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Case Report

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Blood Patch for Post-Surgical Cerebrospinal Fluid Leak: A Case Report

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ABSTRACT

Intracranial hypotension syndrome may occur secondary to Cerebrospinal Fluid Leak (CSFL). Its etiology can be iatrogenic, traumatic or spontaneous. The most common cause is related to incidental or intentional punctures during anesthetic approaches. It is a rare complication during lumbar spine surgery. The clinical manifestations of this syndrome are characterized by orthostatic headache as the most frequent symptom, accompanied by a wide variety of manifestations, which frequently result in a disability for daily life activities and a delayed recovery. Diagnosis is made through a detailed medical history, the presence of symptoms and signs, and additional imaging studies. Initial treatment is conservative; however, using a hematic patch is recommended for a significant number of patients as the next step, reserving surgical treatment for cases that are not resolved with these measures. This paper presents the clinical case of a 56-year-old female patient diagnosed with CSF fistula following a surgical procedure, which is treated by applying a blood patch with complete remission of symptoms; similarly, a therapeutic algorithm is proposed for the diagnosis of CSFL.

Keywords:

Blood patch, Cerebrospinal Fluid Leak (CSFL), Intracranial hypotension, Orthostatic headache.

Abbreviations

CSFL: Cerebrospinal Fluid Leak; IHS: Intracranial Hypotension Syndrome; CSF: Cerebrospinal Fluid; ICHD: International Classification of Headache Disorders; cmH_2O: Centimeters of Water; MTC: Computed Tomography Myelography; EBP: Epidural Blood Patch; STIR: Short T1 Inversion Recovery; MRI: Magnetic Resonance Imaging; MISS: Minimally Invasive Spinal Surgery

Introduction

Intracranial Hypotension Syndrome (IHS) is a relatively rare condition, secondary to Cerebrospinal Fluid (CSF) depletion and intracranial pressure drop. Characterized by heterogeneity in its presentation and prognosis, an annual incidence of 2-5 per 100,000 [1]. This depletion etiology includes hypovolemic states, although it is widely accepted that the main cause of it is secondary to CSF leak, which can have a spontaneous, traumatic, and iatrogenic origin [1,2].

Spontaneous IHS, presents itself as an orthostatic headache without a history of medical interventions, being reported in up to 80% of patients. It has been further associated to other risk factors such as dura mater weakness, mainly in patients with connective tissue diseases [1,3]. In the case of CSF leak of traumatic origin, the main causes are car accidents, sport injuries, falls, as well as avulsions of the brachial plexus and nerve roots [2]. CSF leak of iatrogenic origin, perhaps the most common cause, may be the result of incidental or intentional punctures during epidural or subdural approaches in anesthesia [4]. CSF leak is a common complication during lumbar spine surgery [5]; they occur mainly in spinal decompression surgery, with an incidence of up to 9.5% [6], with a significantly higher risk in patients over 70, surgeries involving more than one vertebral level, history of previous surgery and cigarette consumption [6]. In the case of lumbar surgery for disc repair, an incidence of 2-6% has been reported [7]. They may develop late after 5 days in less than 1% of the cases, which usually delays diagnosis and may additionally be recurrent in up to 17% of cases [6,8].

Clinical manifestations are characterized by orthostatic headache as the most frequent symptom, and it can be accompanied by neck pain, nausea, diplopia, balance alterations, facial paresis, phonophobia, radiculopathy, myelopathy, dementia, ataxia, or cognitive impairment. The symptoms can become so intense as to cause a disability to perform the daily life activities, and if associated with surgical procedures, delay recovery [9]. The diagnosis is established with a detailed medical history, the presence of symptoms and signs, and additional imaging studies [9]. Conservative treatment includes bed rest, hydration with fluids, caffeine, as well as symptomatic treatment, with remission of symptoms in up to 28% of cases in one week [9]. Although there are no guidelines, some authors recommend using the blood patch as the next step in case of persistent symptoms despite the conservative treatment [9]. Surgical treatment is recommended when a specific CSF leak site is identified, and there is no response to conservative measures, or after applying the Epidural Blood Patch (EBP) with poor or no clinical response [4].

Case Study

The case of a previously healthy 56-year-old female patient who reports pain in the gluteus and paresis in her right leg is described. She went to the trauma and orthopedics department, where herniated discs at L4-L5 and L5-S1 where diagnosed. She was operated through an endoscopic surgical approach. 24 hours later, she experienced a suddenly holocranial headache. It was exacerbated when walking, and improved in supine position, so she is referred to Neurosurgery, and received conservative treatment for 4 days with no improvement of the symptoms. A-magnetic resonance imaging was performed, it revealed post operative changes due to the endoscopic surgery in L4/L5/S1 with a collection of CSF along the S1 right nerve root and at the foramen (Figure 1). Based on the surgical history and clinical manifestations, a diagnosis of a CSF fistula secondary to the surgical event was made. A minimally invasive treatment with a blood patch was proposed, which was performed through an epidural puncture at L4-L5 level. A total volume of 20 ml of autologous blood was applied without complications, showing an immediate remission of the symptoms. She remained asymptomatic at 2 weeks and one year after applying the EBP.

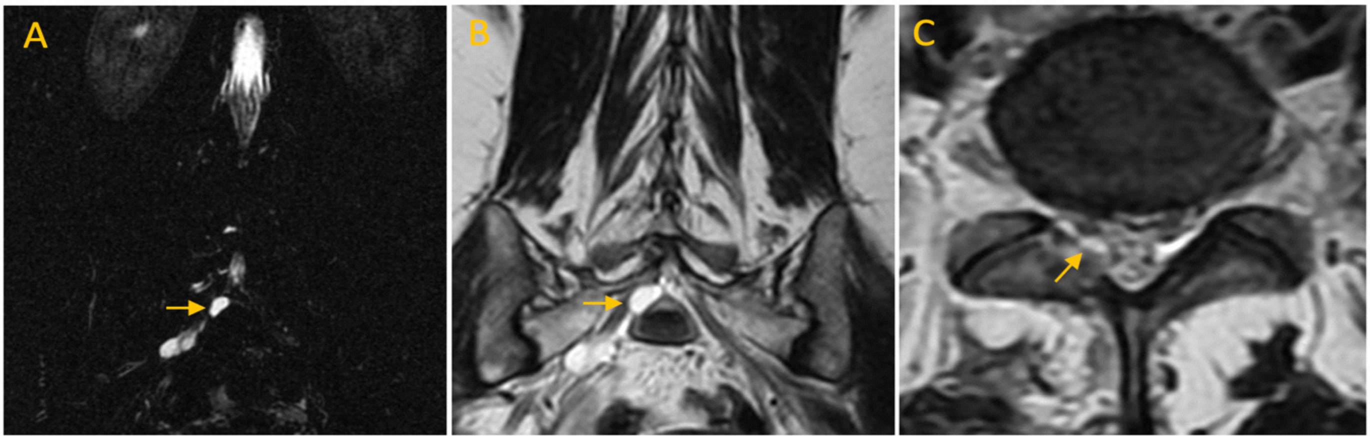

Figure 1: Spinal magnetic resonance imaging. **(A,B):** Coronal image in STIR and T2 sequence show buildup of CSF at L5/S1 foraminal level as well as in the descending path of the ipsilateral nerve root; **(C):** T2 axial image evidencing buildup of superficial CSF on the back of the right nerve root at L5/S1.

Discussion

Monro-Kellie's theory states that since the cranial vault is a rigid compartment, the volume within it remains constant, it contains different components: arterial and venous blood volume, encephalic mass, and CSF; when there is an alteration in the volume of one of these, it will cause a compensatory modification in another of the components [10]. Upon occurrence of a CSFL, a reduction in the intracranial pressure is produced, leading to a venous dilation as a compensatory mechanism [11]. These changes in intracranial pressure also result in a modification of the cerebral blood flow, subarachnoid space collapse, and epidural space dilation, causing headaches due to meningeal and vascular traction [10]. IHS has been linked to other causes such as spinal arachnoiditis, which is incurable and has a poor prognosis [12,13].

Orthostatic headache may of gradual or sudden onset, occurring in up to 82.6% of the cases according to the literature [9]. This cardinal symptom occurs in a diffuse and holocranial form in 75% of cases, followed by localization in the occipital and frontal region, respectively, with less frequency in the fronto-occipital and temporal areas. In 50% it is accompanied by nausea and vomiting, photophobia or vestibular-cochlear signs [9]. Less common clinical data are diplopia, facial pain or weakness, as well as very rare signs and symptoms such as galactorrhea, interscapular pain, radiculopathy, quadriplegia, abnormal movements, cognitive impairment, behavioral changes, and epilepsy [9]. According to the International Classification of Headache Disorders (ICHD), the criteria for the diagnosis of spontaneous orthostatic headache are the following: headache which is time-related to low CSF pressure, CSF pressure less than 6 cmH2O, with or without evidence of CSF leak in imaging studies; other etiology should be excluded [10]

The imaging study of choice is Computed Tomography Myelography (CTM) or intrathecal gadolineum-contrasted magnetic resonance myelography, with high sensitivity for locatization of the leak site in up to 95.8% of cases, especially when slow leaks are suspected [14]. It is also very useful for the detection of meningeal diverticula and dural ectasia in patients without an identified leak site [1]. Cranial tomography shows subarachnoid cisterns clearing or ventricular collapse; cranial MRI shows non-specific signs of intracranial hypotension such as a fluid collection, meningeal enhancement in up to 73% of cases, venous thickening present in 61-83% of patients [15], pituitary hyperemia, decreased ventricle size, blurring of peri-chiasmatic cisterns, optic chiasm arcing, stem bulging, prepontine cisterns blurring, and downward displacement of the cerebellar tonsils at the posterior fossa; however, in up to 30% of cases, no findings suggestive of IHS were evident through this method. On the other hand, spinal Magnetic Resonance Imaging (MRI) is effective in detecting the extent of CSF fistulas, showing suggestive data such as epidural dilation and intradural veins, meningeal diverticula, allowing for detection of the site of CSF leak in 47.5% of cases [1,9].

The blood patches application has been described as a minimally invasive treatment with remission of the symptoms, as in the case herein presented [12]. This technique was first described as a treatment for post-puncture headache [16], under the hypothesis that the mass effect generated by the blood patch locally produces an increase in intracranial pressure, obtaining an immediate symptom relief. At the same time, the blood in the epidural space leads to the formation of a clot with a "patch" action, while generating a chemotactic reaction of other blood cells that promote sealing of the leak site [17]. The EBP application can be performed on patients even if the exact location of the fistula is not available when the clinical suspicion is high, as it is not possible to establish a diagnosis via imaging in up to 20% of cases [4]; however, it is associated with higher success rates when the precise site of CSF leak is identified and the EBP is applied directly in it [2].

Efficacy of the first blood patch is reported in 30% [18]. Response predictors have been described such as: age; short time interval between the leak diagnosis and the application of the blood patch; volumes greater than 20 ml; multiple injections at different levels; fistulas secondary to spinal puncture have a better response than spontaneous fistulas, and the Trendelenburg position increases the probability of success by 50% [2,9,19]. Multiple-level epidural blood patches are reserved for patients with refractory intracranial hypotension syndrome, considering that more levels increase the likelihood of covering the leak and a larger volume increases its extent [20].

Although there is no consensus, the volume most frequently described is between 10 and 20 ml; however, the use of larger volumes has been recommended in patients who do not respond to the application of the first EBP, with no increased risk of complications [4]. Initially, 1-3 ml were applied, considering that larger amounts presented a risk of subdural hematoma, arachnoiditis or paraparesis. Subsequently, 10-20 ml were used, as is the current practice and what was used in the case presented here (20 ml) [21]. Using volumes greater than 22.5 ml improves symptom control in patients with previous EBP with poor response [9,22]. Finally, in the event of refractory CSF leak, percutaneous injection of transforaminal fibrin guided by fluoroscope or computed tomography has been proposed in order to avoid surgical treatment; however, it is not routinely recommended since volume dispersion is limited [23].

Symptoms disappear immediately after the application of the blood patch, with 50% of patients remaining asymptomatic at 3 months. In spontaneous CSF fistula cases, 70% respond within up to 6 months [9].

EBP complications are rare, in which nerve paralysis, paraparesis, cauda equina syndrome, subdural or subarachnoid hematoma, and pneumocephalus may occur [20]. Exceptionally, association with arachnoiditis and aseptic meningitis has been described. The most common complications are vagal vessel syncope, lumbar pain, fever, rebound headache, and increased intracranial pressure [21].

A therapeutic algorithm is proposed (Figure 2), depending on the type of lumbar approach used, the type of fistula presented during surgery, location, extension and time of diagnosis, whether it is intraoperative or a fistula that occurs late. Intraoperative repair is recommended initially If it is noticed and accessible during the procedure; different types of materials can be used to carry out the repair, as observed in the algorithm. However, upon failure of the measures taken intraoperatively, or if the symptoms appear and are diagnosed later, the blood patch is indicated as the next step, reserving surgical reoperation for specific cases, as mentioned above.

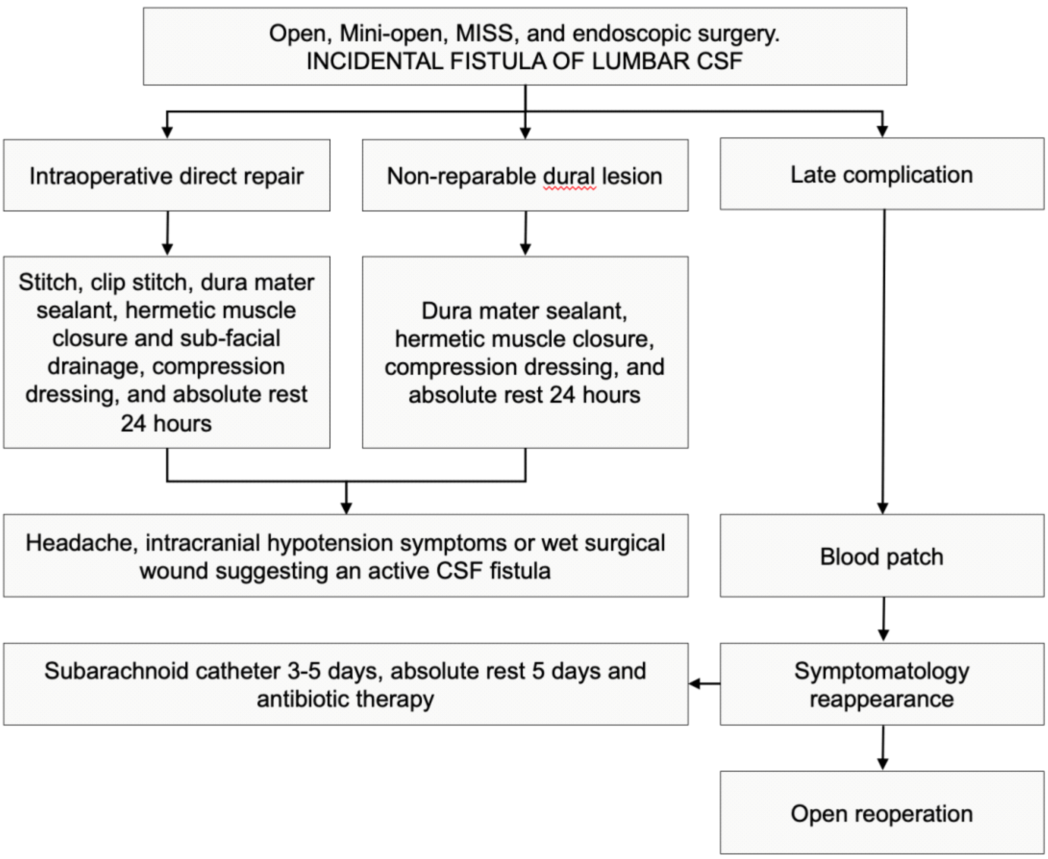

Figure 2: Algorithm for treatment of incidental CSF fistula in various lumbar surgical techniques as immediate or late complication.

Conclusion

Intracranial hypotension syndrome, secondary to CSFL, is a complication that can occur after lumbar spine surgery; its timely diagnosis and treatment improve the short-term prognosis, allowing for an early recovery. Although the literature on the use of EBP as a therapeutic tool is scarce, the literature documents good results from its use, and is therefore a resource that has the potential to avoid surgery. Therefore, it should be considered when there is clinical suspicion and a CSFL diagnosis.

Conflict of Interest

The authors have no conflicts of interest.

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