

Original Article**Evaluation of pre lumbar puncture position on post lumbar puncture headache**

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**Abstract**

**BACKGROUND:** The most common complication of lumbar puncture (LP) occurring in over thirty percent of patients is headache. The position after lumbar puncture, needle type and size, and volume of the extracted cerebrospinal fluid (CSF) have been evaluated as contributory factors in occurrence of post lumbar puncture headache (PLPH), but the position before lumbar puncture has not been evaluated.

**METHODS:** The occurrence of post lumbar puncture headache was evaluated in 125 patients undergoing lumbar puncture, divided randomly into sitting and lateral decubitus groups in the following five days. Chi-square test was used for statistical analysis.

**RESULTS:** Thirty eight patients (30.4%) reported headache after lumbar puncture in the two groups, and post lumbar puncture headache was significantly lower in the lateral decubitus position ( $p = 0.001$ ). There was no significant difference between genders in the post lumbar puncture headache occurrence ( $p = 0.767$ ).

**CONCLUSIONS:** Lumbar puncture in sitting position could produce more post lumbar puncture headache in comparison with lateral decubitus position.

**KEYWORDS:** Post-Dural Puncture Headache, Spinal Puncture, Postoperative Complications.

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Lumbar puncture (LP) is a helpful diagnostic procedure. Yet it often causes anxiety and stress in patients. Although lumbar puncture has some serious complications such as herniation or paraplegia due to trauma to the spinal cord, the most common complication occurring in over 30 percent of patients is headache.<sup>1</sup> Characteristically, the headache starts 24-48 hours after the lumbar puncture and usually lasts one to two days but it may begin as early as one hour after the procedure or may occur beyond one week or sometimes several weeks after it too. There are many theories about pathophysiology of post lumbar puncture headache (PLPH) but the

most accepted one of these theories point to the reduction of cerebrospinal fluid (CSF) pressure after withdrawal of CSF and the downward movement of the brain structure and vasodilatation of cerebral vessels as its consequences.<sup>2-4</sup> The headache is related to low cerebrospinal fluid pressure resulting from spinal fluid leaking through the hole cut in the dura by beveled spinal needles. Traditionally, bed rest position after LP, using smaller needles or blunt needles have been used to prevent post LP headache.<sup>5-10</sup> Some studies showed that bed rest is effective in preventing severe headaches following LP.<sup>11</sup> Results from some other studies, however, disagree with

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this idea.<sup>12,13</sup> Furthermore, despite long years of research there is still considerable controversy about the best position before and after LP. Long post LP bed rest has now largely been discarded because of patient's discomfort.<sup>14</sup> The most accepted contributory factors in post lumbar puncture headaches (PLPH) are needle size, direction of bevel, needle design, replacement of stylet before needle withdrawal and number of attempts. Factors the role of which in PLPH are not accepted are volume of CSF drainage, bed rest, hydration of patient before procedure, and CSF pressure.<sup>1,3,15-17</sup> Another obscure problem in the occurrence of PLPH is the role of patient's position during the procedure. LP is routinely performed in sitting or lateral decubitus position. The sitting position is somewhat easier for the examiner but cerebrospinal fluid (CSF) extraction must be done in recumbent position to decrease the risk of herniation.<sup>4</sup> In review of literature no article was found about the role of pre lumbar puncture position on the post lumbar puncture headache. This study is designed for the assessment of the role of patient's position before or during LP in occurrence of post lumbar puncture headache.

## Methods

One hundred twenty five hospitalized patients were selected from January 2007 to November 2008, including 60 male (48%) and 65 female (52%) patients. The mean of the patients' age was  $50.96 \pm 13.15$  (25-73). Patients with a history of chronic headaches such as migraine and tension or cluster headaches or

unknown origin headaches were excluded from the study. All patients had indication for diagnostic lumbar puncture regardless of this study. All patients randomly divided into two groups. Statistical analysis showed no significant difference between the two groups regarding sex and age (Table 1 and 2). Also, considering the diagnosis before LP, there was no significant difference between two groups (Table 3). In one group LP was performed in the lateral decubitus position with head and knees bent toward the stomach and in the second group LP was performed in sitting position with head bent toward stomach and lower extremity in straight position on the bed. All tests were done with 21 gauge quinke needle in L3-L4 intervertebral space on the line between two iliac crests by only one experienced neurologist. Patients in sitting position changed to lateral decubitus after insertion of needle and then opening pressure was measured and CSF was extracted. Five milliliter of CSF was extracted in all patients in the lateral decubitus position. Patients with abnormal CSF formula (any abnormalities in cells, protein, sugar or positive culture) or elevated CSF pressure ( $> 20 \text{ CmH}_2\text{O}$ ) were omitted in both groups to prevent interfering effects of different CSF formula on outcome of the study. All CSF samples were tested by the same certified laboratory. All the patients followed for occurrence of typical post lumbar puncture headaches (PLPH) in upright position and complete or near complete recovery of headache with recumbent position.

**Table 1.** Patients' demographic specifications

	n (percent)	Mean age (year)	SD
Male	60 (48%)	50.92	13.13
Female	65 (52%)	51.00	13.28
Total	125	50.96	13.15

**Table 2.** Position of lumbar puncture according to sex

Position of patient	Sex		Total	P value
	Male	Female		
Lateral decubitus	33	32	65	0.519
Sitting	27	33	60	-
Total	60	65	125	-

**Table 3.** Diagnosis before lumbar puncture in two study groups

Diagnosis before lumbar puncture	Sitting	Lateral decubitus	P value	Test
Sudden onset of headaches (SAH,...)	9	10	0.98*	Chi-square
Meningitis	14	17	0.7*	Chi-square
Encephalitis	6	5	0.6*	Fisher exact
BIH	2	3	0.7*	Fisher exact
Multiple sclerosis	11	10	0.66*	Chi-square
Optic neuritis	3	4	0.78*	Fisher exact
Malignancy (meningeal carcinomatosis)	4	5	0.82*	Fisher exact
GBS	2	2	0.93*	Fisher exact
Hydrocephaly (NPH,...)	7	8	0.91*	Chi -square
Polyneuropathy	2	1	0.5*	-
Total	60	65	-	-

SAH: Sub Arachnoid Hemorrhage; BIH: Benign Intracranial Hypertension; GBS: Guillain Barre Syndrome; NPH: Normal Pressure Hydrocephalus

\* Non significant

Each patient was followed up for at least five days for the appearance of PLPH symptoms. Methods and objectives of the study were clearly described for each patient and all patients had written informed consent.

All data were registered and analyzed with the SPSS software and chi-square test was used for relational analysis. The ethic committee of Shahed University approved the trial.

## Results

Thirty eight patients were not included in the study due to elevated CSF pressure or abnormal CSF formula. Four patients were discharged before the fifth days and there was no way for follow up. At last sixty (48%) males and 65 (52%) females were studied for the occurrence of PLPH.

Lumbar punctures were successful in first attempt in 58 (96.6%) cases in sitting group and in 63 (96.9%) patients in lateral decubitus position ( $p = 0.5$ ). Besides, traumatic taps were present in 7 (11.6%) patients in sitting position and 9 (13.8%) patients in recumbent position ( $p = 0.12$ ). The mean of CSF opening pressure

was  $15.6 \pm 2.7$  (CmH<sub>2</sub>O) in patients in sitting position and was  $15.4 \pm 2.3$  (CmH<sub>2</sub>O) in lateral decubitus group.

Totally, 38 patients (30.4%) reported headache after lumbar puncture in both groups; while PLPH was significantly lower in lateral decubitus position (Table 4).

There was no significant sex difference in post lumbar puncture headache occurrence (Table 5).

## Discussion

This study compares the appearance of PLPH in two groups of patients, one group for whom LP was performed in lateral decubitus position and another group in which the test was done in the sitting position. Our study results suggest that demographic data such as sex and age showed no significant statistical difference between the two groups. However, comparing the two groups in terms of the position of the patients shows significant statistical difference. Which means the headache is more prevalent and also more severe in patients in the sitting position.

**Table 4.** Post lumbar puncture headache according to position

			Position before lumbar puncture		Total	P value
			Lateral decubitus	Sitting		
PLPH	No	n	54	33	87	0.001
		Percent	83.1%	55.0%	69.6%	-
	Yes	n	11	27	38	-
		Percent	16.6%	45.0%	30.4%	-
Total	n	65	60	125	-	
	Percent	100.0%	100.0%	100.0%	-	

**Table 5.** Post lumbar puncture headache according to sex

			Sex		Total	P value
			Male	Female		
PLPH	No	n	41	46	87	0.767
		Percent	47.1%	52.9%	100.0%	
	Yes	n	19	19	38	
		Percent	50.0%	50.0%	100.0%	
Total	n	60	65	125		
	Percent	48.0%	52.0%	100.0%		

Dura matter is a dense connective tissue and a histological examination of dura shows parallel collagen fibers in longitudinal direction. Recent studies have shown that dura matter consists of several layers of collagen and elastic fiber without any specific directions in lower layers but in the outer layers the fibers are parallel to the surface in longitudinal direction.<sup>18,19</sup> CSF leak after dural puncture has been shown by direct visualization and also radioisotope imaging. This can make CSF pressure become lower than normal and play a pathophysiologic role in the appearance of the headache.<sup>20</sup> Any dura perforation must be repaired to protect the patient from more complications, this is done through proliferation of surrounding tissue toward the hole. Any trauma to the pia, arachnoid or surrounding nervous tissue and also presence of blood clot will enhance this process.<sup>21</sup>

Two theories are accepted in most references as the mechanism of PLPH. The first theory states that low CSF volume and pressure causes elimination of cushion effect of CSF and downward movement of brain that produce pressure upon pain sensitive structures in skull base and pain appears. The second theory is vasodilatation of brain due to activation of adenosine receptors or according to Monro-Kellie doctrine. This doctrine states that the amount of tissue, blood and CSF is constant in the skull and any reduction in CSF volume is substituted with blood due to venodilatation and this increased blood volume will, consequently, lead to headache.<sup>22,23</sup>

As described above, in the sitting position intervertebral spaces are more evident and LP is performed more easily and less traumatic, which makes dura healing longer than lateral decubitus position and as described above this makes longer leak of CSF. Second, CSF pressure in the sitting position is 40 cmH<sub>2</sub>O and in lateral position it is 5-20 cmH<sub>2</sub>O; this higher gradient can make a larger hole in the dura in the sitting position and makes a prolonged leak. The third reason is that in the sitting position needle is perpendicular to outer dura fiber and this makes a larger hole and more CSF leak and at last, in the sitting position downward movement occurs early in the procedure and this early displacement may cause more symptoms.

### Conclusions

This study shows that lumbar puncture in the sitting position results in more post lumbar puncture headache in comparison with patients for whom the test is performed in the lateral decubitus position. Especially in patients who had other risk factors for the appearance of PLPH such as using large gauge needles, and also when large amount of CSF is needed, LP in recumbent position has a lower risk of PLPH. The relation between pre lumbar puncture position and post lumbar puncture headache was examined in this study. The results show that post lumbar puncture headache is significantly lower when LP is performed in lateral decubitus position.

### Conflict of Interests

Authors have no conflict of interests.

### Authors' Contributions

SAM carried out the design and coordinated the study, participated in most of the experiments and prepared the manuscript. SP provided assistance in the design of the study and participated in manuscript preparation. HG, MEY, AD and MJ provided assistance for all experiments. All authors have read and approved the content of the manuscript.

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