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*Case Report*

# MEDULLARY COMPRESSION FROM SPINAL ARACHNOID CYST: A CASE REPORT AND REVIEW OF LITERATURE

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## ABSTRACT

Arachnoid cysts, extradural or intradural, represent a fairly rare cause of compression of the spinal cord. They are mainly intradural cysts, mainly located in the cervico-thoracic sector. The onset is frequently characterized by motor deficits (i.e. tetraparesis, paraparesis), dysesthesia and pain.

Here we describe the case of a 51-year-old man who showed a sensory-motor deficit secondary to a spinal arachnoid cyst (SAC) diagnosed by MR investigation and surgically removed with clinical improvement. We also present a review of literature about terminology, presentation, recommended investigations, management and outcomes of patients with Spinal Arachnoid Cyst.

The patient was clinically evaluated at the admission, after the surgical treatment and with one year follow-up. We recorded clinical scores such as Visual Analogue Scale (VAS) and Roland Morris Disability Questionnaire (RMDQ). The radiographic investigations for the definition of the pathology were X-ray and MRI of the spine, electrophysiological investigations was also performed. The evaluation and treatment of the patient was carried out with a combined approach between an orthopedic specialist and a neurosurgeon.

For the review of the literature a PubMed, NCBI and Google Scholar search was performed with keywords 'Spinal Arachnoid Cyst' and 'spinal arachnoid cyst with spinal cord compression'.

After surgical treatment there was a positive progress with recovery. At three months follow-up the limitation of movements and weakness of the upper limbs were recovered. At one year follow-up the patient had already resumed

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normal daily activities without any reported limitations. For the review of the literature we found 7 articles about the arachnoid cyst of the dorsal spine, of which 6 are single case reports and only one collects two cases.

SACs are rare lesions that can present with various neurological symptoms: paraesthesia, neuropathic pain, paresis, and gait disturbances.

Conservative treatment with careful observation may be an acceptable option for asymptomatic patients. However, in patients with progressive or recurrent symptoms, surgery is the gold standard of treatment.

**KEYWORDS:** *spinal arachnoid cyst, dorsal arachnoid cyst, cord compression, medullary compression, arachnoid cyst adult, decompression arachnoid cyst.*

## INTRODUCTION

Arachnoid cysts are cerebrospinal fluid-filled cavities that can develop between the brain surface and the skull base or on the arachnoid surface, which is one of the three meningeal membranes that surrounds the central nervous system and the initial nerve tract (1-5).

Arachnoid cysts have a higher male incidence (6). Many cases begin in childhood, but onset can be delayed until adolescence (7).

Arachnoid cysts can be located at the brain or spinal level, the latter being rarer than the former (7). There are two types of arachnoid cyst: the primary arachnoid cyst, which is present from birth and due to an incorrect development of the arachnoid, and the secondary arachnoid cyst, caused by other pathologies such as trauma, tumours, infections, etc. (8, 9).

Spinal arachnoid cysts (SACs) are rare entities and are classified into primary (congenital or idiopathic) or secondary (acquired). Acquired SACs are the most frequent. They most frequently occur in the mid-to-lower thoracic levels (7, 10-12).

The arachnoid cyst tends to be asymptomatic when its size is small. It becomes symptomatic when it reaches a significant size (1-5, 7, 13-15).

SACs can present with progressive myelopathy if they compress the common spinal cord. The most common manifestations are paraesthesia, neuropathic pain, paresis, and ataxia of gait (7, 11).

## CASE REPORT

Patient M.A., a 51-year-old male, presented with right low back pain and mild weakness of the right lower limb approximately from 2014. He was initially treated with medical therapy, physiotherapy and ozone therapy with partial benefit. In 2019, left lumbosciatalgia appeared, associated with hypoesthesia of the left lower limb, dorsalgia and right cervicobrachialgia, and worsening the weakness of the right lower limb. ROT Patellar, Achilleus and Middle plantar were normally evocable bilaterally. On physical examination, the patient also complained of weakness in the upper limbs and slowed thoracic movements with severe limitation of flexion movements. The patient was also evaluated with clinical scores for pain with Visual Analogue Scale (VAS) (16) and with the Roland Morris Disability Questionnaire (RMDQ) to investigate the degree of disability given by the existing pathology; VAS value was 7, the RMDQ (17) score was 13.

The patient underwent appropriate diagnostic investigations (X-ray, MRI, electromyography, motor evoked potential, somatosensory evoked potentials) which showed degenerative disc disease L3-L4, L4-L5 and a dorsal cystic neoformation D3-D6 with a mild-severe neurological impairment.

The magnetic resonance showed the presence of a cystic formation, probably intradural, at the mid-dorsal level, in the posterior sector of the spinal canal. This formation causes a discrete compression of the spinal cord, which appears thinned and displaced anteriorly (Fig.1-2-3).

Following an specialist orthopedical and neurosurgical evaluation, the patient was advised to undergo surgery to remove the neoformation in the dorsal tract of the column. On June 2019 he underwent decompression surgery with a posterior approach by means of central laminectomy D3-D7 during which a cystic neoformation in tension D3-D6 was found. The wall of the cyst was incised posteriorly and the content was aspirated. (Fig. 4).

It apparently had a clear appearance and was not stocked. The neoformation, whose margins appeared not in continuity

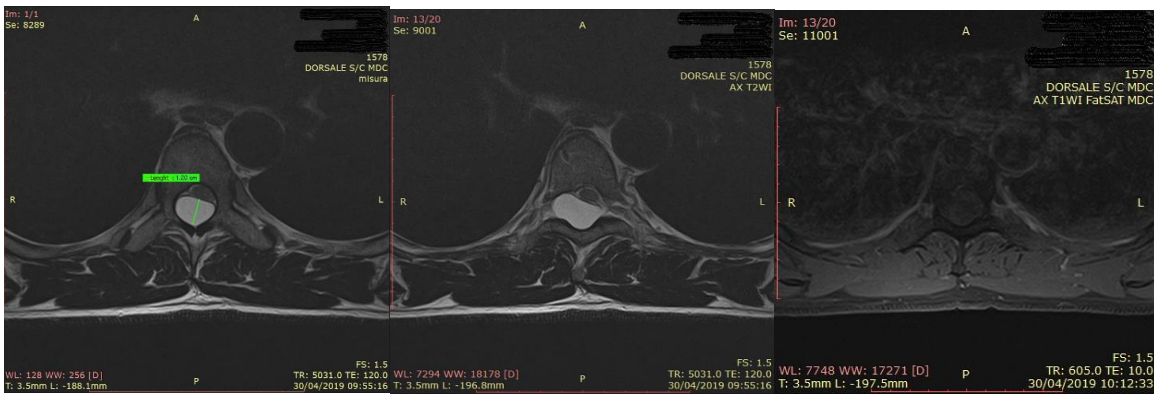
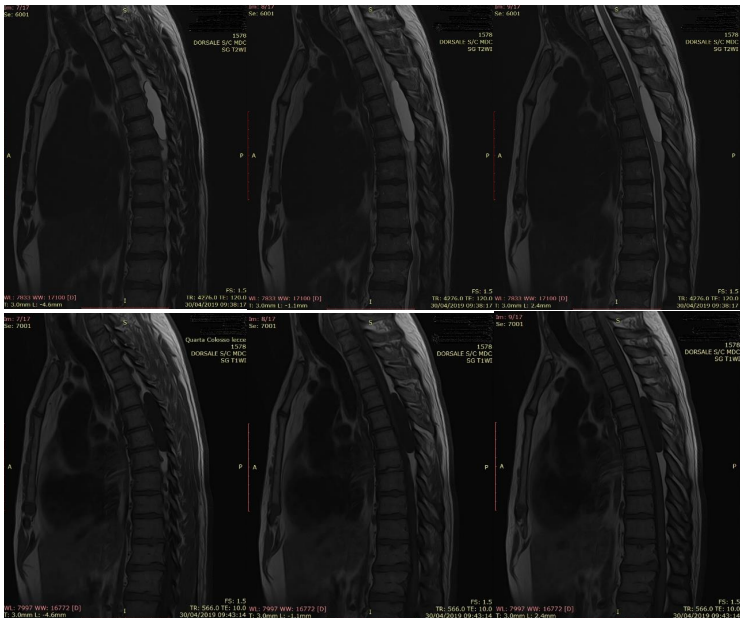



**Fig. 1.** *Images from the RM performed by the patient at the time of diagnosis (April 2019). From the axial cuts in the T1-T2 weights, an anteroposterior diameter of the cyst was found of 1.20 cm*



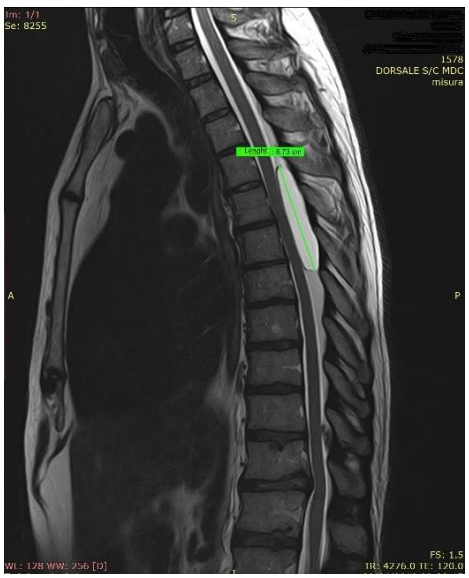



**Fig. 3.**

**< Fig. 2.**

**Fig. 2 -3.** *Images from the RM performed by the patient at the time of diagnosis (April 2019). From the sagittal cuts in the T1-T2 weights, an cranio-caudal length of the cyst was found of 6.73 cm*

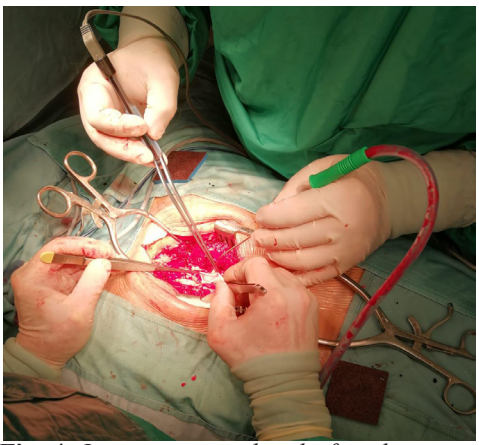
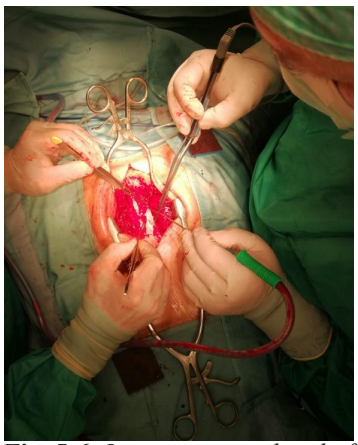


**Fig. 4.** *Intraoperative detail after the incision of the cyst*



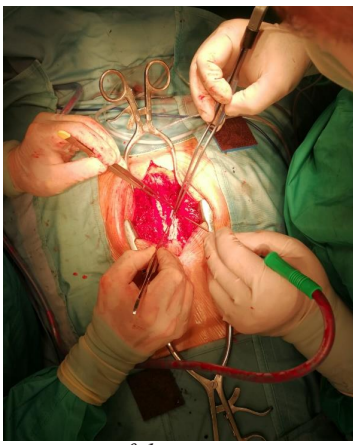


**Fig. 5-6.** *Intraoperative detail after excision of the cyst*

with the perimedullary dura mater, was incised longitudinally and completely excised. Finally, synthetic dura was affixed to protect the dural sac and at the sampling site we proceeded to posterior arthrodesis using reconstruction plates and screws of suitable length. After placing the plates, no possible instability of the segment subjected to laminectomy was detected, which is why no further stabilizations were carried out (Fig. 5-6).

The collected material was sent to a laboratory for histological examination which revealed fibrous tissue with islets of meningothelial cells associated with psammomatous bodies. These features are suggestive of an arachnoid cyst.

After surgery, there was a positive progress with recovery, and the patient underwent adequate follow-up and new diagnostic investigation. Three months after the operation, the pain, assessed with the VAS scale, was around 6 – probably due to the degenerative disc disease of the lumbar spine – and the RMDQ score was slightly decreased at 11. The difficulties at the thoracic level such as limitation of movements and weakness referred at the upper limbs were completely recovered.

Subsequently, in October 2019, with the worsening of the lumbo-cruralgic symptoms, the patient underwent a specialist orthopedic evaluation that suggest and then performed surgery for lumbar spinal stenosis with degenerative disc disease L2-L3, L3-L4. Before this new treatment was repeated the MRI as a follow-up of the dorsal spine and to better evaluate the stenosis in the lumbar tract (Fig. 7-8).

The patient underwent surgery on December 2019 for hemilaminectomy L2-L3, left L3-L4 with foraminotomy L3 and left L4 with a posterior approach and lumbar spine fusion with screws and rods at the same level.

After the second surgery the patient was evaluated at one month, three months, six months and one year of follow-up.

At the last clinical and radiographic check, the clinical scores reported the following values, VAS 2/3 and RMDQ

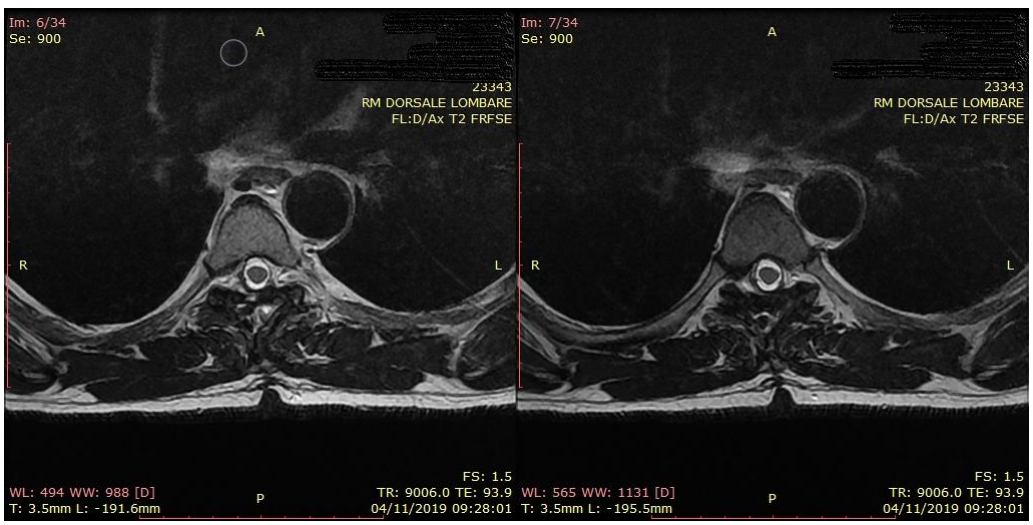



**Fig. 7.** *MRI performed by the patient in November 2019. Axial cuts at the level of the removed cyst*

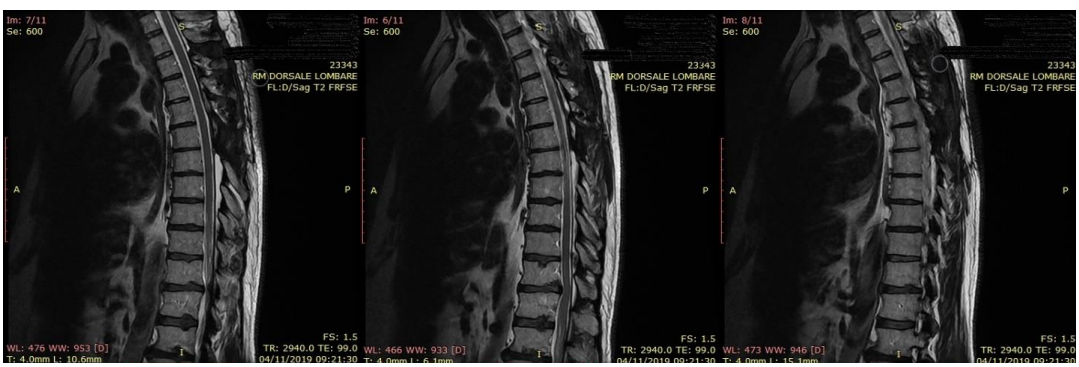



**Fig. 8.** *MRI performed by the patient in November 2019. Saggital cuts at the level of the dorsal spine. As in the axial cuts the spinal cord is completely decompressed with no other prominent signs of the dorsal tract.*

4, and the patient had already resumed normal daily activities without any reported limitations. A one-year follow-up check we also performed electromyography, motor evoked potential and somatosensory evoked potentials. The mild-severe neurological impairment showed at the neurological tests was almost completely regressed and showed up a 60% improvement in results compared to pre-operative controls.

*Review of Literature*

Due to the rarity of this pathology, it is very difficult to conduct case series, retrospective, and prospective studies, however, it is possible to find a wide variety of reported cases in the literature.

A PubMed, NCBI and Google Scholar literature review was performed on case reports with search items 'Spinal Arachnoid Cyst' and 'spinal arachnoid cyst with spinal cord compression'. Of the articles found in the literature we selected only those reporting patients treated with arachnoid cysts at the level of the dorsal spine in the adult population. To the best of our knowledge Table I reported results showed different types of dorsal spinal arachnoid cysts in the literature (7, 10, 12, 18-21).

**Table I.** *Review of the literature of patient with arachnoid cyst of dorsal tract of spine in adult population.*

| Review of the literature of patient with arachnoid cyst of dorsal tract of spine in adult population | | | | | |
|---|---|---|---|---|---|
| **Authors and year** | **Age/Sex** | **Clinical presentations** | **Cyst type and location** | **Therapy** | **Follow-Up** |
| Marrone et al 2022 | 70-year-old male | Lower limbs hyposthenia, Paraesthesia | Spinal Extradural Arachnoid Cyst T11-T12 | Laminectomy T11-T12 | In 3-months complete symptoms resolution |
| Ebot et al 2020 | 80-year-old female | Back pain progressively worsening, lower limbs weakness, incontinence | Spinal Intradural Extramedullary Arachnoid Cyst T4-T10 | Selective laminectomies T4-T5 and T9-T10, duble microsurgical fenestration and decompression | In 1-month lower improve of clinical symptoms |
| Himes et al 2018 | 60-year-old female | Back pain progressively worsening | Spinal Intradural Arachnoid Cyst T3-T7 | Selective laminoplasties T3-T7, double microsurgical fenestration.and decompression | In 7-months complete symptoms resolution |
| Velz et al 2018 | 51-year-old female | Back pain, neck pain, headaches | Spinal Intradural Arachnoid Cyst T4-T7 | Hemilaminectomy T4-T6 marsupialization and placement of an intradural shunt | In 6-months improve of clinical symptoms |
| Lee et al 2018 | 51-year-old male | Gait difficulties, urge incontinence, lower limbs hyperreflexia | Spinal Extradural Arachnoid Cyst T7-T9 | Hemilaminectomy T8-T9; In 2-weeks recurrence; Laminoplasty T7-T9, marsupialization and complete excision | In 8-months improve of clinical symptoms |
| Ghimire et al 2020 | 83-year-old female | Acute heaviness of lower limbs, Upper motor neuron syndrome | Spinal Intradural Arachnoid Cyst T3-T4 | Laminoplasty T2-T4, marsupialization and complete excision | Complete symptoms resolution |
| Raes et al 2021 | 38-year-old female | Progressive hyposthenia, hyperreflexia, dysesthesia of the right leg, mild urinary incontinence. | Spinal Intradural Extramedullary Arachnoid Cyst T2-T7 | marsupialization of the thoracic cyst and laminectomy at T7; 1-month later recurrence: placement cysto-peritoneal shunt; 8-months later recurrence: selective laminectomy T1-T3; | Complete symptoms resolution |
| | 45-year-old male | complete paraplegia, ascending sensibility loss, allodynia | Spinal Intradural Arachnoid Cyst T4-T11 | Laminectomy T9-T11 and marsupialization. Persistent pain post-operative, 2 months later, placement of cysto-peritoneal shunt | Slight improvement left with incomplete disappearance of the neuropathic pain |

## DISCUSSION

*Pathophysiology*

Spinal arachnoid cysts are rare spinal tumours that do not expand within the spinal canal. They can develop as cystic formations caused by dural defects and can grow due to the flow of cerebrospinal fluid originating from the intradural arachnoid space (1).

A SAC can grow extraspinal or intraspinal and is typically located on the posterolateral portion of the spinal canal, compressing the spinal cord towards the anterior side (1).

As the enlargement continues, a SAC can worsen the compression of the spinal cord or nerve root, leading to the development of symptoms such as pain and weakness (1).

The pathophysiological explanation of the formation of arachnoid cysts is still unknown; however, various theories have been proposed.

The main hypothesis is that the SAC derives from a diverticulum or a dissection in the septum posticum; a thin fibrous membrane that joins the arachnoid and the pia mater along the posterior line of the spinal cord (7, 22).

However, reports of ventral cysts in the spinal cord suggest that there may be another origin. For example, the incarceration of arachnoid granulations can produce cerebrospinal fluid that becomes trapped in the arachnoid diverticula. These sequestered fluid sacs lead to further disruption of normal cerebro-spinal fluid (CSF) flow and are therefore capable of producing or expanding arachnoid cysts (7).

For nearly all cases of arachnoid cysts, communication between the subarachnoid spaces and the cysts has been reported. This communication can be induced by a congenital anomaly, or secondary to a traumatic injury to the spinal cord, postsurgical arachnoiditis, meningeal infection, haemorrhage, and other insults that cause inflammation and subarachnoid adhesions (7-12). The possibility of a dural injury increases if patients are suffering from conditions such as. Marfan syndrome or dural ectasia or if they experienced movements of the dural sac such as trauma or loss of cerebrospinal fluid (1, 2, 5, 15).

The dural lesion appears to act as a ball valve allowing CSF flow to form a hernia of the arachnoid membrane, while active secretion of CSF from the residual arachnoid membrane plays a role in the expansion of the cyst, which can enlarge up to cause compression myelopathy (1, 2).

*Clinical presentation*

Arachnoid cysts have a male prevalence with an average peak incidence around 45 years of age.

Most SACs are found in the thoracic region (7, 12, 18, 22, 23). They can be solitary or multiple. SAC can be asymptomatic (mostly congenital cysts), but as they grow, they can present with progressive myelopathy and show signs of upper motor neuron disease. The most common presenting disorders are paraesthesia, neuropathic pain, paresis and ataxia of gait. Hyperreflexia, muscle hyper or hypotonia, bowel dysfunction urinary incontinence, and sexual dysfunction can also occur (7, 11, 21, 24).

Anterior localization of the cyst is associated with more likely to cause weakness and myelopathy, while thoracic cysts are more commonly associated with neuropathic pain and numbness (7, 11).

*Diagnosis*

Clinical presentation suggests upper motor neuron syndrome and requires radiological instrumental confirmation. The diagnosis of SAC is given by imaging of the spinal cord.

The gold standard is magnetic resonance imaging (1, 5, 8), which will show a mass occupying spinal extramedullary space consisting of a collection of CSF (7, 12, 22); in fact, the T1 and T2-weighted signals of the arachnoid cyst are identical to those of the cerebrospinal fluid. There is no improvement with gadolinium contrast liquid. If possible, MRI with CISS-3D sequences should be performed, allowing for high-resolution visualization of the subarachnoid space and detection of septa, trabeculae, and intradural cystoid formations with a more precise size than T2w imaging (7, 22).

MRI flow study or CT / MRI myelography are valid alternative investigations (7, 12). Myelography should be

reserved for unclear cases to show or exclude the communicating sites of the cyst with the subarachnoid space or, in case of consideration of new surgery for insufficient narrowing, when MR imaging appears insufficient (7, 12).

The differential diagnosis is made with neurenteric cysts, dermoid cysts, epidermoid cysts, teratomas, ependymal cysts and parasitic cysts (8, 25).

*Therapy*

The average duration of symptoms before initiation of therapy is 12-17 months (7, 24). There are several treatment options for SAC. If the cysts are not clinically evident, conservative treatment with careful observation may be a justifiable option, especially for children or high-risk surgical patients (7, 12, 18, 22, 23).

Symptomatic SAC may be related to the high pressure of fluid within the cyst pressing on surrounding structures, therefore treatment with acetazolamide (AZM), a carbonic anhydrase inhibitor known to reduce CSF production, has been proposed. Limiting the amount of fluid in the cyst simulates surgical decompression of the cyst, however its effectiveness is still questionable (7, 23).

Surgery is the gold standard of treatment and should be considered in patients with progressive worsening of symptoms or relapse (7, 16, 18, 22, 24). Surgical marsupialization with or without laminectomy is the most commonly used technique (1, 7, 11). However, large arachnoid cysts that span multiple spinal segments require extensive longitudinal exposure and bony removal increasing the rate of complications, including surgical site infection, hematoma, and spinal instability (19).

In these cases selective bony windows at the margins of the cyst and placement of a cystoperitoneal drain can be considered and it represents a viable, less invasive alternative approach to effective cyst decompression (7, 11, 19, 22). During this procedure is possible to use an ultrasound to directly visualize the cyst, to monitor CSF flow across the area and to confirm disappearance of the cyst (20).

After surgery, 60-70% of patients experience an improvement in symptoms (7, 11, 22). Motor ability has the highest response rate (71%) and the least pain (50%) (7).

Revision surgery was indicated in 12.5% of cases (7). Long-term follow-up shows no differences in quality of life between the different surgical techniques (7, 22).

The case reported here underwent exeresis of the arachnoid cyst with laminectomy and found an considerable improvement of the symptoms.

## CONCLUSION

SACs are rare lesions that can present with various neurological symptoms: paraesthesia, neuropathic pain, paresis, and gait disturbances, much like a progressive spinal cord injury due to spinal cord compression. The SAC can also be acquired, as the result of a traumatic injury to the spinal cord. The pathogenesis remains unknown.

Conservative treatment with careful observation may be an acceptable option for asymptomatic patients. However, in patients with progressive or recurrent symptoms, surgery is the gold standard of treatment.

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