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Spinal Arachnoid Cysts—Our Experience

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Abstract

Introduction Spinal arachnoid cysts are rare. Most of these lesions are located in the thoracic and thoracolumbar regions. Magnetic resonance imaging is a valuable tool for understanding their location and provides important information regarding their origin and expansion. The aim of our study was to evaluate the demographics, presentations, surgical management, and outcome of a spinal arachnoid cyst.

Materials and Methods All the patients from January 2003 to December 2021 who were symptomatic for spinal arachnoid cysts were taken for study. A retrospective analysis was performed. Radiological investigations were performed, and patients were graded according to the Nabors classification. Operative results were graded according to surgical technique.

Results The study included 22 patients, 11 female and 11 male patients, with a male-to-female ratio of approximately 1:1. The mean age of presentation was 34.7 years (4–60 years). Of 22 patients, 15 have intradural arachnoid cysts, 7 have an intradural extramedullary arachnoid cyst, and 8 have an intramedullary arachnoid cyst. Symptoms varied from weakness in the lower limbs (50%), quadriparesis and spasticity (32%), bladder/bowel incontinence (14%), and pain (10%). Out of 22 patients, complete cyst excision was performed in 17 patients, marsupialization in 4 patients, and cystic-subarachnoid shunt in one patient. Weakness and spasticity gradually recovered over a period of time. At 1-year follow-up, all the patients had complete improvement in their weakness, spasticity, and bladder functions. No recurrence of the cyst was seen at 1-year follow-up.

Conclusion Spinal arachnoid cysts are very rare in the spinal cord. Most of the lesions are located in the thoracic and thoracolumbar regions. Asymptomatic cyst requires counseling and conservative management, whereas symptomatic cyst, if operated on with surgical expertise, recurrence and complications are very low. The best surgical technique for operating these spinal arachnoid cysts is still under question, but symptom improvement is seen in all operative procedures.

Keywords
- spine
- arachnoid cyst
- extradural
- intradural
- intramedullary

Introduction

Spinal arachnoid cysts are loculated cerebrospinal fluid (CSF) collections composed of the slightly thickened arachnoid membrane. Communication with the subarachnoid space may or may not be present. They are more commonly located in the cranium. Spinal arachnoid cysts are rare and can be extradural, intradural, or intramedullary.[1] They are more commonly found in the thoracic region, followed by the

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lumbar area. The origin of these cysts may be spontaneous or secondarily due to infection, bleeding, or iatrogenic causes. Symptoms vary from pain, weakness, and bladder-bowel involvement. Some cysts may be asymptomatic.[2] Few case series of spinal arachnoid cysts have been reported in the literature.[3–10] We present one such case series of spinal arachnoid cysts at our center and evaluate the demographics, presentations, surgical management, and outcome.

Materials and Methods

All the patients from January 2003 to December 2021 who were symptomatic for spinal arachnoid cysts were taken for study from our center. A retrospective analysis was done. Patients who were asymptomatic and not giving consent were excluded from the study. Asymptomatic patients were managed conservatively and followed up.

For diagnosis, magnetic resonance imaging (MRI) of the spine was done in different sequences (T1 and T2 diffusion sequence and contrast), and according to MRI reports, cysts were differentiated by Nabors classification into three categories. Category 1 includes extradural meningeal cysts without spinal nerve root fibers. Category 2 includes extradural meningeal cysts with spinal nerve root fibers (Tarlov cyst). Category 3 includes spinal intradural arachnoid cysts. Category 1 is further divided into 1a—extradural meningeal/arachnoid cyst—and 1b—sacral meningoceles.[11]

All the data on the patient's demographics, clinical condition, neurological examination, radiological findings, and management were collected. Follow-up of the patients was done at 6 months and 1 year after suture removal was done. At follow-up, a clinical neurological examination of the patient was done, and details were noted.

Results

22 patients were operated on in the abovementioned period, fulfilling the inclusion and exclusion criteria. The details of our patients have been tabulated in ►**Table 1**.

Out of 22 patients, there were 11 female and 11 male patients, with male-to-female ratio being 1:1. The mean age of presentation was 34.7 years (4–60 years). Based on MRI findings, they were divided by Nabors classification into extradural and intradural cysts. Seven patients had extradural arachnoid cysts (Nabors category 1), and 15 had intradural arachnoid cysts (Nabors category 3). Of these 15 patients with intradural arachnoid cysts, seven had an intradural extramedullary arachnoid cyst and eight had an intramedullary arachnoid cyst. According to the location at the vertebral level, six patients had cysts in the thoracic region, seven in the thoracolumbar area, five in the cervicothoracic region, two patients in the cervical region, one at the cervical-medullary junction, and one in the sacral region. Based on MRI findings in the sagittal plane, ten cysts were dorsally placed, four were ventrally, and eight were intramedullary in location.

Symptoms varied from weakness, pain, spasticity, and bladder-bowel incontinence. Eleven patients presented with weakness in the lower limbs (50%). Seven patients presented with quadriparesis and spasticity (32%). Three patients had bladder incontinence (14%). Two patients presented with isolated pain in the back radiating to the lower limbs without weakness (10%). Power was graded by the Medical Research Council (MRC) score.

All patients underwent a surgical procedure. Surgery included complete excision, marsupialization, and cyst-subarachnoid shunt. All the patients were subjected to surgery under general anesthesia. One patient was operated on twice for a cervical-medullary cyst outside our center. 17 out of the 22 patients underwent complete cyst excision, four underwent marsupialization, and one underwent cyst-subarachnoid shunt. Laminoplasty was done in every patient postprocedure. An operative complication was noted in one patient postoperatively. The patient had developed an infection at the wound site postoperatively, for which the wound was reexplored. Later, the patient was managed conservatively with intravenous antibiotics.

Weakness and spasticity gradually recovered over a period of time. At 1-year follow-up, all the patients had complete improvement in their weakness, spasticity, and bladder function. No recurrence of the cyst was seen at the 1-year follow-up.

Representative Cases

Case 10

A 40-year-old female patient presented to our center with weakness and spasticity in both lower limbs for 4 months. Her power was MRC grade 4 in both lower limbs, with exaggerated deep tendon reflexes and hypertonia in both lower limbs. MRI cervical spine revealed a well-defined, nonenhancing T1 hypointense, T2 hyperintense purely cystic extramedullary ventrally placed lesion extending from the mid part of the C7 vertebral body up to the lower part of the D1 vertebral body (►**Fig. 1A–C**). She under C7-D1 laminectomy with complete excision of the ventral cystic lesion and its walls by gently mobilizing the cord parenchyma after cutting the denticulate ligaments. Follow-up MRI cervical spine showed full resolution of the cystic lesion with no evidence of recurrence and resolution of symptoms (►**Fig. 1D–F**).

Case 18

A 54-year-old female presented to us with a 7-month history of difficulty walking, tightness and sensory symptoms in all four limbs, and bladder and bowel involvement. Two years back, she had similar complaints when diagnosed with a cervicomedullary arachnoid cyst on MRI cervical spine. She underwent C6 laminectomy with aspiration of cyst fluid at the local center twice with recurrence of symptoms, and for the same, she was referred to our center. MRI cervical spine showed a well-defined, nonenhancing T1 hypointense, T2 hyperintense purely cystic lesion extending from the pontomedullary junction to the cervical spinal cord up to the C7 level, measuring approximately $10.1 \times 3.0 \times 2.6$ cm in size (►**Fig. 2A, B**). The patient underwent cervical laminectomies

Table 1 Patients' description of spinal arachnoid cyst at our center

Sr. no	Age	Sex	Symptoms	Vertebral column level	Spinal column level on MRI	Dorsal/ ventral/ intramedullary	Treatment	Outcome at 1-year follow-up
1	27	F	Weakness in both lower limbs	T10-L1	Extradural cyst	Dorsal	Complete excision	Power improved
2	21	F	Weakness in both lower limbs	T10-L3	Extradural cyst	Dorsal	Complete excision	Power improved
3	35	F	Weakness in both lower limbs	Sacral	Extradural cyst	Dorsal	Complete excision	Power improved
4	29	M	Weakness in both lower limbs	T11-L2	Extradural cyst	Dorsal	Complete excision	Power improved
5	16	F	Pain in lower limbs	T11-L3	Extradural cyst	Dorsal	Complete excision	Power improved
6		M	Weakness in both lower limbs	T8-T12	Extradural cyst	Dorsal	Complete excision	Power improved
7	50	M	Pain in both lower limbs	T11-L1	Extradural cyst	Dorsal	Complete excision	Pain relieved
8	35	M	Weakness in all 4 limbs, spasticity lower limbs	C3-C4	Intradural cyst	Ventral	Complete excision	Power improved
9	40	M	Weakness in both lower limbs	T11-T12	Intradural cyst	Dorsal	Complete excision	Power improved
10	40	F	Weakness in lower limbs, spasticity in lower limbs	C7-T1	Intradural cyst	Ventral	Complete excision	Power improved
11	38	M	Weakness in both lower limbs	T11-L1	Intradural cyst	Ventral	Complete excision	Power improved
12	25	F	Weakness in both lower limbs	T1-T2	Intradural cyst	Dorsal	Complete excision	Power improved
13	15	M	Weakness in both lower limbs	C6-T1	Intradural cyst	Ventral	Complete excision	Power improved
14	54	M	Weakness in all 4 limbs, spasticity lower limbs	C7-T1	Intradural cyst	Dorsal	Complete excision	Power improved
15	10	F	Weakness in all 4 limbs, spasticity lower limbs, bladder-bowel	C4-T2	Intramedullary	Intramedullary	Marsupialization	Power improved
16	4	F	Weakness in all 4 limbs, spasticity lower limbs, bladder-bowel	C4-C6	Intramedullary	Intramedullary	Complete excision	Power improved
17	45	F	Weakness in both lower limbs	T4-T5	Intramedullary	Intramedullary	Marsupialization	Power improved
18	54	F	Weakness in all 4 limbs, spasticity lower limbs, bladder-bowel	CVJ	Intramedullary	Intramedullary	Cysto-subarachnoid shunt	Power improved
19	56	F	Weakness in both lower limbs	T12-L1	Intramedullary	Intramedullary	Complete excision	Power improved
20	24	M	Power improved, spasticity decreased	C7-T1	Intramedullary	Intramedullary	Marsupialization	Power improved
21	60	M	Weakness in both lower limbs	T10-T12	Intramedullary	Intramedullary	Complete excision	Power improved
22	32	F	Weakness in both lower limbs	T4-T10	Intramedullary	Intramedullary	Marsupialization	Power improved

Abbreviations: CVJ, craniovertebral junction; F, female; M, male; MRI, magnetic resonance imaging.

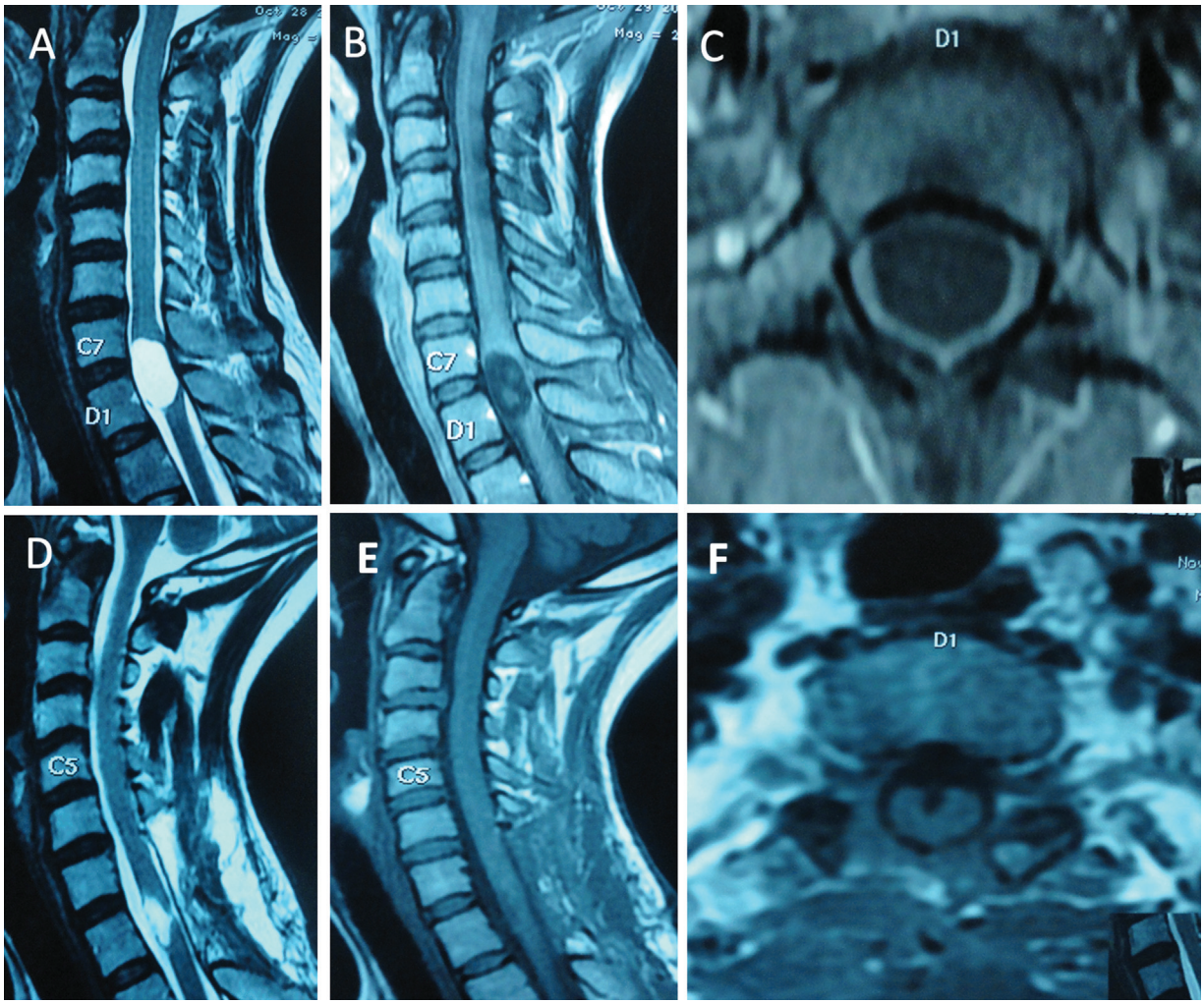

Fig. 1 Magnetic resonance imaging (MRI) cervical spine view showing extramedullary cystic lesion ventral to the spinal cord extending from C7 to D1 vertebral level which appears hyperintense on sagittal T2-weighted image (**A**) and hypointense on T1-weighted image, sagittal (**B**) and axial view (**C**).

with midline myelotomy and drainage of cyst fluid. As there was no plane between the cyst wall and spinal cord parenchyma, a cysto-subarachnoid shunt was performed where a silastic tube was anchored in such a way so that it communicates the intracystic space with extramedullary subarachnoid space. Follow-up cervical spine MRI showed complete resolution of the intramedullary cystic lesion with no evidence of recurrence and resolution of symptoms (►**Fig. 2C, D**).

Discussion

Arachnoid cysts of the spinal canal are very rare in nature. Marburg first described these cysts in 1902, but Spiller first reported a case of a spinal arachnoid cyst in 1903.[12,13] Later in the literature, multiple names, such as a leptomeningeal cyst and arachnoid diverticula, were described.[14,15] Tarlov described these as Tarlovs cysts or perineural cysts in 1948.[16] However, in 1988, Nabor et al gave a classification of spinal arachnoid cysts which divided these cysts into three categories.[11] Klekamp divided these cysts into primary, no previous inflammatory process, and secondary, associated with inflammation related to meningitis or iatrogenic causes.[8] 15 patients in our study were category 3, whereas seven were category 2 of the Nabors classification.

Pathogenesis of spinal arachnoid cysts is quite distinct. Multiple researchers have postulated different theories for the formation and expansion of these cysts. Tarlov explained that these cysts developed due to degenerative changes secondary to hemorrhage or trauma.[16] One possible reason is that these cysts may arise due to the septum posticum in the spinal cord. Anatomically, the septum posticum extends from the lower cervical spine up to the conus medullaris.[17] Adhesions in this septum posticum due to any cause can cause an arachnoid cyst.[8] Some explain that defects in the dura (dural rents) may result in the formation of an extradural arachnoid cyst.[18,19] Many other theories have been postulated for these cysts' development and expansion, including a one-way ball valve mechanism, pulsatile CSF flow dynamics, and active secretion by cells lining the cyst wall.[20–22]

The most common location of these cysts is the posterior part of the thoracic spinal cord, the lumbar spine, the sacral, and the least involvement of the cervical cord.[8,11,23,24] Intramedullary arachnoid cysts are even rarer.[25] In our case series, seven patients had cysts in the thoracolumbar region; six had

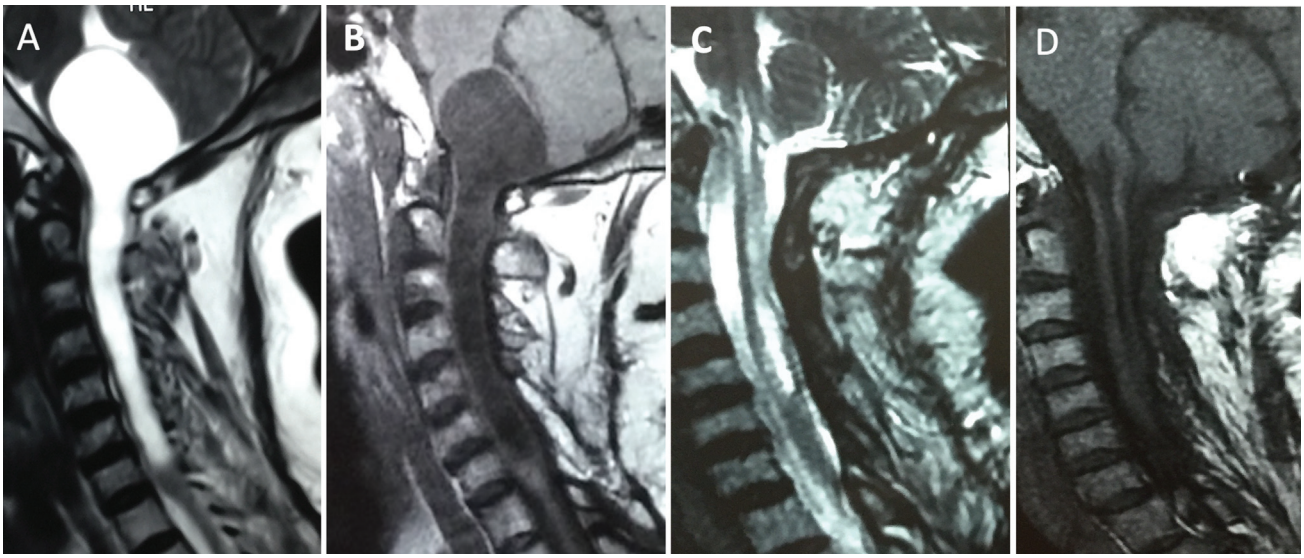

Fig. 2 Magnetic resonance imaging (MRI) cervical spine with craniovertebral (CV) junction sagittal view showing intramedullary cystic lesion extending from the pontomedullary junction to the C7 level which appears hyperintense on T2-weighted image (**A**) and hypointense on T1-weighted image (**B**). Postoperative MRI cervical spine with CV junction sagittal view showing near-complete resolution of the cystic lesion on T2-weighted image (**C**) and T1-weighted image (**D**).

in the thoracic region, five had in the cervicothoracic, three cervical, and one case of the sacral and cervical-medullary junction each.

The mean age group in various studies varied from 52 to 60 years, whereas in our study, the mean age group was 35 years (4–60 years).[7–10,26] The male:female ratio in our study was 1:1, which was around 2.7:1 in another study.[6] Symptoms vary from weakness, pain, spasticity, bladder and bowel deficit, and sensory symptoms. In a study conducted by Klekamp, the patients presented with pain (69%) followed by hypesthesia (55%), motor weakness (45%), and lastly, sphincter disturbances (21%). In our study, most patients presented with weakness followed by quadriparesis, spasticity followed by bladder bowel disturbances, and isolated pain without weakness.

An MRI scan is vital in diagnosing the spinal arachnoid cyst. On MRI, arachnoid cysts typically appear hypointense on T1-weighted images and hyperintense on T2-weighted images. They do not enhance on intravenous contrast and are not associated with perilesional edema. MRI scan also helps to delineate the lesion in terms of its size, location, extension, and severity of cord compression.[27] Computed tomography myelography is usually reserved for inconclusive cases on MRI. It helps to localize the connection between the cyst and the subarachnoid cyst, but a definite conclusion cannot be obtained in some arachnoid cysts.[28] In our study, management was based only on MRI findings, and myelography was not done in any patient. In various studies, arachnoid cysts are more commonly located extradural than intradural arachnoid cysts.[6,11] However, in our study, intradural arachnoid cysts were present in 68% of cases (intradural extramedullary and intramedullary) compared with extradural arachnoid cysts, which were seen in 32% of our patients. In the literature, dorsal cysts are more common than ventral, which supports our study findings.[29]

Microsurgical excision by multiple-level laminectomy, along with complete excision of the cyst and dural repair, is the standard treatment of choice.[30] However, if total excision is impossible, it can be fenestrated or marsupialized. In the case of an intramedullary cyst, the cyst is exposed by midline myelotomy or, in some cases, by the dorsal root entry zone.[31] Cystoperitoneal shunt is considered in refractory cases.[2,7,26,32] In our case series, 17 patients underwent complete cyst excision with dural closure, 4 underwent marsupialization, and 1 underwent cyst-subarachnoid shunt.

20 patients in our study had a motor weakness, out of which power improved in all the patients. Ten patients had complete recovery of power, six walked without support, and four walked with support at 6-month follow-up. Full recovery was present at the sixth-month follow-up for patients with pain without motor deficits. Spasticity and bladder-bowel symptoms also recovered. No patient had developed recurrence at 1-year follow-up, suggesting that surgical outcomes are better in patients.

Very few case series have been conducted on spinal arachnoid cysts in the literature (►**Table 2**). In 2003, Wang et al conducted a case series of 21 patients, of which 14 were located in the thoracic region, and all underwent surgical excision with no recurrence after 1 year of follow-up.[3] Similar studies were conducted, showing the origin of the spinal arachnoid cyst from the thoracic or thoracolumbar region more commonly, and surgical excision is beneficial with improvement in symptoms. Also, if operated on with surgical expertise, very few cases of recurrence are present. Similar findings have been noted in our study.

Surgical management includes complete exposure of the cyst by proper dissection of the cyst wall and complete removal of the cyst and its walls. If the cyst wall is firmly

Table 2 Reported series of spinal arachnoid cysts in the literature review of literature

Sr. no	Author	Year	No. of patients	Average age	Presentation	Location	Methods of surgical treatment	Recurrences at follow-up
1	Wang et al	2003	21	52	Pain, myelopathy, sphincter disturbances	14 thoracic, 4 cervical, 3 lumbar	Fenestration, excision, syringe-subarachnoid shunting	No recurrences at follow-up
2	Bassiouni et al	2004	16	43.6	Pain, myelopathy	12 thoracic	Excision if less than 5 levels, otherwise fenestration	No recurrence at follow-up
3	Funao et al	2012	12	39.7	Pain, weakness, paresthesia, sphincter disorders	12 thoracolumbar	Total resection with closure of dural defects	No recurrences noted during follow-up
4	Garg et al	2017	11	32.9	Pain, weakness	2 cervicodorsal, 1 cervicolumbar, 3 thoracic, 3 thoracolumbar, 2 lumbar	Excision, marsupialization, fenestration	No recurrences at follow-up
5	Viswanathan et al	2017	14	52	Pain, weakness, paresthesia, sphincter disorders	12 thoracic, 1 cervicothoracic, 1 thoracolumbar	Cyst wall fenestration, partial resection	No recurrences till follow-up
6	French et al	2017	10	60	Pain, weakness, paresthesia, Sphincter disorders	Unspecified	Fenestration, complete excision	Unspecified
7	Klekamp et al	2017	109	52	Pain, weakness, paresthesia, sphincter disorders	94 in thoracic region. Rest unspecified	Unspecified	Not specified
8	Fam et al	2018	22	53.5	Pain, weakness, gait ataxia, sphincter disturbances	1 cervical, 1 cervicothoracolumbar, 17 thoracic, 3 lumbar	Fenestration, complete excision, marsupialization	No recurrence till follow-up
9	Sadek and Nader-Sepahi	2018	17	58.2	Pain, weakness	All thoracic	Complete excision	2 recurrences

adherent to the dorsal dura, it is better to excise the wall along with the dura and repair the dura with autologous grafts. If the cyst wall is adherent to the ventral dura or cord or the nerve roots, alternative options such as marsupialization of the cyst or cysts-subarachnoid shunts can be done to prevent CSF leaks or neurological injury.

Conclusion

Spinal arachnoid cysts are very rare in the spinal cord. Most of the lesions are located in the thoracic and thoracolumbar regions. MRI is a precious tool for the location of spinal arachnoid cysts and can give very valuable information regarding the origin and expansion of these cysts. Asymptomatic cyst requires counseling and conservative management, whereas symptomatic cyst, if operated on with surgical expertise, recurrence and complications are very low. The best surgical technique for operating these spinal arachnoid cysts is still under question, but symptom improvement is seen in all operative procedures known to us.

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Conflict of Interest
None declared.

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