CT-guided percutaneous translaminar approach for blood patching: case report and technical note

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Abstract In this article the authors describe a novel technique for performing epidural blood patch (EBP) by percutaneous CT-guided translaminar approach in challenging cases where interlaminar approach is not possible. A 24-year-old woman with medical history of multiple spinal surgeries and instrumentations for the treatment of scoliosis, presented 3 months post-operatively with acute and severe orthostatic headaches that began 1 week after surgery. Neurological examination was normal. Brain magnetic resonance imaging (MRI) showed mild thickening and contrast enhancing in the bilateral dura. Computed tomography (CT) myelography revealed CSF leakage in the level of T3 vertebra. EBP was attempted using fluoroscopic and then CT guidance; however, despite multiple attempts, the epidural space could not be accessed through the interlaminar route due to extensive instrumentation of the spine and profound structural bony abnormalities. EBP was performed successfully via a CT-guided translaminar

approach using an Ostycut trephine needle (Angiomed®/Bard, Karlsruhe), without complications.

Keywords CT myelography · Epidural blood patch · Intracranial hypotension syndrome · Magnetic resonance imaging · Translaminar approach

Introduction

Intracranial hypotension (IH) is a clinical syndrome in which absolute or relative hypovolemia of the cerebrospinal fluid (CSF) results in various neurological symptoms [10]. Recent reports show that the incidence of this syndrome may be much higher than previously presumed [2–4, 7, 9, 12, 13, 15]. One of the causes of IH is spinal CSF leakage due to a dural tear complicating spinal surgeries [3, 7]. Patients complaining of new onset neurological symptoms after spinal surgery, especially orthostatic headache, IH syndrome must be considered in the differential diagnosis, and neuroimaging studies, such as computed tomography (CT) and magnetic resonance imaging (MRI) myelography and radionuclide cisternography (RC) must be performed accordingly [1]. Treatment modalities for IH include bed rest, intravenous fluid, intravenous or oral caffeine, theophylline, steroids, epidural blood patch (EBP) and surgical exploration. In this report, we present a case of IH, which developed after spine surgery and instrumentation for scoliosis, and describe a novel technique for performing EBP using a translaminar approach.

Case report

A 24-year-old woman with a medical history of multiple spinal surgeries and instrumentation for the treatment of

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scoliosis presented with acute attacks of diffuse postural headaches, nausea, and vertigo, which began each morning and become more severe in the afternoon. Walking or standing exacerbated the headaches, and caused blurred vision. On the other hand, the patient described symptomatic relief in the supine position. The patient had three previous operations for scoliosis; the last operation was performed 3 months prior to presentation. The patient's symptoms began 1 week following operation. The patient had three previous operations for scoliosis and the last operation was performed before 3 months. The symptoms of the patient started 1 week after the operation. Physical examination revealed posterior median operation wound in the back and mild scoliosis of the spine, with no pathologic finding in the neurological examination. Cranial CT scan revealed no pathologies. Brain MRI showed minimal thickening and contrast enhancing in the bilateral dura (Fig. 1). A preliminary diagnosis of intracranial hypotension was made based on the lack of radiological findings and the patient's clinical picture. Due to the presence of the metallic spinal instrumentation (Fig. 2a, b), CT myelography was performed and revealed a CSF leak at the T3 vertebral level. We hypothesized that the dural tear might have occurred during pedicle screw insertion at the time of surgery. After identification of the leakage, the patient was prepared for EBP. Initially, a fluoroscopically guided interlaminar approach was used to attempt to gain entry to the epidural space at the level of the leakage. However, the epidural space could not be accessed, despite multiple attempts in two adjoining levels of the leakage with a lumbar puncture needle. For this reason the CT-guided procedure was performed with Philips MX 8000 (Best, Netherland) scanner with 3-mm cuts, with better visualizing of the spinal anatomy. However, attempts to enter the epidural space again failed due to the spinal

instrumentation and the profound structural bone abnormalities related to the scoliotic pathology and the previous operations. Therefore, we decided to enter the epidural space using a percutaneous translaminar approach. Under CT guidance, an Ostycut trephine needle (Angiomed®/Bard, Karlsruhe) (Fig. 3a) was successfully advanced through the T3 lamina and into the epidural space (Fig. 3b). Serial CT scans are performed to assist the position of the needle. Contrast agent was injected to confirm needle placement in the epidural space (Epidurography) and to confirm the site of CSF leakage (Fig. 3c). Fifteen cc of autologous blood was then injected until resistance to injection occurred (Fig. 3d). The postoperative period went uneventful, and the patient was kept in flat supine position. After 5 days of full bed rest her symptoms improved completely, and the patient was discharge with full recovery.

Discussion

Although once considered uncommon, the recent increasing number of reports considering IH showed that the incidence of this syndrome may be indeed much higher than presumed [2–4, 7, 9, 12, 13, 15]. The etiology of the IH syndrome can be classified as (1) spontaneous (primary), and (2) secondary. The latter can be divided further into: (2a) traumatic, mostly iatrogenic; (2b) degenerative spine disorders; (2c) truly hypovolemic, mostly from systemic dehydration; and (2d) overdrainage of the CSF by neurosurgical procedures [7]. Prolonged CSF leakage is a serious complication of spine surgery, and many cases of

Fig. 1 Contrast enhanced coronal brain MRI, showing minimal thickening and contrast enhancing in the bilateral dura (arrows)

Fig. 2 A–P (a) and lateral (b) spinal plain radiographs showing the spinal instrumentation in our case

Fig. 3 **a** A photograph demonstrating the ostytrephine needle (Angiomed®/Bard, Karlsruhe). Note the sharp center of the needle (*thin arrow*) and the screw-shaped outer layer (*thick needle*). **b** Axial spinal CT scan demonstrating the needle as introduced to the epidural space through the bony lamina of T3 vertebra. **c** Contrast agent is injected to the epidural space (epidurography) to confirm the site of the leakage. **d** Injection of autologous blood to the epidural space

orthostatic headaches following spinal surgery might be due to IH as a result of a dural tear with CSF leakage. However, the actual incidence of IH following spinal surgery might well be higher than initially thought, as spine surgeons might under recognize the symptoms, and these patients rarely undergo neuroimaging studies. Advances in the understanding of the pathophysiology of IH, advances in imaging techniques, and increasing numbers of case reports have recently brought more attention to this syndrome. Reports of IH after spinal surgery included those after discectomy, laminectomy and instrumentation [3]. Typically, those patients were diagnosed with IH several weeks or months after spine surgery. In their review of IH in spine pathologies, Inamasu and Guiot [7] described that imaging studies often revealed a pseudo meningocele or a CSF collection at the site of surgery in the posterior discectomy group, and a subarachnoid-thoracic fistula in the anterior thoracic spine surgery group [6, 7, 9, 17].

In the present article, we present a case of IH after spinal surgery and instrumentation for scoliosis. The cause was probably a dural tear during screw insertion, as the leakage site was found related to the pedicle screw. In 4,369 scoliosis cases treated by posterior instrumentation and fusion, dural tear was reported in 8 cases (0.18%) [5]. Thus, pedicle screw placement in the thoracic spine in scoliosis surgery requires caution and considerable experience in order to avoid the complications. Differentiating IH from other headache syndromes may not be easy and misdiagnosis still seems to take place commonly. Postural

headache is characterized by aggravation in the upright position and relief when lying supine. This phenomenon is caused by vasodilation and by traction of pain-sensitive structures due to downward displacement of the brain [14]. Distortions of the nerve trunks may cause dysfunction of the optic and VIth cranial nerves presented clinically by diplopia and visual field abnormalities, respectively, and reported to be improved after appropriate management [16]. Other symptoms, such as, vestibular and auditory symptoms due to variations in intra labyrinthine pressure [4], partial pituitary insufficiency due to traction of the pituitary stalk [12], cortical venous thrombosis due to the decreased venous blood flow velocity [15] and paroxysmal ataxia of gait [4] have been reported. In patients presenting with cranial neurological symptoms (especially orthostatic headache) after spinal surgery, IH syndrome is considered as a differential diagnosis and neuroimaging studies, such as, CT and MRI myelography and RC [1, 10, 11]. In our case, MRI myelography was not considered due to the presence of the spinal instrumentation, and we performed CT myelography which was successful in determining the site of the dural tear. Also, because of the doubt of the sensitivity of both CT and MRI myelography due to the artifacts of the metal instruments, RC could be performed as the first radiodiagnostic tool. RC seems to have a relatively high “sensitivity” with its panoramic view of the entire spine, and in such similar cases it may be the only radiodiagnostic method able to detect the exact point of leakage unaffected by the metal artifacts [3].

Treatment of IH begins with conservative management, including bed rest, restoring the depleted CSF volume by intravenous fluid, intravenous or oral caffeine, theophylline, and steroids [10, 11]. Patients who are refractory to the initial conservative management are candidates for EBP, either by percutaneous or open surgical approaches. In the present case, because the patient was operated several times and due to the presence of the extensive post-operative fibrosis, we believed that reoperation might carry higher risk of neural injury compared to the minimal invasive percutaneous approach. For this reason we preferred the percutaneous approach option upon the open surgical reoperation.

The percutaneous approach can be performed by blinded insertion of the needle of under guidance of fluoroscopy or CT. CT-guided approach is more advantageous due to the ability to perform the diagnostic CT myelography and the therapeutic EBP in the same session and identification of the spinal structures with less risk of neural injury. Moreover, in cases with history of spinal deformity and/or previous surgery, as the present case, the abnormal anatomy of the spine with the distorted neural relations may lead to increase the risk of the neural injury and the failure rate of the procedure if performed without visualizing the neural structures. In the percutaneous approach, the epidural space is entered through the interlaminar space and ligamentum flavum. However, in the present case, multiple attempts through two adjoining levels of the leakage failed to enter the epidural space. The reason was the presence of the extensive instrumentation of the spine and the profound structural bone abnormalities, either related to the scoliotic pathology or the previous operations. We believed that trying to enter the epidural space from more distant interlaminar spaces would be of no benefit, because of the extensive bony fusions of the posterior spine in many levels which was seen on the spinal CT. Also, according to our experience, we believe that EBP performed with a large volume of blood at the same level of the leakage is very important to achieve the best results in the obliteration of the leakage and the improvement of the syndrome [2, 3, 13]. Therefore, we decided to enter the epidural space by the translaminar approach, and were performed by using ostyicut trephine needle. This is a novel technique which can be performed safely by the ostyicut needle in similar situations when the spinal pathology or a previous surgery had resulted in hindering or obliteration of the interlaminar space. In cases of IH, the collapsed dura creates a relatively increased epidural space, and thus; a safe space for the procedure. Also, slow and careful screwing of the ostyicut trephine needle will lead to a safe approach to the epidural space. During advancing of the needle serial CT scans are performed to assist the position of the needle. Entrance to the epidural spaces is checked by the contrast injection. In

this way we can increase the safety of this approach. However, the technique requires very skilled practitioners who are familiar with the treatment of IH with EBP.

Surgical treatment is reserved for patients who fail multiple attempts of EBP [8, 10, 11]. Also, in patients in whom the spinal level of a CSF leak is determined but no underlying lesion is visualized by the imaging studies, exploratory surgery, consisting of a laminectomy (with or without foraminotomy) and inspection of the spinal dural sleeves, is performed [7]. Also, Inamasu and Guiot [7] found that the majority of patients in the posterior group responded favorably to conservative management, while the anterior group was more refractory to conservative management and necessitated a revision surgery for a CSF leak.

Conclusion

The authors presented a case of IH after spinal surgery and instrumentation for scoliosis, caused by dural tear during screw insertion. Prolonged CSF leakage is a serious complication of spine surgery, and many cases of orthostatic headaches after spinal surgery may underlie IH due to spinal CSF leakage. For this reason, in cases of orthostatic headache after spinal surgery neuroimaging studies must be considered presuming the presence of a dural tears and CSF leakage as a complication of the surgery. Also, the percutaneous translaminar approach is a novel technique for applying EBP, and can be considered in cases where interlaminar approach is not possible due to the presence of the extensive instrumentation of the spine and the profound structural bone abnormalities, either related to the scoliotic pathology or the previous operations.

Conflict of interest None of the authors has any potential conflict of interest.

References

1. Albayram S, Kilic O, Ozer H, Baghaki S, Kocer N, Islak C (2008) Gadolinium-enhanced MR cisternography to evaluate dural leaks in intracranial hypotension syndrome. *AJNR Am J Neuroradiol* 29:116–121
2. Albayram S, Tuzgen S, Gunduz A, Kiliç F, Baş A (2008) Spontaneous intracranial hypotension after labor without spinal intervention. *Eur J Neurol* 15:91–93
3. Albayram S, Ulu MO, Hanimoglu H, Kaynar MY, Hanci M (2008) Intracranial hypotension following scoliosis surgery: dural penetration of a thoracic pedicle screw. *Eur Spine J* 17(Suppl 2):S347–S350
4. Chung SJ, Kim JS, Lee MC (2000) Syndrome of cerebral spinal fluid hypovolemia: clinical and imaging features and outcome. *Neurology* 55:1321–1327
5. Coe JD, Arlet V, Donaldson W, Berven S, Hanson DS, Mudiyan R et al (2006) Complications in spinal fusion for adolescent idiopathic scoliosis in the new millennium. A report of the Scoliosis

- Research Society Morbidity and Mortality Committee. *Spine* 31:345–349
6. Hentschel SJ, Rhines LD, Wong FC, Gokaslan ZL, McCutcheon IE (2004) Subarachnoid-pleural fistula after resection of thoracic tumors. *J Neurosurg* 100(4 Suppl Spine):332–336
 7. Inamasu J, Guiot BH (2006) Intracranial hypotension with spinal pathology. *Spine J* 6(5):591–599
 8. Inenaga C, Tanaka T, Sakai N, Nishizawa S (2001) Diagnostic and surgical strategies for intractable spontaneous intracranial hypotension: case report. *J Neurosurg* 94:642–645
 9. Mino M, Narita N, Adachi M (2001) Epidural blood patch for the treatment of intracranial hypotension due to cerebrospinal fluid leakage after thoracic spine surgery. *No Shinkei Geka* 29:865–869
 10. Mokri B (2004) Low cerebrospinal fluid pressure syndromes. *Neurol Clin* 22:55–74
 11. Paldino M, Mogilner AY, Tenner MS (2003) Intracranial hypotension syndrome: a comprehensive review. *Neurosurg Focus* 15:ECP2
 12. Platz J, Glucker T, Gratzl O, Woydt M (2007) Spontaneous intracranial hypotension: case report with subdural hematomas, steroid dependency and clinical improvement after myelography. *Zentralbl Neurochir* 68:87–90
 13. Uysal S, Albayram S, Ercan TE (2008) Spontaneous intracranial hypotension: a case report. *J Child Neurol* 23:1312–1315
 14. Wang LP, Schmidt JF (1997) Central nervous side effects after lumbar puncture. A review of the possible pathogenesis of the syndrome of postdural puncture headache and associated symptoms. *Dan Med Bull* 44:79–81
 15. Wang YF, Fuh JL, Lirng JF, Chang FC, Wang SJ (2007) Spontaneous intracranial hypotension with isolated cortical vein thrombosis and subarachnoid haemorrhage. *Cephalalgia* 27:1413–1417
 16. Watanabe A, Horikoshi T, Uchida M, Koizumi H, Yagishita T, Kinouchi H (2009) Diagnostic value of spinal MR imaging in spontaneous intracranial hypotension syndrome. *AJNR Am J Neuroradiol* 30:147–151
 17. Watanabe A, Takai H, Ogino S, Ohki T, Ohki I (2002) Intracranial subdural hematoma after resection of a thoracic spinal cord tumor. *J Spinal Disord Tech* 15:533–536