

# The causal-effect of bed rest and post-dural puncture headache in patients receiving diagnostic lumbar puncture: A prospective cohort study

Chien-Shu Tai<sup>a</sup>, Shang-Liang Wu<sup>b</sup>, Shao-Yu Lin<sup>a</sup>, Ying Liang<sup>a</sup>, Shuu-Jiun Wang<sup>c,d,e,f</sup>, Shih-Pin Chen<sup>c,d,e,f,g,\*</sup>

<sup>a</sup>Department of Nursing, Taipei Veterans General Hospital, Taipei, Taiwan, ROC; <sup>b</sup>Department of Medical Research, Taipei Veterans General Hospital, Taipei, Taiwan, ROC; <sup>c</sup>Department of Neurology, Neurological Institute, Taipei Veterans General Hospital, Taipei, Taiwan, ROC; <sup>d</sup>Institute of Clinical Medicine, School of Medicine, National Yang Ming Chiao Tung University, Taipei, Taiwan, ROC; <sup>e</sup>Brain Research Center, National Yang Ming Chiao Tung University, Taipei, Taiwan, ROC; <sup>f</sup>Faculty of Medicine, School of Medicine, National Yang Ming Chiao Tung University, Taipei, Taiwan, ROC; <sup>g</sup>Division of Translational Research, Department of Medical Research, Taipei Veterans General Hospital, Taipei, Taiwan, ROC

## Abstract

**Background:** Post-dural puncture headache (PDPH) is the most common complication of lumbar puncture. Patients who received lumbar puncture were previously suggested to remain in bed for a certain time to prevent PDPH; however, this concept was challenged by recent studies. We aimed to investigate whether ambulation instead of resting supine following lumbar puncture could increase the risk of PDPH.

**Methods:** The study used a prospective cohort design, applying convenience sampling among patients who received diagnostic lumbar puncture between January and September 2018 in the neurology ward of a tertiary medical center. The patients who fulfilled the inclusion criteria were informed that the current practice suggests lying supine for 6 to 8 hours after lumbar puncture, but they were allowed to either follow the suggestion or ambulate by their wills. The timing of bed rest was recorded, in addition to other possible risk factors of PDPH. The study endpoint is the presence or absence of PDPH within 48 hours of lumbar puncture.

**Results:** A total of 137 patients who received lumbar puncture were enrolled, including 103 with bed rest following lumbar puncture and 34 without. There was no difference in demographics between the two groups. PDPH was found in 21 patients, with a total follow-up period of 5959 person-hours and an incidence density of 0.35%. There was no significant difference between the incidence of PDPH between the two groups (non-bed rest group 5.9% vs bed rest group 18.4%;  $p = 0.078$ ), nor was incidence density (non-bed rest group 0.13% vs bed rest group 0.43%,  $p = 0.113$ ). The results remained the same after adjusting for age.

**Conclusion:** Bed rest following lumbar puncture does not prevent PDPH, and even leads to a marginally increased risk of PDPH. Amendment to the current practice guideline post-lumbar puncture care might be needed to improve patient care.

**Keywords:** Bed rest; Post-dural puncture headache; Spinal puncture

## 1. INTRODUCTION

A lumbar puncture is an important medical procedure that is commonly used in anesthesia or the diagnostic assessment for conditions such as infection of central nervous system, subarachnoid hemorrhage, multiple sclerosis, acute inflammatory demyelinating polyradiculoneuropathy or meningeal carcinomatosis, etc. Post-dural puncture headache (PDPH) is the most common

complication of lumbar puncture, which is related to the leakage of cerebrospinal fluid (CSF) through the puncture hole (ie, dural defect) created by the needle.<sup>1</sup> The loss and decrease of CSF, low intracranial pressure, and traction on pain-sensitive structures of the head were thought to be possible mechanisms of PDPH. The incidence of PDPH ranges between 1% and 40% among different studies.<sup>2</sup> The major symptom of PDPH is “positional headache,” which can be relieved by a supine position and recurs soon after resuming a sitting or standing position. In 66% of patients with PDPH, the symptom started within the first 48 hours after procedure.<sup>2,3</sup> A report showed that 91% of the headaches occurred within the first 72 hours, extremely few occurred between the third and the sixth day, and almost no case occurred after the sixth day.<sup>4</sup>

Factors affecting incidence of PDPH have been investigated by studies in the past years, which include female <40 years of age with history of headache;<sup>5</sup> >30 cm<sup>3</sup> of CSF were drained;<sup>6</sup> a traumatic tap CSF red blood cells (RBCs) >400/mm<sup>3</sup> as traumatic bleeding;<sup>7</sup> etc. The most common factors associated with a traumatic tap include inadequate experience of the operator, use of traumatic needles, and smaller gauge of lumbar puncture needles (ie, larger in diameter).<sup>8-13</sup>

\* Address correspondence. Dr. Shih-Pin Chen, Department of Neurology, Neurological Institute, Taipei Veterans General Hospital, 201 Section2, Shi-Pai Road, Taipei 112, Taiwan, ROC. E-mail address: chensp1977@gmail.com (S.-P. Chen).

Conflicts of interest: Dr. Shuu-Jiun Wang, an editorial board member at *Journal of the Chinese Medical Association*, had no role in the peer review process of or decision to publish this article. The other authors declare that they have no conflicts of interest related to the subject matter or materials discussed in this article.

*Journal of Chinese Medical Association.* (2021) 84: 791-794.

Received March 4, 2021; accepted April 29, 2021.

doi: 10.1097/JCMA.0000000000000562.

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Patients who received spinal tap were previously suggested to remain in bed for a certain time to prevent PDPH. Sicard has recommended in 1902 that patients required bed rest for 24 to 48 hours.<sup>14</sup> Jones found in 1974 that the lowest incidence of headache was in patients with bed rest for 6 hours,<sup>4</sup> which further became practice guidelines for caring patients receiving such procedures. Recently, the key arguments have lain in the necessity of bed rest following spinal tap or what is the adequate time for bed rest to prevent headache. Some studies have indicated that bed rest following lumbar puncture has no significant benefits in the prevention of PDPH<sup>14</sup> or even increased risks of postural headache and deep vein thrombosis when the patients were prolonged bounding to the beds.<sup>15</sup> However, lying supine without a pillow cushion for 6 to 8 hours following lumbar puncture remains as requirements of standard operating procedure for hospitals in Taiwan despite contradicting evidences that have been demonstrated in other ethnic groups. Besides, it is difficult for patients to comply to this practice for the physical discomfort after prolonged bed rest, and additional procedures or devices that were used to ease the discomfort have led to increased unnecessary utilization of medical resources. Hence, this study aimed to investigate the association between bed rest and the incidence density of headache following lumbar puncture in Taiwanese and to evaluate if the “regular practices” were really helpful.

## 2. METHODS

### 2.1. Patient recruitment

The study used a prospective cohort design, applying convenient sampling among patients who received lumbar puncture between January and September 2018 in the neurology wards (a total of 111 beds) of Taipei Veterans General Hospital, a 2802-bed tertiary medical center. The inclusion criteria were adults  $\geq 20$  years of age, being conscious and able to describe his/her headache characteristics, and willing to participate in the study. Patients who received lumbar puncture due to headaches secondary to spontaneous intracranial hypotension or conditions that required absolute bed rest were excluded. This study was approved by the Institutional Review Board (IRB) of Taipei Veterans General Hospital (IRB no. 2017-05-009CC). All participants provided informed consent before entering the study.

### 2.2. Operational definition

In this study, the operational definitions for various performance measures were as follows: (1) diagnostic lumbar puncture: a spinal tap used to evaluate the illness, with no medication being injected into spinal canal except for subcutaneous injection of local anesthetics. (2) Bed rest: (a) Posture: lying supine without a pillow cushion; (b) duration: those who lay supine following completion of procedure for  $\leq 30$  minutes were categorized as the non-bed rest group, and those who kept lying supine for  $>30$  minutes are categorized as the bed rest group. (3) Experiences of the physician who conducted the procedure: previous numbers of spinal taps that the physicians had performed before the current procedure. (4) Puncture needle size: all used cutting needles (as atraumatic needles were not available in our hospital), use of needles sized smaller than 21G ( $\leq 21$  Fr.) are categorized in the large needle group, use of needles sized larger than 22 G ( $\geq 22$  Fr.) are categorized in the fine needle group. (5) CSF volume: total amount ( $\text{cm}^3$ ) of CSF drained via puncture needle. (6) Traumatic tap: CSF RBCs  $>400/\text{mm}^3$  are referred to as a traumatic tap. (7) PDPH determination: the presence of at least one of the following symptoms: (a) headache increased when standing or sitting, reduced upon bed rest; (b) neck pain or neck stiffness; (c) tinnitus or subjective hearing symptoms; (d)

photophobia and/or nausea, followed by detailed evaluation of physicians to determine the causality based on the proposed criteria in the International Classification of Headache Disorders, third edition.

### 2.3. Process

In addition to explaining the objectives, procedures, and risks for performing lumbar puncture, the physicians and nurses described the precautions following the procedure according to the current practice, namely the routine requirements of lying supine without a pillow cushion for 6 to 8 hours. To maximize the numbers of patients who could be enrolled in the study, we adopted a pragmatic design. Instead of assigning the patients into a specific group, we instructed the patients to judge the time to spend on bed depending on their wills and discretion. The actual beginning and the end times of lying supine were observed and recorded, and the presence of PDPH symptoms within the first 48 hours was also assessed.

### 2.4. Statistical analysis

Controlled variables in the study included patient's age, gender, the presence of headache history, experiences of the physicians who performed the procedures, size of lumbar puncture needle, volume of CSF collected, and the presence of traumatic tap, while independent variable was the status of bed rest, and the dependent variable was the presence of PDPH within 48 hours. With the estimated sample size of 10-fold number of independent variables (including controlled variables) according to the method available for multiple regression (in this study, a total of eight, including one independent variable and seven controlled variables), the minimum sample size required in the study should be 80 patients.<sup>16</sup>

Microsoft Excel was used in data filing and statistical analysis was performed with IBM SPSS software package (version 20). In test of homogeneity for samples, Pearson's Chi-squared test was used for categorical variables (gender, the presence of headache history, size of puncture needle used, and the presence of traumatic tap); continuous variables (age, experiences of the physician, and volume of CSF collected) were assessed using Student's *t*-test. In inferential statistics, the R software package was used with Cox regression model for analysis of association between bed rest following the puncture and incidence density of headache.

## 3. RESULTS

### 3.1. Demographics

A total of 137 patients were included in this study, including 103 with bed rest following lumbar puncture and 34 without bed rest. In these 137 cases, the reasons to perform lumbar puncture included cognitive change or dementia ( $n = 35$ , 25.5%), headache ( $n = 31$ , 22.6%), fever of unknown origin ( $n = 22$ , 16.1%), normal pressure hydrocephalus ( $n = 18$ , 13.2%), meningitis ( $n = 17$ , 12.4%), and others ( $n = 14$ , 10.2%). There was no difference in the nine controlled variables between the two groups. The patients were predominantly female (54%), with an average age of 56.8 years (range 20-94); 24.8% of them had a prior headache history. Average experience value for operators performing lumbar puncture was 24.8 times (range 0-100). Fifty-three percent of the puncture were performed with a needle size  $\leq 21$ G. Most of the punctures were nontraumatic tap, with only nine patients (7%) with CSF RBC  $>400/\text{mm}^3$ . The average volume of CSF drained was  $17.1 \text{ cm}^3$  (range 0-50  $\text{cm}^3$ ) (as shown in Table 1). The mean opening pressure and closing pressure measured at lumbar puncture are  $154.5 \pm 65.9 \text{ mmHg}$  and  $96.9 \pm 50.2 \text{ mmHg}$ .

**Table 1**  
Comparison of controlled variables between the bed rest group and the non-bed rest group (n = 137)

Variable	Early ambulation (n = 34)	Bed rest (n = 103)	X <sup>2</sup> /t	p
Age	60.7 ± 19.3	55.5 ± 18.7	1.39	0.167
Female	47.1%	56.3%	0.55	0.459
With headache history	23.5%	25.2%	0.00	>0.99
Experience value of operator (times)	23.1 ± 18.4	25.3 ± 19.9	0.57	0.570
Size of puncture needle ≤ 21G	41.2%	56.3%	1.78	0.182
Traumatic tap	8.8%	5.8%	0.05	0.830
CSF volume (cm <sup>3</sup> )	15.4 ± 11.2	17.7 ± 8.6	1.25	0.214

CSF = cerebrospinal fluid.

**Table 2**  
Risk association analysis between the status of bed rest and incidence density of PDPH

Variable	HR (95% CI)	p
Bed rest (bed rest/non-bed rest)	5.71 (0.73-44.31)	0.096
Gender (male/female)	0.64 (0.24-1.73)	0.379
Age	0.97 (0.94-0.99)	0.016
Headache history (yes/no)	2.02 (0.83-4.96)	0.123
Experience value of operator	1.00 (0.98-1.02)	0.957
Size of puncture needle (smaller/larger)	1.20 (0.45-3.22)	0.716
Traumatic tap (yes/no)	0.84 (0.11-6.56)	0.876
CSF volume (cm <sup>3</sup> )	0.99 (0.94-1.06)	0.862

Risk analysis after adjusting age.

CI = confidence interval; CSF = cerebrospinal fluid; HR = hazard ratio; PDPH = post-dural puncture headache.

### 3.2. The association between bed rest and incidence density of PDPH

Among the 137 cases, PDPH occurred in 21 patients (two in the non-bed rest group and 19 in the bed rest group) with an incidence of 15.3% (5.9% in the non-bed rest group and 18.4% in the bed rest group). All the PDPHs were mild and were relieved by subsequent bed rest or treatment with intravenous normal saline infusion after the observed study period. No significant difference was found between incidence of PDPHs between the two groups (Pearson's Chi-squared test,  $\chi^2 = 3.109$ ,  $p = 0.078$ ). The relative risk of bed rest vs non-bed rest group is 3.14 (95% confidence interval [CI], 0.77-12.78;  $p = 0.111$ ). The total follow-up time was 5959 person-hours, with an incidence density of 0.35% (21/5959), that is, PDPHs occurred in 3.5 patients per 1000 person-hours. After adjusting the "age" variable, the incidence density of PDPH in the bed rest group was 5.7 times higher than that in the non-bed rest group, which, however, did not reach the level of statistical significance (as shown in Table 2). Older age seemed to have a protective effect of PDPH; however, the effect is marginal (Table 2). In addition, there was a trend of higher incidence of PDPH in female patients (Table 2).

## 4. DISCUSSION

In this study, we found that bed rest itself had no significant benefit in preventing PDPH, and even conferred a tendency of higher risk as indicated by incidence density, an indicator that has never been employed in previous studies. To the best of our knowledge, there has been no similar study conducted in Taiwanese.

It has been long debated that bed rest could prevent PDPH. Earlier studies suggest a beneficial effect of bed rest; however, the results could not be replicated by subsequent studies. Moreover, Asian populations have not been included in previous studies. Several systematic reviews have evaluated the effect of bed rest on preventing PDPH. The first systematic review in 2001 suggested that there was no evidence that bed rest for 24 hours surpassed immediate ambulation, neither can bed rest for eight hours prevent headache.<sup>17</sup> However, heterogeneity and risk of bias were not described in the study. A subsequent systematic review including 1723 subjects showed that there was no significant difference in incidence of PDPH among patients with bed rest and other postures (odds ratio: 1.21; 95% CI, 0.94-1.55); nevertheless, increased risks of postural headache and venous thrombosis were found in those with prolonged bed rest.<sup>15</sup> A latest systematic analysis including 2477 subjects indicated that there was no significant difference in incidence of severe PDPH among patients with bed rest and early ambulation.<sup>14</sup> However, in the incidence of mild PDPH and any other types of headache, the bed rest group was higher than the early-ambulation group, which corresponds to the result of higher incidence density in our study.

The finding that older patients had less chance of PDPH is consistent with the previous study.<sup>5</sup> There seems to be a trend of higher incidence of PDPH in our patients, which was also consistent with the findings of previous studies. However, our study is not without limitations. First, this is not a randomized controlled trial; the grouping of patients depends on the patients' will to follow the routine practice guidance or not. Hence, the patient number between both groups were not balanced. Nevertheless, there was no significant difference between their characteristics, or the performance of procedures (in terms of the experiences of the operator or the incidence or traumatic taps). Second, the smaller case number in the early ambulation group might lead to the underpower of the study so that the results were not statistically significant even though the hazard ratio was as high as 5.71. Further studies including large sample size with randomized controlled design are needed to confirm the trend observed in our study that the outcome is probably better in the non-bed rest group. Third, atraumatic needle was not available in our hospital. Therefore, we could not be aware of the use of atraumatic needle could significantly reduce the incidence of PDPH and could not evaluate whether the conclusion would be the same in the other settings.

In conclusion, our study suggested that bed rest following lumbar puncture did not prevent PDPH and might even lead to higher chance of PDPH. This finding was consistent with most recent studies conducted in other ethnic groups and may serve as a primer for the authorities to reevaluate whether it is mandatory to amend the current practice guideline for post-lumbar puncture clinical care.

## ACKNOWLEDGMENTS

This work was supported by the Taipei Veterans General Hospital, Taiwan (V107A-014 [to C.-S.T.] and V110C-102, VGHUST110-G1-3-1, and V109D52-001-MY3-2 [to S.-P.C.]). The funders had no role in study design, data collection and analysis, decision to publish, or preparation of the manuscript. We thank the Department of Neurology, Neurological Institute, Taipei Veterans General Hospital for their help with data collection.

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