Jordan Medical Journal, Volume 56, No.3 2022
DOI: *https://doi.org/10.35516/jmj.v56i3.354*

Lumbar Puncture in a Teaching Hospital: Indications, Findings, and Complications over Five Years with Adult Patients

Shada Ba-Abbad[1], Aladdin Dahbour[2], Mays Akileh[2], Basel Ghaith[3], Said Dahbour[2]✉

Abstract

Background: Lumbar puncture (LP) is a bedside procedure used to investigate diseases of the central and peripheral nervous systems. We report the experience of a major teaching hospital in this procedure over a 5-year period. **Methods**: Medical records were reviewed of patients aged ≥ 13 years who underwent LP in the years 2014¬–2018. Age, gender, technique, indications, findings, complications, and final diagnosis were analyzed. **Results**: 195 patients, of whom 133 (68.2%) were females (aged 40.0 ±15.7) were studied. Opening pressure was measured in 104 (53.3%) patients (86, 82.7% females) showing a mean of 31.2±12.1cm, and closing pressure was measured in 54 (27.7%) patients with a mean of 16.5±5.7cm. Leukocyte and erythrocyte counts, and glucose and protein levels were measured in most patients (99.0%, 98.5%, 96.9%, and 96.9%, respectively). Bacterial culture and gram stain were performed in 28 (14.4%) and six (3.1%) patients, respectively. Cytology and oligoclonal bands were studied in 16 (8%) and 28 (14.4%) patients, respectively. Headache, peripheral neuropathy, and papilledema were the main indications found in 69 (35.4%), 41 (21.0%), and 26 (13.3%) patients, respectively. The most common final diagnoses were idiopathic intracranial hypertension, central nervous system inflammatory diseases, peripheral neuropathy, and meningoencephalitis in 68 (34.9%), 27 (13.3%), 20 (10.3%) and 16 (8.7%) patients, respectively. No major complications were recorded. **Conclusions**: LP is a common bedside procedure and the most common indications were intracranial pressure and inflammatory neurological disorders. It is a quite safe and useful procedure.

Keywords: Lumbar puncture, cerebrospinal fluid analysis, indications, complications.

(J Med J 2022; Vol. 56 (3):206-211)

Received	*Accepted*
February, 4, 2022	*May, 16, 2022*

Introduction

Cerebrospinal fluid (CSF) is generated from ultrafiltration of the blood by the choroid plexus of the ventricles. It is a clear colorless liquid that fills the ventricles and surrounds the brain and the spinal cord. It performs variable vital functions, including the provision of nourishment, waste removal, and acting as a cushion or shock absorber against trauma to the central nervous system. The total volume of CSF in adults ranges from 140–270 ml. The volume in the ventricles is about 25 ml. CSF is produced at a rate of 0.2–0.7 ml per minute or 600–700 ml per day [1, 2].

Lumbar puncture (LP), also called spinal tap, is an invasive medical procedure generally performed to obtain pressure measurements and to withdraw CSF to secure a sample of the fluid for cellular, chemical, and microbiologic

[1] Zarka Governmental Hospital
[2] University of Jordan, Faculty of Medicine, Jordan University Hospital
[3] Islamic Hospital, Aqaba
✉ Corresponding author: saiddahbour@hotmail.com

examination. In some cases, LP is used to administer spinal anesthetics, antibiotics, or chemotherapy, or to inject a radiopaque or water-soluble contrast medium substance for myelography. During an LP, the patient is placed in the left lateral decubitus position. Under aseptic technique, a spinal needle is inserted between the vertebrae, usually at the level of L3/4 or L4/5, into the subarachnoid space [3]. LP plays an important role in the diagnosis of certain conditions, including idiopathic intracranial hypertension, meningitis, inflammatory central and peripheral nervous system disorders and subarachnoid hemorrhage [4]. It has variable complications including back pain, post-lumbar puncture headache (PLPH), infections, subdural hematoma, and cerebral venous thrombosis [5–7].

Methods

This is a retrospective study performed in a major teaching hospital in Jordan. We collected our data from the medical records of patients admitted to hospital between January 1, 2014, to December 31, 2018, using a special code designed for LP. The files of patients who were ≥13 years of age were studied. The following factors were studied: indications, CSF appearance, opening and closing CSF pressure measurements in cm, fluid analysis for cells, chemistry, cytology, bacterial culture and staining, special tests like herpes simplex virus (HSV) polymerase chain reaction (PCR), and oligoclonal bands (OCB) when available, as well as immediate or late complications. The indications for LP were categorized as: headache, central nervous system (CNS) infections, malignancy, papilledema/blurring of vision, intracranial hypertension (headache and papilledema), peripheral polyneuropathy, inflammatory and demyelinating CNS diseases, and dementia. All procedures were performed with written consent from the patient or their guardian under aseptic technique in the left lateral decubitus position (a few in the sitting position). CSF pressure was measured only while the patient was relaxed and lying in the left lateral position, using intravenous giving set tubing, using the level of the needle as the zero line and the highest level of the CSF in the tubing as the pressure measurement. This was because no calibrated manometers are available at our hospital. Opening pressure (OP) was measured immediately after accessing the subarachnoid space and closing pressure (CP) after collecting the CSF sample (typically after taking 5–15 ml based on the level of OP). Statistical analysis: we used IBM SPSS Version 22, Chicago Ill, 2019 to analyze the data using descriptive analysis of the parameters collected. For continuous variables, we measured mean, range, and standard deviation.

Results

Demographics

The total number of patients was 195, split into 62 (31.8%) males and 133 (68.2%) females. The mean age was (39.9±15.7 years) with a range of 13–91 years.

Indications

The most frequently encountered indications were: headache, peripheral neuropathy, papilledema, intracranial hypertension (headache and papilledema) and CNS infection, which occurred in 35%, 21%, 13%, 12.8%, and 5.6% of patients, respectively.

Cerebrospinal fluid (CSF) findings

The OP measured in 104 (53.3%) patients was (31.2± 12, range 6–70cm of CSF), and the CP measured in 54 (27.7%) patients was (16.5±5.6, range 5–47cm of CSF). Leukocyte and erythrocyte count cell/ml, glucose, and protein levels mg% were measured in most patients: 193 (99%), 192 (98.5%), 189 (96.9%), and 189 (96.9%), respectively. See Table 1 for detailed results.

Table 1: CSF features of the cohort

Parameter	Number of studied patients (out of 195)	Mean ± SD
Age (years)		39.9±15.7
OP (CSF cm)	104	31.2±12.1
CP (CSF cm)	54	16.5±5.7
WBC/ cu mm	193	33.5±185.2
NEUT/ cu mm	187	1.4±7.9
LYMP/ cu mm	188	7.0±29.9
RBC/ cu mm	192	1708.4±9028.6
Glucose (mg %)	189	68.8±21.1
Protein (mg %)	189	47.4±59.0

OP, CP: opening and closing pressure, respectively. WBC: white blood cells, Neut: neutrophils, Lymph: lymphocytes, RBC: red blood cells

Gram stain was conducted in six (3.1%) patients, and none was positive; a diagnosis of meningoencephalitis was confirmed in only one of these six as viral meningitis based on CSF analysis only. The total number of cultured CSF samples was 28 (14%), none of which was positive, and the diagnosis of meningitis was confirmed in 11 patients (39%) based on routine CSF analysis. OCB were tested in 28 patients suspected to have multiple sclerosis (MS), 18 (64.2%) were females and only four (22%) of these were positive, while of the ten (35.7%) tested males, none (0%) was positive. Final diagnosis of MS was secured in only nine (32%) patients, seven (77%) females and two (22%) males. All those who had positive OCB were finally diagnosed with MS. In this small sample, sensitivity of OCB for MS diagnosis was low (44.4%) while specificity was high (100%). CSF cytology was analyzed in 16 patients and only three (18%) were positive. In fact, these patients were known to have systemic cancer and the LP was performed here for therapeutic purposes (intrathecal chemotherapy).

Final diagnosis

The most common final diagnosis in this study was idiopathic intracranial hypertension in 68 cases (35%). Sixty-seven of these subjects were treated with acetazolamide and one had optic nerve fenestration. CNS inflammatory diseases were diagnosed in 27 (13.3%) patients, polyneuropathy in 20 (10.3%) patients, and meningoencephalitis in 17 (8.7%) patients; the least frequently found diagnosis was malignancy, in only six (3.1%) patients. Diagnoses (32%) in these cases were based on other tests as LP was unrevealing and included: hydrocephalus, anxiety, myasthenia gravis, orbital myositis, medications side effect, sinusitis, intracranial hemorrhages, brain infarcts, sinus thrombosis, Todd's paralysis, keratoconjunctivitis, dizziness and giddiness, papilledema of unspecified cause, nutritional causes (including nutritional axonal neuropathy and Wernicke's encephalopathy).

Complications

One complication was observed in a single patient (0.5%), that of post-dural puncture headache, and this might be attributed to a lack of documentation on other minor side effects.

Discussion

This study provides relevant information on

the diagnostic efficacy and safety of LP in this middle aged, predominantly female population. It also refers to the wide range of different disorders that LP can help to diagnose. Compared to other studies which investigated indications of LP [8–10], this study differs in not being conducted in an emergency room; most of the patients were admitted electively for evaluation of their symptoms of headache, peripheral or CNS complaints. Since idiopathic intracranial hypertension was the most common final diagnosis, this study is reflective of the fact that these patients were mostly women with a high index of suspicion for such a diagnosis, where LP is the only way to confirm such a diagnosis. Also, as seen in [11], a positive culture or gram stain were quite rare in this study, as most of our patients were electively admitted for their LP and the suspicion for CNS infection in this group of patients was relatively low. The importance of LP and CSF analysis in patients suspected of having inflammatory CNS and PNS diseases is supported by this study as they were the third and fourth most common diagnoses, respectively. Unlike studies conducted in western countries [12] and in Kuwait [13], this study showed poor sensitivity of OCB for the diagnosis of MS in this population. This may reflect the low number of tested patients, genetic factors, or technical issues in our laboratory. The cytology of CSF in patients with the diagnosis of systemic cancer and clinical evidence of neurological disorder was quite sensitive to the detection of carcinomatous meningitis in this highly select group. Otherwise, it was negative in the other 13 tested patients who had no known history of malignancy. The low frequency of complications in this study (0.5%) is contrary to previous studies which showed post-LP headache prevalence in the range of 8–37% [14]. This low frequency of side effects mostly reflects poor documentation or being mostly mild enough to be ignored by both the patient and treating physician.

Conclusion

While this study has clear limitations, it shows that most elective LP patients in the adult population in a teaching hospital in Jordan were related to intracranial pressure disorders. The low infectious and inflammatory disorders yield reflects a selection bias rather than a prevalence of such disorders in the Jordanian community. Further studies addressing these issues are needed.

Acknowledgements: the authors would like to thank the information technology team at Jordan University Hospital for their technical help and wish to express their appreciation to the physicians involved in the care of these patients.

Ethical issues: The study was approved by the Jordan University Review Board (IRB)/Faculty of Medicine research committee decision.

Conflict of interest: the authors have no conflict of interest.

Author contribution: AD, MA, BG have contributed to data collection and analysis. SB, SD participated in idea generation and data analysis, and the writing and editing of this article.

Funding: this research was self-supported and completed without funding from any institute or person.

References

1. Levin E, Muravchick S, Gold MI. Density of normal human cerebrospinal fluid and tetracaine solutions. Anesth Analg. 1981; 60: 814-817.
2. Sakka L, Coll G, Chazal J. Anatomy and physiology of cerebrospinal fluid. Eur Ann Otorhinolaryngol Head Neck Dis. 2011;128(6):309-16.
3. Doherty CM, Forbes RB. Diagnostic Lumbar Puncture. Ulster Med J. 2014;83(2):93-10.
4. Wright BL, Lai JT, Sinclair AJ. Cerebrospinal fluid and lumbar puncture: a practical review. J Neurol. 2012; 259(8):1530-45.
5. Ward E, Gushurst CA. Uses and technique of pediatric lumbar puncture. Am J Dis Child.1992; 146: 1160-1165.
6. Sandoval M, Shestak W, Sturmann K, Hsu C. Optimal patient position for lumbar puncture, measured by ultrasonography. Emerg Radiol. 2004;10(4):179-81.
7. Shlamovitz GZ, Shah NR. 2018 Medscape URL: https://www.medscape.com/answers/80773-32948/how-is-measurement-of-the-opening-pressure-taken-during-a-lumbar-puncture-lp
8. Sternbach G. Lumbar puncture. J Emerg Med 1985; 2:199
9. Powers RD. Emergency department lumbar puncture: clinical application and utility of laboratory testing. Am J Emerg Med. 1987;5(6):516–520.
10. Alsuwailem MH, Alkhatem AH, Alshabib AA, Aldraisi MH, Al Jughiman AK, Al-Turaifi MH, Al-Ali SM and Al Nujaydi AH. Lumbar Puncture: Indications, Complications, Technique and CSF Analysis in Paediatric Patients.2018 EJHM ;70 (4), 638-643.
11. Neuman MI, Tolford S, Harper MB. Test Characteristics and Interpretation of Cerebrospinal Fluid Gram Stain in Children. Pediatr Infect Dis J 2008; 27(4):309-13.
12. Dobson R, Ramagopalan S, Davis A, and Giovannoni G. Cerebrospinal fluid oligoclonal bands in multiple sclerosis and clinically isolated syndromes: a meta-analysis of prevalence, prognosis, and effect of latitude. J Neurol Neurosurg Psychiatry 2013; 84 (8):909–914
13. Alshubaili AF, Alramzy K, Ayyad YM, and Gerish Y. Epidemiology of multiple sclerosis in Kuwait: new trends in incidence and prevalence. Eur Neurol 2005; 53(3):125–31.
14. Wu C, Guan D, Ren M, Ma Z, Wan C, Cui Y, Zhong P, Zhoa W, Li C, Yan F, Xie J, Xue F, Lian Y, Liu H, Wang C, Ji X and Xie N. Aminophylline for treatment of postdural puncture headache. Neurology 2018; 90 (17) e1523-e1529

دواعي ونتائج ومضاعفات بزل السائل الشوكي بين المرضى الأردنيين

شذى أحمد شيخ باعباد[1]، علاء الدين دحبور[2]، ميس عكيلة[2]، باسل غيث[3]، سعيد دحبور[2]

[1] وزارة الصحة الأردنية، مستشفى الزرقاء الحكومي الجديد
[2] كلية الطب الجامعة الأردنية / مستشفى الجامعة الأردنية
[3] المستشفى الإسلامي / العقبة

الملخص

المقدمة: بزل السائل الشوكي هو إجراء طبي سريري يُستخدم لمعرفة أمراض الجهاز العصبي المركزي والطرفي، وهدفت الدراسة الحالية إلى استطلاع خبرة مستشفى تعليمي في هذا الإجراء على مدى خمس سنوات.

الطريقة والإجراءات: تمت مراجعة السجلات الطبية للمرضى الذين كانت أعمارهم (13) عامًا أو أكثر، والذين خضعوا لبزل السائل الشوكي في السنوات (2014–2018) وفقا لمتغيرات العمر والجنس والمؤشرات والنتائج والمضاعفات، والتشخيص النهائي للمرضى.

النتائج: كان عدد المرضى الكلي (195) مريضًا، من بينهم (133) مريضًا من الإناث، أي ما نسبته (68.2٪)، وبلغ متوسط أعمارهم (40.0 عاما ±15.7). تم قياس ضغط السائل الشوكي لـ(104) مريضًا بنسبة (53.3٪)، وكانت النتائج (86) وبنسبة (82.7٪) بمتوسط ضغط السائل الشوكي الافتتاحي (31.2 ± 12.1) سنتيمتر، وضغط السائل الشوكي الانغلاقي تم قياسه لـ(54) مريضًا (27.7٪) وبمتوسط (16.5 ± 5.7) سنتيمتر. تم قياس تعداد الكريات البيضاء والكريات الحمراء، ومستويات السكر والبروتين للسائل الشوكي في معظم المرضى، وكانت نسبته (99.0٪، 98.5٪، 96.9٪، 96.9٪) على التوالي. وأجريت الزراعة البكتيرية وصبغة جرام لـ (28) مريضًا وبنسبة (14.4٪) و(6) بنسبة (3.1٪) على التوالي، وتمت دراسة تحليل الخلايا والعصابات قليلة السائل (OCB) في 16 (8٪) و28 (14.4٪) مريضًا، على التوالي، ولعل من أهم دواعي استخدم بزل السائل الشوكي: الصداع، اعتلال الأعصاب الطرفية، وذمة حليمة العصب البصري في (69) مريضًا وبنسبة (35.4٪)، و(41) مريضًا وبنسبة (21.0٪)، و(26) مريضًا وبنسبة (13.3٪) على التوالي.

كانت التشخيصات النهائية الأكثر شيوعًا هي ارتفاع ضغط السائل الشوكي مجهول السبب، والأمراض الالتهابية للجهاز العصبي المركزي، واعتلال الأعصاب الطرفية، والتهاب السحايا والدماغ في (68) مريضًا وبنسبة (34.9٪)، و(27) مريضًا وبنسبة (13.3٪)، و(20) مريضًا وبنسبة (10.3٪)، و(16) مريضًا وبنسبة (8.7٪) على التوالي.

الاستنتاج: بزل السائل الشوكي إجراءٌ شائع يُجرى في سرير المريض، وكان أكثر دواعي إجرائه في هذه الدراسة، هو اضطرابات السائل الشوكي، والتهابات الجهاز العصبي، وما زال هذا الإجراء يُعتبر نافعًا وآمنًا.

الكلمات الدالة: بزل السائل الشوكي، تحليل السائل الشوكي، دواعي استخدام بزل السائل الشوكي.