Case Report

Report of cerebral vasospasm as a complication of intracranial subarachnoid hemorrhage following traumatic lumbar puncture

Mohammad Arsal Arshad1, Louis Samuel Reier1, James B. Fowler1, Hamid Hadi1, Hassan Khan2, Usman Beg3, Brian Fiani4

1Department of Neurosurgery, Desert Regional Medical Center, Palm Springs, CA, 2Department of Internal Medicine, MacNeal Hospital Loyola University, Berwyn, IL, 3Arizona College of Osteopathic Medicine, Midwestern University, Glendale, AZ, 4Department of Neurosurgery, Weil Cornell Medicine, New York, NY, United States.

E-mail: *Mohammad Arsal Arshad - maarshad93@gmail.com; Louis Samuel Reier - louisreier3@gmail.com; James B. Fowler - james-fowler@augustana.edu; Hamid Hadi - hamidhadi09@gmail.com; Hassan Khan - hasanpkhan@gmail.com; Usman Beg - beg.usman1@gmail.com; Brian Fiani - bfiani@outlook.com

*Corresponding author: Mohammad Arsal Arshad, Department of Neurosurgery, Desert Regional Medical Center, Palm Springs, CA, United States.
maarshad93@gmail.com

INTRODUCTION

The lumbar puncture (LP) was first reported by Quinke in the late 19th century. Today, this technique has become an essential tool providing both diagnostic and therapeutic purpose. It is routinely used for the diagnosis of a variety of conditions including meningitis, encephalitis, subarachnoid hemorrhage (SAH), central nervous system vasculitis, autoimmune conditions, paraneoplastic syndromes, and some intracranial tumors.[1]

Understanding lumbar spine anatomy is vital in performing a safe LP. As the spinal needle is inserted in the lumbar spine, it will pierce the skin, subcutaneous tissue, supraspinous

ABSTRACT

Background: This case report is the first documented and illustrated case of the identification and treatment of intracranial vasospasm as a sequelae of traumatic lumbar puncture (LP). LP is a routine procedure performed for both diagnostic and therapeutic purposes. Although rare, this procedure has risks and complications that should be considered before performing.

Case Description: A 58-year-old male was found to have intracranial subarachnoid hemorrhage (SAH) 2 days after a traumatic LP which occurred in the setting of subtherapeutic international normalized ratio. During his hospitalization, the patient developed both clinical and radiographic signs of vasospasm. He was taken for angiography, which demonstrated significant vasospasm of bilateral middle cerebral arteries and bilateral anterior cerebral arteries. All vasospasms resolved and the patient improved clinically after intra-arterial spasmolytic therapy.

Conclusion: LP is a routine procedure with complications that are often overlooked. The authors describe intracranial vasospasm from traumatic LP before correction of patient's coagulopathy. Cases with similar hemorrhage occurring in the spine resulting in non-aneurysmal SAH and vasospasm were reviewed.

Keywords: Cerebral vasospasm, Lumbar puncture, Spinal hematoma

INTRODUCTION

The lumbar puncture (LP) was first reported by Quinke in the late 19th century. Today, this technique has become an essential tool providing both diagnostic and therapeutic purpose. It is routinely used for the diagnosis of a variety of conditions including meningitis, encephalitis, subarachnoid hemorrhage (SAH), central nervous system vasculitis, autoimmune conditions, paraneoplastic syndromes, and some intracranial tumors.[1]

Understanding lumbar spine anatomy is vital in performing a safe LP. As the spinal needle is inserted in the lumbar spine, it will pierce the skin, subcutaneous tissue, supraspinous

This is an open-access article distributed under the terms of the Creative Commons Attribution-Non Commercial-Share Alike 4.0 License, which allows others to remix, transform, and build upon the work non-commercially, as long as the author is credited and the new creations are licensed under the identical terms.
©2022 Published by Scientific Scholar on behalf of Surgical Neurology International
ligament, interspinous ligament, ligamentum flavum, epidural space, dura, arachnoid, and ultimately into the subarachnoid space.\footnote{4,11}

Contraindications to performing a LP include infection near the site of the LP, posterior fossa mass with increased intracranial pressure, and coagulopathy. Risks of LP include spinal headache with intracranial hypotension, nerve root irritation, infection, brain stem herniation, and bleeding complications.\footnote{2} The epidural venous plexus and radicular vessels that follow the nerve roots are the primary cause of traumatic LPs. Rare complications of both intracranial and spinal hemorrhage have been reported with traumatic LPs.\footnote{1,3,7} However, only one other case of non-aneurysmal SAH with vasospasm has been reported as a complication secondary to LP. Furthermore, it is essential to address any coagulopathy; a patient may have before attempting a LP.

**CASE DESCRIPTION**

A 58-year-old male with medical history of autoimmune deficiency syndrome, hypertension, diabetes mellitus, polysubstance abuse disorder, psychogenic movement disorder, and antiphospholipid antibody syndrome presented to emergency department (ED) with altered mental status. Initial computed tomography (CT) head without contrast was negative for hemorrhage. The ED proceeded with performing a LP to obtain cerebrospinal fluid (CSF) for the diagnostic purpose of ruling out meningitis and HIV encephalitis. The LP yielded 20cc of bloody CSF. Of note, patient was on Coumadin for antiphospholipid syndrome and had an international normalized ratio of 2.0 and prothrombin time of 19.8. The ED failed to reverse his warfarin before performing the LP and the patient developed headache soon after, which sustained for the next few days. A second CT of the head without contrast was completed 48 h after the LP, for sustained headache and development of somnolence, which demonstrated diffuse SAH with intraventricular extension [Figure 1]. The patient was transferred to the intensive care unit for close neurological monitoring.

The patient subsequently developed low back pain, lower extremity weakness with radiculopathy, and urinary retention. Magnetic resonance imaging of the lumbar spine demonstrated ventral extra-axial hematoma measuring 1.3 cm with compression of the cauda equina most severely at L2-L3 level [Figure 2]. Neurosurgery was consulted and the patient was taken to surgery for emergent decompression of the hematoma. Intraoperatively, the dura was tense with a durotomy noted and both intradural and extradural hematomas were evacuated.

The patient’s mental status remained altered postoperatively with additional deficits of the upper extremity weakness on postbleed day 13. Transcranial Doppler (TCD) demonstrated elevated intracranial velocities (right middle cerebral arteries [MCA] velocity 251 cm/s, right posterior cerebral artery velocity 104.1 cm/s, and left MCA velocity 162.1 cm/s). Lindegaard ratio was 8.7 and 4.6 on the right and left, respectively. CT angiogram revealed moderate-to-severe narrowing of bilateral MCA and anterior cerebral arteries vessels as well as moderate narrowing of the basilar artery. Patient was started on hyperdynamic therapy and underwent a cerebral angiogram for delivery of intra-arterial spasmolytic therapy, which resolved the radiographic vasospasms [Figure 3]. Throughout his hospital course, the patient underwent one additional intra-arterial spasmolytic

![Figure 1: CT head without contrast before lumbar puncture (Pre LP) and 48 h after lumbar puncture (Post LP) demonstrated interval development of intraventricular hemorrhage in the fourth and left lateral ventricle with SAH posteriorly, most pronounced at the vertex.](image-url)
Arshad, et al.: Traumatic lumbar puncture with cerebral vasospasm

Surgical Neurology International • 2022 • 13(128) | 3

treatment for clinical vasospasm on postbleed day 15. At that
time, patient had recurrent weakness of the upper extremities
as well as TCD findings suggestive for vasospasm.

The patient was discharged from the hospital 45 days
after admission after completing a 3-week course in
the neurocritical care unit for close observation for any
subsequent vasospasm and followed by rigorous inpatient
physical therapy. At discharge, the patient's upper extremity
weakness had resolved, but he remained paretic in the
lower extremities. He was able to feed and groom himself
independently and transfer himself from bedside to
wheelchair (modified Rankin score [mRS] 4). At 2-year
follow-up, the patient had improvement in his lower
extremity strength with some deficits noted (mRS 2).

**DISCUSSION**

Traumatic LP in a patient taking anticoagulants is one
etiology of spinal hematomas,\(^{6,10}\) which may be classified
as epidural, subdural, subarachnoid, or intramedullary.
Diagnosis may be made radiographically, intraoperatively,
or at autopsy.\(^ {8}\) Traumatic LP as the cause of intracranial
hemorrhage or SAH is rare. Although an intradural spinal
SAH and intracranial SAH could occur independently, it is
more likely that the mechanisms causing one would cause
the other as well. In such cases, an arterial injury is likely
to have occurred causing significant bleeding and spread of
blood products to the intracranial compartment. We believe
that the blood products were the source of this patient's
cerebral vasospasms, based on the temporal association.

There has been extensive research regarding the
pathogenesis of arterial vasospasm. Some studies provide
evidence that particular substances found in CSF after SAH,
namely, oxyhemoglobin found in xanthochromic CSF, are
the main mediators of cerebral vasospasm.\(^ {13}\) Within the
first 24 h of SAH, there is large infiltration of white blood
cells that phagocytose and breakdown red blood cells.\(^ {13}\)
This process peaks around day 7 coinciding with the period
for peak risk of cerebral vasospasm after aneurysmal
SAH. This breakdown of red blood cells within the
subarachnoid CSF space results in elevated levels of blood
breakdown products such as vasoactive oxyhemoglobin and
bilirubin.\(^ {13}\)

There have only been four other cases reported of spinal
hematoma resulting in intracranial vasospasm as listed in
[Table 1].\(^ {8,9,12,13}\) Three of these reports found hematoma at
level of the spinal cord itself while one reported hematoma
around the conus and cauda equina. In all but one case,\(^ {9}\)
spinal hematoma associated intracranial vasospasm was
also found to have intracranial hemorrhage.\(^ {8,12,13}\) There
has been only one other reported case of LP associated
intracranial vasospasm;\(^ {12}\) however, in this case, vasospasm

**Figure 2:** MRI lumbar spine with gadolinium: axial cut (left) at
L1-L2 and corresponding midsagittal cut (right) demonstrates a
large compressing ventral hematoma with maximal thickness at
L2-L3 disc space.

**Figure 3:** Cerebral angiogram, pre and post intra-arterial
vasospasm treatment (a) right internal carotid artery (ICA)
frontal projection pretreatment demonstrating moderate-to-
severe vasospasm of the M1 and M2 segments of the MCA.
ACA demonstrates mild-to-moderate vasospasm (b) right ICA
frontal projection demonstrating improved vessel lumen caliber
posttreatment (c) left ICA frontal projection demonstrates
moderate-to-severe M1 and mild M2 vasospasm pretreatment
(d) left ICA frontal projection demonstrating improved vessel
lumen caliber posttreatment.
was not treated and patient ultimately developed permanent quadriplegia secondary to cerebral infarction. In our case, there was only a small amount of intracranial blood along the posterior peripheral sulci and ventricular systems without evidence of increased intracranial pressure. This suggests that cerebral vasospasm had resulted from vasoactive blood breakdown products carried in the CSF. Clinical cerebral vasospasm is not classically considered among the risks of LP; however, we have outlined other cases in addition to ours that present this phenomenon. Furthermore, adequate assessment of indications and contraindications should be evaluated before proceeding with LP.

CONCLUSION

LP is not an emergent nor benign procedure. Therefore, proper indications, contraindications, and all risks should be considered before performing it, especially in a coagulopathic patient. We report a case of traumatic LP resulting in a patient developing nonaneurysmal SAH and subsequent intracranial vasospasm. This complication could have been avoided in this case if, first, the indication and necessity for LP were considered and, second, if the risk of completing the procedure with coagulopathy was considered. Our case demonstrates the successful and timely treatment necessary to improve outcomes for patients who develop this complication.

Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent.

Financial support and sponsorship

Nil.

Table 1: Similar cases of spine hemorrhage resulting in intracranial vasospasm.

<table>
<thead>
<tr>
<th>Case</th>
<th>Author</th>
<th>Year</th>
<th>Etiology of spinal hematoma</th>
<th>Anticoagulation</th>
<th>Location of spinal hematoma</th>
<th>Intracranial hematoma</th>
<th>Vasospasm</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Shakur and Farhat[13]</td>
<td>2013</td>
<td>Spontaneous</td>
<td>Coumadin</td>
<td>T2-12 intradural</td>
<td>Bilateral frontoparietal subarachnoid hemorrhage</td>
<td>Right MCA, bilateral ACA</td>
</tr>
<tr>
<td>2</td>
<td>Nam et al.[8]</td>
<td>2014</td>
<td>Spontaneous, Heparin, dual antiplatelet</td>
<td></td>
<td>C7-T6 intradural</td>
<td>Bilateral parietal subarachnoid hemorrhage</td>
<td>Right MCA</td>
</tr>
<tr>
<td>3</td>
<td>Oh et al.[9]</td>
<td>2015</td>
<td>Spontaneous</td>
<td>None</td>
<td>C5-T4 Intradural</td>
<td>None</td>
<td>Multifocal</td>
</tr>
<tr>
<td>4</td>
<td>Sawaya and Sawaya[4]</td>
<td>2018</td>
<td>Lumbar puncture</td>
<td>None</td>
<td>L1-S1 intradural and epidural</td>
<td>Bilateral frontoparietal subarachnoid hemorrhage</td>
<td>Bilateral MCA, ACA, PCA</td>
</tr>
<tr>
<td>5</td>
<td>Current case</td>
<td>2022</td>
<td>Lumbar puncture</td>
<td>Coumadin</td>
<td>L2-3 intradural and epidural</td>
<td>Bilateral parietal subarachnoid hemorrhage, intraventricular hemorrhage, tentorial subdural hematoma</td>
<td>Bilateral MCA and ACA</td>
</tr>
</tbody>
</table>

Conflicts of interest

There are no conflicts of interest.

REFERENCES


