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Case Report

Meningitis due to intra-abdominal cerebrospinal fluid fistula following gunshot wound successfully treated with antibiotics and blood patch: A case report and literature review

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Received : 25 April 2022
Accepted : 04 July 2022
Published : 15 July 2022

DOI
10.25259/SNI_390_2022

Quick Response Code:

ABSTRACT

Background: Penetrating spinal cord injury (PSCI) represents an average of 5.5% of all SCIs among civilians in the United States. The formation of a cerebrospinal fluid (CSF) fistula following PSCI occurs in approximately 9% of cases. Intra-abdominal CSF fistulae are rarely reported.

Case Description: We present the case of a 28-year-old Caucasian female who suffered a single gunshot wound to the abdomen with a missile fragment lodged within the left L2 pedicle and transverse process without obvious canal compromise. The patient developed bacterial meningitis 13 days after the initial injury, treated with IV antibiotics. CT myelogram demonstrated intra-abdominal ventral CSF fistula from the left L2–L3 neuroforamen. The patient was successfully treated with fluoroscopy-guided dorsal autologous blood patch graft.

Conclusion: This case highlights a rare complication of PSCI successfully managed with the use of a blood patch graft.

Keywords: Cerebrospinal fluid fistula, Epidural blood patch, Meningitis, Spinal gunshot wound, Trauma

INTRODUCTION

Penetrating spinal cord injury (PSCI) represents an average of 5.5% of all SCIs among civilians in the United States.[3] The incidence of cerebrospinal fluid (CSF) fistula from PSCI is not well described, but appears to be higher in cases of trauma than in spontaneous or postsurgical cases.[5] Of these fistulae, central nervous system (CNS) infections may occur more frequently with concomitant intra-abdominal injuries.[7,22] The literature on the treatment of traumatic CSF fistulae of the spine is lacking; however, various treatment modalities have been described, including epidural blood patch graft.

CASE REPORT

We present the case of a 28-year-old Caucasian female who sustained a single abdominal gunshot wound (GSW). She underwent emergent laparotomy where a proximal jejunum perforation was discovered and repaired. Postoperative computed tomography (CT) imaging showed bullet fragments in and adjacent to the left L2 pedicle, without obvious spinal canal compromise [Figure 1]. Her postoperative course was complicated by the discovery of a left ureteral injury requiring placement of nephrostomy tube and intra-abdominal drains by urology. She was discharged postinjury day 8.

The patient then returned to the emergency department at our center postinjury day 13 with headache, photophobia, and nausea. On examination, she was found to be febrile to 38.6 Celsius, lethargic with meningismus, but fully oriented with an otherwise nonfocal neurologic examination. Contrasted CT of the abdomen was unremarkable. CSF studies were obtained through lumbar puncture which revealed cloudy CSF with elevated nucleated cells (7925 cells/μL) and red blood cells (168 cells/μL), low glucose (<5 mg/dL), and elevated CSF protein (318 mg/dL) suggestive of bacterial meningitis. Gram stain revealed >25 polymorphonuclear cells per low-power field, but revealed no organisms, and aerobic and anaerobic culture did not identify causal organisms. Her intra-abdominal drain contents were sampled and negative for β2-transferrin. A pyelogram revealed a persistent ureteral leak, for which the patient received a ureteral stent. Empiric IV antibiotic therapy with vancomycin, cefepime, and metronidazole was initiated for the treatment of meningitis and sustained for 14 days. A lumbar CT myelogram was obtained, revealing an area of contrast leakage ventrally into the retroperitoneum in the area of the left L2–L3 neuroforamen without myelographic block [Figure 2]. Given these findings, the patient underwent fluoroscopy-guided dorsal epidural autologous blood patch graft placement at the L2–L3 level [Figure 3]. After the blood patch, the patient's meningitis subsequently resolved. There was no clinical evidence of additional CSF leakage or intracranial hypotension, and the patient was discharged from the hospital 2 weeks after blood patch placement.

Figure 1: Axial and sagittal CT images showing bullet fragments violating the anterolateral vertebral body of L2, with a large bullet fragment lodged in the left L2 pedicle.

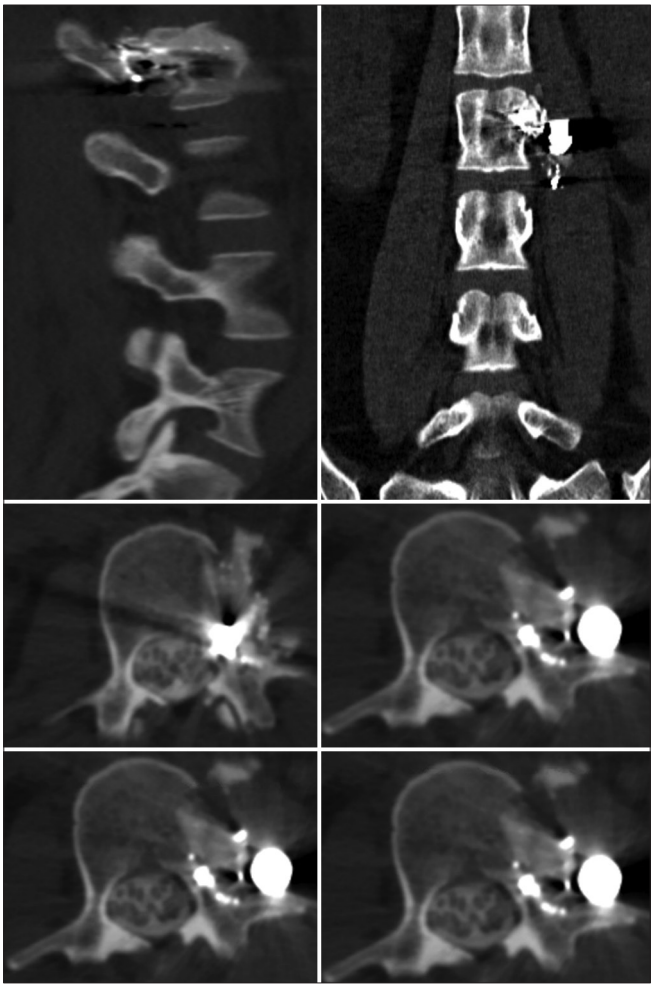

Figure 2: Sagittal, coronal, and axial CT myelogram images showing anterolateral cerebrospinal fluid fistula, with leakage of contrast into the left psoas muscle.

DISCUSSION

Within the United States, PSCI represents 5.5% of all SCIs among civilians.[3] Among PSCI in the United States, the described incidence of firearm-associated injuries is high, with 92–98% of cases attributed to firearms.[15,16] The most commonly affected regions of the spine are the thoracic and lumbar spine, which have similar injury incidence, followed less commonly by the cervical and sacrococcygeal spine.[3,15,22]

Due to the abdomen and pelvis being common regions of firearm injuries, the incidence of concomitant abdominal or pelvic organ injury is high, with studies estimating abdominal viscus injury occurring in 57–69% of cases.[18,22] In the case of PSCI associated with abdominal viscus injury, the risk of CNS infection has been variably reported. Lin *et al.* recorded no cases of CNS infection among 29 patients suffering

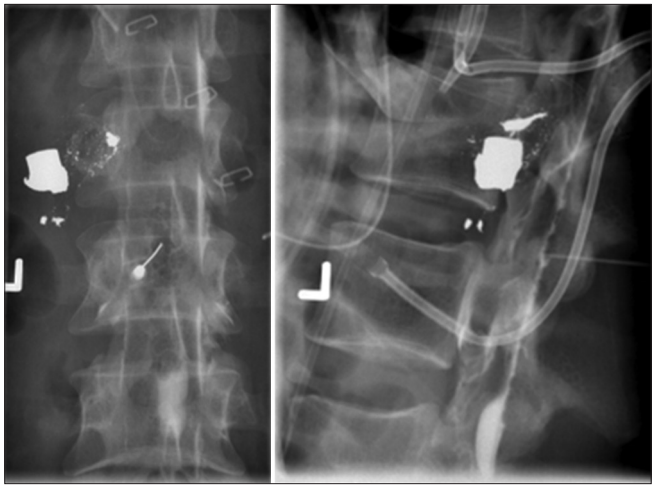

Figure 3: Anterior-posterior and lateral fluoroscopy images of dorsal epidural blood patch grafting with spinal needle inserted in the thecal sac at L2–3 interspace.

transperitoneal GSWs involving the spine.[14] Similar findings were described among 33 patients presenting with spinal missile injury associated with abdominal viscus injury by Kumar *et al*.[12] Roffi *et al*. found only one patient developed acute meningitis among 42 patients presenting with missile injury to the spine associated with abdominal viscus injury.[20] In contrast, Quigley and Place found a statistically significant increased risk of spine infections in patients with transgastrointestinal wounds to the spine, particularly with injures to the colon (Chi = 13.36, $P < 0.001$).[19] Romanick *et al*. also reported that hollow viscus injury associated with vertebral column fracture results in meningitis in 88% of cases.[21] Schwed *et al*. further showed in their single-institution retrospective review of PSCI that hollow viscus abdominal injury is associated with a higher incidence of spinal and neurologic infections (26 vs. 6%, $P < 0.001$).[22] Therefore, while the data on risk of CNS infection from spinal missile wounds associated with abdominal viscus injury are mixed, there appears to be an increased risk of CNS infection associated with transabdominal injuries.

CSF fistula is an uncommon complication of firearm-associated PSCI, occurring in approximately 9% of cases.[10] These CSF fistulae manifest as either leaks to the skin, the subcutaneous tissues,[17] or into internal structures including the mediastinum,[28] pleural space,[1,24] and the abdominal cavity.[10,22,27]

At present, there are no guidelines for the management of CSF fistulae from traumatic missile injuries to the spine.[9] Management is, therefore, individualized based on the level of injury, degree of neurologic deficit, and observed complications due to CSF leakage. Generally speaking, treatment follows a similar paradigm to that of cranial CSF leaks.[13] This includes careful observation for spontaneous resolution of CSF fistula, CSF diversion, blood patch grafting, and/or open surgical repair. Antibiotic therapy is widely considered to be an important component of overall management and often administered regardless of other management considerations.[7] Interestingly in our case, CSF culture data did not grow causative organisms. Our case may, therefore, represent one of the approximately 20% of cases of bacterial meningitis with negative culture data[25] or may be secondary to the patient having received doses of piperacillin-tazobactam and ciprofloxacin for intra-abdominal injuries during their original presentation a week prior.

In the cases that spontaneous resolution of CSF fistula does not result, CSF diversion may be attempted. For example, fistulae isolated to the thoracolumbar spine may benefit from placement of a lumbar drain.[11] For cervical injuries, external ventricular drain placement may be considered.[6] Minimally invasive repair may be attempted using autologous blood patch grafting,[8] with both dorsal and ventral approaches having been described.[2] Studies on the efficacy of blood patch for the treatment of traumatic spinal CSF leak are lacking, but data from the literature on spontaneous CSF leaks suggest treatment success of around 30%.[23] Therefore, blood patch grafting may be attempted multiple times to achieve treatment success. Finally, open surgical repair may be considered if more conservative treatment modalities have failed or if initial spinal cord injury warrants urgent surgical intervention, at which time, the CSF leak may be repaired.[4,6,7,26]

CONCLUSION

Intra-abdominal CSF fistula secondary to projectile missile injury represents an uncommon manifestation of penetrating vertebral column injuries. Such fistulae are associated with higher rates of meningitis or other nervous system infections. Various treatment modalities have been described; however, there are no guidelines for the treatment of these fistulae. In our case, the patient presented with a single projectile missile wound to the abdomen with an involvement of the left L2 pedicle and L2–L3 neuroforamen. Our patient presented in a slightly delayed fashion with meningitis, and intraperitoneal CSF fistula was confirmed on CT myelogram. She was treated with empiric antibiotic therapy and dorsal epidural blood patch grafting, with resolution of meningitis and without development of intracranial hypotension symptoms. Our case demonstrates the successful treatment of this rare clinical entity with a minimally invasive approach.

Declaration of patient consent

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

Financial support and sponsorship

Nil.

Conflicts of interest

There are no conflicts of interest.

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How to cite this article: George DD, Houk C, Pieters TA, Towner JE, Stone JJ. Meningitis due to intra-abdominal cerebrospinal fluid fistula following gunshot wound successfully treated with antibiotics and blood patch: A case report and literature review. Surg Neurol Int 2022;13:308.