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

Shada Ba-Abbad¹, Aladdin Dahbour², Mays Akileh², Basel Ghaith³, Said Dahbour²

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.

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...
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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) 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

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

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, polynuropathy 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.

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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.

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References

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Doi and results of lumbar puncture in Jordanian patients

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Abstract

Introduction: The lumbar puncture is a diagnostic procedure used to detect diseases of the central and peripheral nervous system, and the aim of the current study was to review the experience of this procedure in teaching hospitals over five years.

Method and procedures: The medical records of patients aged 13 years or more who underwent lumbar puncture in the years (2014–2018) were reviewed based on age, gender, indications, results, and complications, and the final diagnosis of patients.

Results: A total of 195 patients, of which 133 were female (68.2%), with an average age of 40.0 ± 15.7 years, were treated. The lumbar puncture was performed for 104 patients (53.3%) with an average opening pressure of 31.2 ± 12.1 cmH2O, and the final diagnosis was 69 patients (35.4%) with increased unknown cause of cerebrospinal fluid pressure, and 41 patients (21.0%) with inflammation of the central nervous system, and 20 patients (10.3%) with increased intracranial pressure. The study results: Lumbar puncture is a common procedure in patients’ wards, and one of the main indications of this procedure in this study is neurological disorders, infections, and their complications, and the procedure is still considered safe and effective.

Keywords: Lumbar puncture, CSF analysis, Indications of using lumbar puncture.