The available literature shows some evidence favoring the use of small-diameter, noncutting needles to prevent PLPH. There is lack of evidence in favor of prolonged bed rest, hydration, and administration of vasoconstrictor drugs when PLPH appears. Nursing assessment of patient undergoing LP should include risk factors related to PLPH (BMI, age, gender, previous LPs, and previous episodes of PLPH; Alstadhaug et al., 2012; Ghaleb, 2010). A thorough nursing assessment of the patient's clinical history could provide comprehensive data on the patient's characteristics as well as pre-alert clinicians when some elements recognized as risk factors are found. As suggested by the guidelines of the American Association of Neuroscience Nurses (2011), nurses should ensure that the patient understands the need for the invasive procedure, the process involved, and his or her role during and after the procedure as well as the possible complications. It is important to ensure that the antiseptics are allowed to dry completely before the punctures; the use of small-gauge, atraumatic needles is probably the single most important factor reducing PLPH. Someone could argue that the inclusion of a discussion of needle size in this article is inappropriate, but nurses are requested to perform this diagnostic examination in some clinical settings. Therefore, the nursing role must be considered important not only in caring for patients during and after procedure but also in performing LP.

While dealing with patients who have undergone an LP, nurses should keep in mind that a short period of bed rest is primarily requested to favor the spontaneous closure of the dural rent; this could help preventing the onset of dural hematomas, which in literature, show high incidence rates. However, nurses should also remember that additional bed rest after LP is not recommended to prevent PLPH and may even be harmful. When rest is unnecessary, its clinical and economic disadvantages become self-evident, especially in neurological units where LPs are often performed. Nursing assessment and planning should fulfill some other basic needs, when patients are unable to move from bed. Reduced mobility could be stressful for patients; nurses must reassure them that a short recumbent period is normal after the procedure and explain the reason why bed rest is temporarily requested. Moreover, patients require close observation during the immediate post-LP period to both detect problems, which could cause further complications, and promote optimal health restoration.

As regard to the treatment of PLPH with caffeine, additional fluid intake, and bed rest, clinical trial results are few in number and have often shown conflicting results. When PLPH occurs, nurses should allow patients to assume bed positions they prefer: the supine position is as good as any other. The administration of caffeine for treating PLPH should be considered with caution, because of the lack of conclusive evidence supporting its effectiveness. In case of administration, nurses should assess the patient's heart rate frequently to promptly detect the onset of atrial fibrillation, which is a potential collateral effect of caffeine. High blood pressure, insomnia, and aggressive behaviors are other elements nurses should detect to understand when caffeine administration is inappropriate.

TABLE 1. Concepts for Clinical Practice

Category	Concept	Reference
Needle design and LP technical procedure	Small (20–24 gauge) needles reduce headache incidence rates.	Ahmed et al., 2006; Armon & Evans, 2005; Lavi et al., 2006; Stendell et al., 2012
	Cutting needles reduce the frequency of PLPH and favors healing (bevel direction parallel to dural fibers).	Arendt et al., 2009
	Replacing the stylet before withdrawing the needle reduces PLPH frequency.	Armon & Evans, 2005
Bed rest and early mobilization	No differences in PLPH incidence rates exist between 1-hour bed rest group versus 6-hour bed rest group.	Tejavanija et al., 2006
	Prolonged bed rest may increase the risk for postural headache.	Sudlow & Warlow, 2010
	Routine bed rest is unnecessary; patients may mobilize freely after LP.	Sudlow & Warlow, 2010; Williams et al., 2008
Posture and head position	Nurses should allow patients to allow any position in bed.	Sudlow & Warlow, 2010
Cerebral vasoconstriction	There is no pharmacological rationale for caffeine as an antinociceptive agent for PLPH.	Halker et al., 2007
Hydration	No strong evidence exists regarding the need for additional fluid intake.	Stendell et al., 2012; Sudlow & Warlow, 2010
Closure of the puncture site	Epidural injections of saline fluid promotes closure of the dural perforation.	Abdulla et al., 2011
	Conflicting evidence exists regarding the effects of epidural blood patching.	Lavi et al., 2010; Rodriques & Roy, 2007; Stendell et al., 2012; van Kooten et al., 2008
Patients characteristics	Age, gender, BMI, pregnancy status, number of dural puncture attempts, history of LPs	Amorim & Valença, 2008; Angle, Tang, Thompson, & Szalai, 2005; Bezov et al., 2010; Ghaleb, 2010
Drug therapy	NSAIDs for initial treatment	Kleine-Bruggeney, Kranke, & Stamer, 2011
	Acetaminophen for initial treatment; weak opioids in case acetaminophen fails	Candido & Stevens, 2003

Note. LP = lumbar puncture; PLPH = post-lumbar puncture headache; NSAIDs = nonsteroidal anti-inflammatory drugs; BMI = body mass index.

It is uncertain whether routine fluid supplementation reduces the risk of PLPH or not. Nevertheless, in several clinical settings, nurses frequently encourage patients to drink additional fluids freely, if concomitant diseases allow doing so. Finally, patient education is an integral part of nursing care; nurses should properly inform patients about the potential adverse events or effects that can occur after the LP and suggest proper behavior and interventions to reduce PLPH. We suggest implementing a checklist, which should include all the factors involved in PLPH onset, especially in the neuroscience departments. With such an instrument, nurses could document and collect all these elements to promptly identify patients who will probably develop PLPH. Table 1 illustrates our main findings and could be used as a guide to create the checklist. The PLPH is considered the most frequent adverse event of LP procedures; several pharmacological treatments and postural approaches are still in use, despite insufficient levels of evidence. It is necessary that nurses rely only on solid evidence and possibly carry out further studies to clarify some aspects of the problem and maximize the efficacy of nursing care.

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