Spinal Subarachnoid Hematoma After Spinal Anesthesia
Hematoma Subaracnoideo Espinhal Após Raquianestesia

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ABSTRACT
The occurrence of spinal subarachnoid hematoma (SSH) after lumbar puncture for anesthesia is a rare complication and in most cases results from difficult spinal anesthesia. Predisposing factors are: presence of tumors or vascular malformations within the spinal canal, coagulopathies, use of antiplatelet and/or anticoagulant therapy, direct spinal cord trauma, spinal canal stenosis, combined spinal anesthesia, multiple and difficult traumatic punctures. We report a case of a patient which after spinal anesthesia for orthopedic surgery developed cauda equina syndrome postoperatively. The patient was submitted to lumbosacral MRI and diagnosed with SSH. Emergency surgical treatment was performed, with clinical and neurological improvement in the immediate postoperative period. A review of the literature was conducted aiming to discuss the pathophysiology and etiological factors involved, as well as aspects related to the diagnosis, treatment and prognosis of this rare clinical condition.

Keywords: Spinal subarachnoid hematoma; Spinal hematoma; Spinal anesthesia

RESUMO
A ocorrência de hematoma subaracnoideo espinhal pós-punção lombar para anestesia é tida como uma complicação rara e, na maioria dos casos, resulta de raquianestesia difícil e sem êxito. Fatores predisponentes são presença de tumores ou malformações vasculares dentro do canal espinhal, coagulopatias, uso de terapia antiplaquetária e/ou anticoagulantes, trauma medular direto, estenose do canal espinhal, anestesia combinada raqui-peridural, punções traumáticas, múltiplas e difíceis. Relatamos o caso de paciente que após raquianestesia para cirurgia ortopédica evoluiu no pós-operatório com síndrome de cauda equina. Foi submetida à RM de coluna lombossacral e diagnosticada com hematoma subaracnoideo espinhal. Tratamento cirúrgico de emergência foi realizado, havendo melhora clínica e neurológica no pós-operatório imediato. Uma ampla revisão da literatura foi realizada visando discutir a fisiopatologia e fatores etiológicos envolvidos, bem como os aspectos relacionados ao diagnóstico, tratamento e ao prognóstico desta rara condição clínica.

Palavras-chave: Hematoma subaracnoideo espinhal; Hematoma espinhal; Raquianestesia

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INTRODUCTION

Spinal hematoma associated with spinal anesthesia is an uncommon complication and can be classified as epidural, subdural, or subarachnoid based on its topographic location. The incidence of spinal hemorrhage following epidural anesthesia or spinal anesthesia was 1:150,000 for epidural anesthesia and 1:220,000 for spinal anesthesia.

Some predisposing factors are presence of tumors or vascular malformations within the spinal canal, coagulopathies, use of antiplatelet therapy and/or anticoagulants, direct medullary trauma, spinal canal stenosis, combined spinal anesthesia, multiple and complicated traumatic punctures. However, it is not always possible to identify these risk factors or the etiology of the hematoma.

We report a case of a patient who after spinal anesthesia for orthopedic surgery developed cauda equina syndrome and was diagnosed with SSH. We discuss the pathophysiology, etiological factors and the aspects related to the diagnosis, treatment and prognosis of this rare clinical condition.

CASE PRESENTATION

Female patient, 58-year-old presenting high blood pressure and chronic anemia on regular use of oral antihypertensive. After a fall, she developed a traumatic fracture of the left tibial plateau, seven days before the procedure. She was submitted to osteosynthesis in the left limb, and received spinal anesthesia at the level L3-L4 vertebral space, without any intraoperative complications. Eight hours later, she evolved with lower extremity hypoesthesia in the topography of L3 sensory level, associated with saddle anesthesia, crural paraparesis (muscle strength grade IV for flexion and extension of the quadriceps, and muscle strength grade I for plantar extension and flexion bilaterally), and urinary and fecal disability. Lumbosacral spine magnetic resonance imaging (MRI) revealed a massive SSH in the cauda equina region (Figure 1).

The patient was submitted to an emergency L3-L4 decompressive laminectomy, followed by a durotomy, with cauda equina exposure, which was entangled and compressed by a massive hematoma (Figure 2). Microsurgery was performed with complete hematoma drainage in the spinal subarachnoid space, with nerve roots release and liquor flow restoration, followed by duroplasty and closure. In the postoperative period, the patient presented with the improvement of sensory and sphincteric function and partial recovery of the crural paraparesis.

Figura 1. MRI of the sacral lumbar spine showing a massive extradural hematoma at L3-L4, with significant compression of the cauda equina.
Spinal hematoma, although rare, is an established complication of lumbar puncture, and may occur in the epidural, subdural or subarachnoid spaces. Depending on the chronology of the events, these hematomas can be classified as acute, subacute or chronic.\textsuperscript{1,2,7}

Anatomy
The spinal cord extends into the spinal canal in adults up to the 12th thoracic vertebra or the 1st lumbar vertebra, where it ends forming the medullary cone. After that, the cauda equina extends into the lumbar and sacral vertebral canal. The spinal cord is covered by the pia mater and coated by the arachnoid. The subarachnoid space, which lies between the pia mater and the arachnoid, is filled with cerebrospinal fluid (CSF) and can flow freely in this space.

The spinal dura covers the arachnoid directly, constituting the dural sac, which in the space of the lumbar spinal canal contains the cauda equina. When the spine shapes into a cone, its lower portion extends a filament which is inserted into the periosteum of the coccyx, called the terminal filament. The epidural (or peridural) space is located between the spinal dura and the periosteum of the vertebral canal.\textsuperscript{1} The subdural space is a “capillary cleft” under physiological conditions, a virtual space, forming a cavity only under pathological conditions, such as in subdural hemorrhages. On the other hand, the subarachnoid and epidural space are genuine spaces, whose extension increases from the cervical region to the lumbar region.\textsuperscript{3,8}

The segmental lumbar arteries which arise from the lumbar level, irrigate the vertebrae, paraspinal muscles, dura mater, and the spinal cord.\textsuperscript{6} The main nourishing artery of the lumbosacral region in the canal is the artery of Adamkiewicz, which in 75\% of the patients originates from T9 to T12. Below L4, the supply comes from the internal iliac arteries and the median sacral artery. Several radicular arteries accompany the anterior and posterior roots which help to supply this region. The Adamkiewicz’s artery and vein cross the subarachnoid space at the level of the cauda equina and, sometimes, originate only at the L3-L5 levels. Venous drainage is variable, but usually follows arterial anatomy. Radiculomedullary veins drain into the internal (epidural) vertebral venous plexus, which empties into the cava system through the ascending lumbar vein.\textsuperscript{18} Vessels which follow the roots of the cauda equina can be damaged through the lumbar puncture.\textsuperscript{8,10}

Spinal subarachnoid hematoma x Spinal subarachnoid hemorrhage
The term spinal subarachnoid hematoma was introduced in 1967 by Berney et al.\textsuperscript{11} to define a rare condition, in which hemorrhage in the subarachnoid space with an intact arachnoid membrane forms a clot/blood collection, and due to the mass effect, generates a medullary or cauda equina compression.

DISCUSSION
Spinal hematoma, although rare, is an established complication of lumbar puncture, and may occur in the epidural, subdural or subarachnoid spaces. Depending on the chronology of the events, these hematomas can be classified as acute, subacute or chronic.\textsuperscript{1,2,7}

Figura 2. A. Decompressive laminectomy L3-L4. B. After opening the dura mater a massive subarachnoid hematoma was evidenced between the nerve roots. C. Parts of the hematoma drained through microsurgery.
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syndrome. Only after 1984, the terms spinal subarachnoid hemorrhage and spinal subarachnoid hematoma were used separately in the literature to distinguish between these two different modalities of bleeding in subarachnoid space.

Pathophysiology

The occurrence of SSH after lumbar puncture for anesthesia is considered a rare complication, and most cases reported in the literature have resulted from difficult and unsuccessful spinal anesthesia. A possible cause of the low frequency could be the difficulty for this hemorrhage to become a hematoma, since the blood is usually diluted in the CSF, and irrigated with the flow of this fluid.

However, in some situations such as spondylarthrosis, arachnoiditis, disc herniation, and yellow ligament hypertrophy, normal CSF flow is compromised and the spinal canal is narrower, with a greater predisposition to form hematomas. On the other hand, even when there are no anatomical changes in the vertebral canal, the hematoma can occur if substantial bleeding is present. In practice, the main factor that contributes to bleeding or hematoma formation after spinal anesthesia are disturbances in blood coagulation.

Despite all the possible etiologic causes of SSH, the underlying mechanism and the origin of the bleeding are not always well established and only presumed. Some authors believe that rupture of the arteries and root veins are responsible for bleeding, especially in iatrogenic SSH.

According to Bills et al., accidental puncture of Adamkiewicz's vein along the L3, L4 or L5 vertebral root may also be the cause of spinal hemorrhage after a lumbar puncture. The same authors maintain that this is even more likely if the puncture deviates from the midline. Besides, Linde and Bingöl reinforce that the epidural puncture technique may be a significant risk factor for the occurrence of spinal hemorrhage. In this case reported, it was not possible to establish the etiology for the occurrence of SSH, but it was possible to correlate it to anticoagulants usage in preventive dosage at the preoperative period. Even with combination of prophylactic anticoagulation therapy and spinal anesthesia, the incidence of spinal hematoma is very low.

Clinical status and diagnosis

The symptomatology associated with the spinal hematoma is not very precise and may range from persistent low back pain to paraplegia. Such symptoms may arise from 2 minutes up to 10 days after puncture. SSH usually presents as severe and refractory low back pain, radiculopathy, acute or subacute paraparesis, associated or not with sphincter dysfunction. Symptoms such as headache (which does not meet criteria for headache after dural puncture) and signs of meningeal irritation (spinal rigidity, opisthotonus) may also be present in these cases.

Early diagnosis is essential, once the late one worsens the prognosis and the possibility of neurological recovery. Whenever a spinal hematoma is suspected (based on clinical findings and history of lumbar puncture), a MRI should be carried out as emergence. This exam confirms the diagnosis of SSH, and reveals its location, size, relationship with nerve roots, and the effect of compression if present. MRI is also capable of detecting tumor and vascular lesions or associated malformations. It is worth mentioning that although CT scans can be performed, not always can provide a conclusive diagnosis.

In this case, the patient started to feel low back pain eight hours after the surgical procedure, evolving with motor and sensory deficit, which became more evident in the second postoperative day. Lumbar spine MRI was the chosen exam to confirm the diagnosis.

Treatment

The SSH treatment is mostly surgical, due to the compressive effect of the hematoma on the spinal cord or cauda equina, which leads to neurological dysfunction with rapid deterioration, and generates ischemic injuries, secondary to the hematoma mass effect and secondary lesions. Surgical decompression should be performed as soon as possible, usually by laminectomy with hematoma removal. The main objective of the surgical procedure is the restoration and preservation of the neurological function and to improve the quality of life.
Conservative treatment may be applied to patients with minimal neurological manifestations, as suggested by some authors. However, this approach requires frequent neurological evaluation and imaging exams to recognize a possible worsening, as early as possible. Due to the cauda equina syndrome, the related patient was submitted to emergency surgical treatment.

A SSH is a rare event, even among hematomas of the spinal canal. Early diagnosis is the most essential chance to full neurological recovery. When suspected, according to the history of spinal anesthesia and typical symptoms, an emergency MRI should be performed. Patients with previously risk factors need the utmost care in the lumbar puncture technique and vigorous post-procedure neurological surveillance, or if possible, should undergo another anesthetic technique.

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