

## CASO CLÍNICO

# Spinal Adhesive Arachnoiditis with Severe Neurological Complications After Neuroaxial Anaesthesia

## *Aracnoidite Adesiva Medular com Complicações Neurológicas Graves Pós-Raquianestesia*

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### Keywords

Anesthesia, Spinal/adverse effects; Arachnoiditis/etiology; Magnetic Resonance Imaging

### Palavras-chave

*Aracnoidite/etiologia; Doenças do Sistema Nervoso/induzidas quimicamente; Raquianestesia/efeitos adversos; Ressonância Magnética*

## ABSTRACT

Arachnoiditis is an inflammation of the meningeal arachnoid layer. When accompanied the accumulation of fibrinous adhesive bands leading to reduced blood supply, tethering and encapsulation/tethering of nerve roots and spinal cord, the term adhesive arachnoiditis is employed. Adhesive arachnoiditis resulting from procedures involving spinal anaesthesia and presenting with severe neurological debilitation is extremely rare but may present in many different forms. Such findings may develop anywhere from minutes to months after the procedures, and response scenarios can vary from spontaneous resolutions to intractable states. We herein present the cases of two patients with severe neurological sequelae after neuraxial anaesthesia and their respective management. Several distinct, probably concomitant and somewhat unpredictable factors may lead to or promote the development of adhesive arachnoiditis after spinal anaesthesia. Nonetheless, even if not completely avoidable, awareness for the condition may allow for an earlier diagnosis and intervention, which may reflect in mitigated neurological sequels.

## RESUMO

O processo inflamatório da aracnoide – aracnoidite - pode ser complicado pela acumulação de bandas fibrosas desencadeando o compromisso do fluxo sanguíneo, encapsulamento das raízes nervosas e elementos neurais – aracnoidite adesiva. Aracnoidite adesiva encontra-se associada a procedimentos anestésicos (principalmente raquianestesia), mas o estabelecimento de causalidade é complicado

pela ausência de imagiologia pré-intervenção. Se em determinados casos tais complicações podem ter uma resolução espontânea, outras apresentam evolução crónica com graves complicações neurológicas. O facto de os sintomas poderem surgir imediatamente ou várias semanas/meses após o procedimento pode dificultar a sua associação à raquianestesia. Apresentamos o caso de dois doentes de evolução temporal diferente com síndromes neurológicas após procedimento de raquianestesia, explorando as características imagiológicas, tratamento instituído e evolução clínica. Vários fatores parecem contribuir e promover o desenvolvimento de aracnoidite adesiva após raquianestesia. A consciência para a possibilidade de tais complicações poderá permitir uma deteção e intervenção terapêutica apropriadas, permitindo assim minimizar sequelas neurológicas.

## INTRODUCTION

The 3 layers of the meninges (pia, arachnoid, and dura mater) provide protective covering to the brain and spinal cord. Arachnoiditis is an inflammation of the middle layer arachnoid, but may also often involve (or progress to) inflammation of the pia and dura mater layers. An inflammatory stage at the level of the arachnoid membrane allows for the formation of oligocellular, fibrinous exudates which, together with the constant cerebrospinal fluid (CSF) circulation, allow for the unrestricted accumulation of fibrinous adhesive bands. Because magnetic resonance imaging (MRI) findings reveal nerve roots clumping and adhesion to the arachnoid layer, the term adhesive arachnoiditis (AA) is often employed to describe the condition.

The causes of AA have changed over time. Any damage to the

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arachnoid lining or to the nerve roots may trigger AA, and potential causes are currently divided into 4 main groups: anatomical disorders of the spine, genetic connective tissue conditions, physical traumas and autoimmune perturbations. Of particular note, AA has come been associated with invasive anaesthesia administration procedures, as epidural or spinal anaesthesia.

While the administration of spinal anaesthesia is generally considered safe, the involved procedures may lead to AA development due to incidental dural puncture, nerve trauma roots, haemorrhage and injection of neurotoxic or neuro-irritant substances into subarachnoid spaces. Incidences for neurological complications upon subarachnoid/epidural/intrathecal blocks have been reported (~1 case per 10,000 blocks),<sup>1,2</sup> but those for AA development are scarce and the condition is still considered rare.

The spectrum of clinical findings in AA is large, from the common absence of apparent signs to the rare instances of severe motor/sensory impairments. Herein, we present two rare presentations, in which cases two patients undergoing spinal anaesthesia developed severe neurological damage.

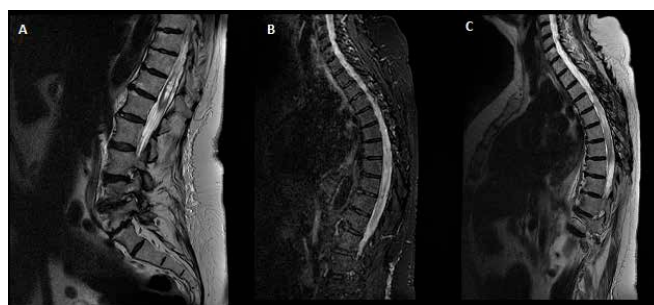
## CASE REPORT

### CASE 1

A 66-year-old woman with a history of spinal lumbar degenerative disease and lumbar hernia at level L4, arterial hypertension and past arthroplasty was received in our clinic presenting progressive gait impairment due to weakness on both legs, numbness on the left leg and back pain irradiating down the left side. There were no urinary or gastrointestinal complaints. Symptoms had started 6 months after an uneventful arthroplasty to the right knee carried out under spinal anaesthesia. No records pertaining to the nature and dosage of the anaesthetic agent employed were available at the time of admission.

The patient reported successful puncture at first attempt with no pain or discomfort. Muscle tonus was normal and tendon reflexes symmetrically brisk on upper and lower limbs. Abdominal reflexes were absent on the left side. An extensor plantar response was present on the right. Extensive weakness was noticed on both lower limbs. A loss of pinprick (at T3/T4) and vibratory/proprioception (on the left foot) sensations were observed.

A spinal cord lesion was suspected, and thoracic/lumbar MRI revealed a syringomyelic cavity from C7-D1 until the conus medullaris. Multiple arachnoid cysts with spinal cord compression and adhesive lesions in the dorsal region together with tethering of the cauda equina were observed (Fig. 1). Lumbar puncture revealed mild polymorphonuclear pleocytosis (8 cells), increased protein (70 mg/dL) and normal glucose levels. Infectious causes, sarcoidosis and other autoimmune diseases were excluded. No malignant



**Figure 1. Sagittal T2 (B) and STIR (A, C) MRI sequences of dorso-lumbar spine of Case 1, revealing arachnoid cysts and meningeal adhesions at multiple dorsal levels**

cells were found in the CSF. A diagnosis of AA complicated by a giant arachnoid cyst and syringomyelia due to spinal anaesthesia was put forward, and a D3 to D7 laminectomy with dissection of the meningeal adhesions and cyst drainage were undertaken. A shunt was placed in the D3-D4 subarachnoid cyst.

Disappearance of the D3-D4 arachnoid cyst and spinal compression (together with functional) improvement were transiently attained. However, symptoms chronically progressed over the years to loss of ambulation, wheelchair dependence, urinary incontinence and radicular pain.

### CASE 2

An 87-year-old woman underwent orthopaedic surgery under spinal anaesthesia with levobupivacaine after a femoral fracture.

The patient had a history of asymptomatic thoracic hernia at T11 level and lumbar canal stenosis below L4 with no neurologic deficits. The surgical team involved reported the intervention as uneventful and pain-free. No other pharmacologic agents were administered into the subarachnoid compartment. On the following day, numbness and strength loss on the lower limbs together with back pain acutely developed. The patient presented diminished lower limbs tonus, absent tendon reflexes and flexor plantar responses. Upper limb strength was normal, but paraplegia was noticed on lower limbs. There was a sensory level at T12 and proprioception/vibration senses were absent on the lower limbs.

MRI revealed cauda equina nerve roots clumping/thickening, discopathy and moderate L4–L5 spinal stenosis, suggestive of AA. Nerve conduction studies revealed absence of sensory action potentials on the lower limbs with reduced motor action potential on the lower limbs. Sensory and motor studies of the upper limbs revealed no abnormalities.

Treatment with a 3-day course of methylprednisolone 1 g daily was started and repeated 1 week later, but no clinical improvement was attained. The patient was discharged on a wheelchair, with urinary/faecal incontinence and permanent urinary catheterization.

## DISCUSSION

We have herein presented two patients with a diagnosis of AA following spinal anaesthesia administration with a very different clinical course, but similar outcome and disability. The first patient presented with a spinal cord syndrome due to syringomyelic cavities and spinal cord compression by the arachnoid cysts. Perturbed CSF circulation might result from meningeal inflammation and explain the formation of syringomyelic cavity. The second patient presented signs of damaged spinal sensitive and motor nerve roots secondary to an inflammatory process of the leptomeninges. Nevertheless, both patients fulfilled the criteria purposed for the diagnosis of AA: presence of back pain, leg pain increasing with activity, abnormal neurological exam and MRI findings consistent with AA. Such findings have been previously shown to have good sensitivity (92%) and excellent specificity (100%) for the diagnosis of AA.<sup>3</sup>

An inflammatory reaction in the arachnoid or its surroundings may result in intrathecal scarring and tethering of neural fibers. It is hard to pinpoint exactly what triggers this inflammatory response and the trigger might differ from case to case. Injected substances are a likely cause, as spread of the injected drugs correlates with the size of the region in which arachnoiditis is observed.<sup>4</sup> Which agent is the culprit has not been established and a compounded effect cannot be ruled out. While local anaesthetics can be neurotoxic at high concentrations, epidural injection of lidocaine alone (1%) to monkeys and dogs failed to trigger arachnoiditis development.<sup>5</sup> In contrast, while injection of methylprednisolone acetate injection in dogs and pigs revealed evidences of pia, arachnoid and dura mater adhesion with nerve roots fibrosis after intrathecal injection, the same was not observed in humans.<sup>6</sup> In turn, contrast agents such as iohexolin and antiseptic agents such as chlorhexidine have also been reported as associated with AA and neurological deterioration.<sup>7</sup>

Even though no bleeding in the subarachnoid space was observed in the cases herein described, one should be aware that the mere presence of blood in the subarachnoid space has been associated with inflammatory reactions against the arachnoid layer. Similarly, traumatic lumbar punctures have been reported to render the subarachnoid space more prone to chronic inflammatory processes, but no solid associations have been established or herein observed.

In what concerns the cases herein discussed, information pertaining to the nature and dosage of the anaesthetics employed is not complete. However, this is not likely to be a limiting factor in establishing causality (or lack thereof), as no solid bias towards a specific group of anaesthetics (over others) has been reported to date. Given the body of conflicting literature available, one is for the time being lead to believe that patient-specific factors are more likely

to contribute to AA development. Nonetheless, it should be considered that individuals will present with different reactions to distinct drugs, as genetic variability results in significant discrepancies regarding drug metabolism capacity and immune system reactivity. Hence, considering the interplay between both factors (host-specific genetic background and nature of the administered anaesthetics) may be of value in elucidating the underlying pathophysiology of AA in the future.

The resulting neuroinflammation is thought to be caused by activation of glial cells in the brain and spinal cord. Hence, therapy focus at least partially on reducing glial activation and neuroinflammation. The brain and spinal cord produce neurohormones capable of suppressing neuroinflammation and promoting nerve cell regeneration. These include pregnenolone, allopregnanolone, progesterone, dehydroepiandrosterone and oestradiol, and have been show to dampen neuroinflammation.

The first attempts to treat (or at least manage the symptoms of) AA date back to the 18<sup>th</sup> century, but AA has nonetheless been for the most part considered an untreatable condition until more recent years. Patients that develop signs and symptoms suggesting that damage occurred or that a strong immune reaction is in place soon after a medical procedure may benefit from very potent anti-neuroinflammatory agents such as ketorolac and methylprednisolone administered very early on. Once adhesions are formed, however, strong steroid administration is ineffective in arresting neurological decline.

A “first generation” established medical treatment relies on i) suppressing neuroinflammation (e.g. ketorolac, methylprednisolone), ii) promoting neuroregeneration (e.g. pregnenolone, nandrolone) and iii) controlling pain (e.g. naltrexone, gabapentin, opioids). In parallel to pharmacological regimens, physical therapy is advised in order to maximize spinal fluid flow and minimize scarring.<sup>8</sup>

In addition, surgical interventions to lyse the adhesions have attempted, and drainage of arachnoid cysts and decompressive laminectomies have been described.<sup>9,10</sup> In the patient first described herein, a surgical approach was also attempted, but the clinical improvement was temporary and clinical deterioration soon followed mirroring clinical progressions previously reported.<sup>9</sup> The second patient, in contrast, was treated with 2 cycles of high dose steroids. However, mostly likely because extensive clumping and adhesions where already present, clinical improvement was not attainable.

Imaging evaluation after invasive medical procedures including injections and spinal taps is the only way of detecting a local inflammatory reaction that may lead to the development of adhesions. The cost/benefit relationship is, however, unlikely to support such studies. As such, slowly

progressing cases like the ones herein presented are likely to continue to develop until it becomes too late for successful reversal of the trauma caused such reactions.

## CONCLUSION

AA developing or unveiling in association with procedures requiring spinal anaesthesia may present in many different forms, with a myriad of distinct clinical and radiological findings. Such findings may develop anywhere from minutes to months after the procedures, and response scenarios can vary from spontaneous resolutions to intractable states. An inflammatory reaction to the anaesthetic agent injected into the subarachnoid space is widely considered as the culprit of the resulting arachnoiditis, but lack of imaging studies prior to interventions have complicated the establishment of a causal relationship. In addition, the role of pre-existing (potentially silent) pathologies and risk factors is unknown, and risk markers for AA development have not been established. Several distinct, probably concomitant and somewhat unpredictable factors may lead to or promote the development of AA upon central neuraxial anaesthesia. Nonetheless, even if not completely avoidable, awareness for the condition may allow for an earlier diagnosis and intervention, which may reflect in mitigated neurological sequelae.

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
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