Clinical and Radiologic Outcomes After Fenestration and Partial Wall Excision of Idiopathic Intradural Spinal Arachnoid Cysts Presenting with Myelopathy

Vibhu K. Viswanathan, Sakthivel R. Manoharan, Hyunwoo Do, Amy Minnema, Sophia M. Shaddy, J. Brad Elder, H. Francis Farhadi

■ BACKGROUND: **Intradural spinal arachnoid cysts (ISACs) with associated neurologic deficits are encountered infrequently. Various management strategies have been proposed with minimal data on comparative outcomes.**

■ OBJECTIVE: **We describe the clinical and radiologic presentation as well as the outcomes of 14 surgically managed patients who presented with an ISAC and associated myelopathy.**

■ METHODS: **We retrospectively reviewed the clinical course of consecutive patients presenting with neurologic deficits associated with idiopathic ISACs at our institution. The diagnoses were based on preoperative magnetic resonance imaging studies followed by intraoperative and histopathological confirmation.**

■ RESULTS: **A total of 14 consecutive patients with ISACs (1 cervicothoracic, 12 thoracic, and 1 thoracolumbar) and associated myelopathy were identified. Syringomyelia was noted in 8 patients. All ISACs were treated with cyst fenestration and partial wall resection through a posterior approach. Preoperative neurologic symptoms were noted to be stable or improved in all patients starting at 6-week postoperative follow-up. The median (interquartile range) preoperative mJOA score was 13 (12.0—14.8), whereas the postoperative median score at a mean follow-up of 22 months (range 6—50 months) was 16 (14.0—17.0), which represents a median improvement (ΔmJOA) of 2.0 (1.3—3.0) ($P < 0.001$). Comparison of ΔmJOA scores between cases without and with associated syrinxes did not reveal a significant difference ($P = 0.23$). Postoperative magnetic resonance imaging scans revealed spinal cord re-expansion at the level of the ISAC in all cases and either complete or partial syrinx resolution in 7 of 8 cases.**

■ CONCLUSIONS: **Early treatment with fenestration and partial wall resection allows for cord decompression, syrinx resolution, and gradual resolution of myelopathic symptoms in most cases.**

INTRODUCTION

Arachnoid cysts can be classified, based on their etiology, as idiopathic cysts or as acquired cysts.[1] They also can be classified, based on their relationship to surrounding structures, either as intradural extramedullary, intradural/extradural, intraspinal extradural, or intraspinal/extraspinal.[2] Intradural spinal arachnoid cysts (ISACs) are rare, benign cerebrospinal fluid (CSF)-filled cysts that bear variable relationships with the neural elements.[3,4] ISACs often are identified incidentally on magnetic resonance imaging (MRI), most commonly in male patients, and usually are located in the mid- to lower thoracic spine.[5,6] Progressively growing cysts may manifest clinically with axial pain as well as with symptoms related to cord or root compression.[7-13]

Although various surgical options have been reported for symptomatic cases, ranging from percutaneous or endoscopic cyst drainage[14,15] to radical cyst resection,[8] cyst fenestration and

Key words
- Compressive myelopathy
- Fenestration
- Intradural spinal arachnoid cyst
- Syringomyelia

Abbreviations and Acronyms
CSF: Cerebrospinal fluid
ΔmJOA: mean improvement in Japanese Orthopaedic Association score
ISACS: Intradural spinal arachnoid cyst
mJOA: modified Japanese Orthopaedic Association
MRI: Magnetic resonance imaging
UMN: Upper motor neuron

Department of Neurological Surgery, The Ohio State University Wexner Medical Center, Columbus, Ohio, USA

To whom correspondence should be addressed: H.Francis Farhadi, M.D., Ph.D. [E-mail: Francis.Farhadi@osumc.edu]

Supplementary digital content available online.

Citation: World Neurosurg. (2017) 105:213-222.
http://dx.doi.org/10.1016/j.wneu.2017.05.136

Journal homepage: www.WORLDNEUROSURGERY.org

Available online: www.sciencedirect.com

drainage commonly is performed in treated cases.[13,16] Because of the relative rarity of myelopathy-associated ISACs, there is limited knowledge on the overall outcomes after surgical treatment.[17] The current article describes the surgical management and neurologic outcomes of 14 consecutive patients diagnosed with idiopathic ISACs presenting with myelopathy.

METHODS

Patients and Study Design

Institutional review board approval was obtained to retrospectively assess patients who presented with ISACs and were managed by either of 2 senior surgeons (H.F.F. and J.B.E.). Fourteen consecutive patients (5 female and 9 male) presented between September 2010 and October 2016 and underwent surgical management for ISACs presenting with myelopathy. Patients who had a previous history of severe trauma, previous spinal surgery, meningitis, or did not present with concomitant myelopathic deficits were excluded. Furthermore, none of the patients had a history of spinal deformity.

History and physical examination was obtained on every pre- and postoperative clinic visit. Initial postoperative follow-up included a 6-week assessment in all cases. All patients were then followed up at 3-, 6-, and 12-month intervals, further at 1-year intervals, and as required postoperatively.

Radiologic Assessments

MRI with and without contrast was used for initial diagnosis. ISACs were evaluated for a variety of associated pathologies, including dorsal or ventral arachnoid bands, calcific arachnoiditis, and spinal cord herniation. MRI scans were obtained in all patients at the time of earliest significant clinical recovery or at final follow-up. Spinal cord decompression and the extent of ISAC and syrinx resolution were assessed on follow-up MRI scans. Additional MRI scans were obtained in patients who presented with worsening or new neurologic symptoms during the follow-up period.

Operative Management

A posterior approach was taken in all cases with a 3-level laminectomy exposure on average. The rostrocaudal extent of the ISAC was exposed for 1- and 2-level involvement (9 cases) and the area of greatest cord compression was exposed for greater than 3 level involvement (5 cases). Intraoperative neurophysiologic monitoring of somatosensory- and motor-evoked potentials was performed in all cases. Confirmatory intraoperative ultrasonography also was performed in all these cases to define the cyst location and tailor the dural opening. After the dura was opened, the underlying ISAC wall was fenestrated and partially resected in all cases under microscopic magnification. Calcific fragments of arachnoid were noted and resected in 3 cases. Spontaneous egress of copious amounts of clear-colored fluid was evident in all cases. Mention was made in 13 of 14 cases that the CSF appeared to be under elevated pressure. Care was taken in all cases to excise as much of the cyst membrane as possible. Samples of cyst walls were sent for histopathologic analysis. In a single case (case 13), cyst wall excision was minimal, given that the ISAC was located anteriorly over the C7—T6 levels. As such, a Holter distal atrial type E catheter tubing (Codman; Raynham, Massachusetts, USA) was additionally tunneled in the subdural space to maximize cyst drainage.

Statistical Analysis

Statistical analyses were performed that compared clinical outcomes after surgery for the whole cohort and for specified subgroups based on their radiologic findings. Data were analyzed with Stata 14 software (StataCorp, College Station, Texas, USA). Nonparametric tests were used because of small sample sizes. Wilcoxon signed-rank and Wilcoxon rank sum tests were used to assess for significant changes between pre- and postoperative values and for subgroup analyses. $P < 0.05$ was considered significant.

Literature Review

A PubMed literature search was performed using the key words "spinal arachnoid cyst." Pediatric, spinal dysraphism, deformity associated, and acquired (secondary) cyst series were excluded. Studies with less than 3 relevant cases also were excluded. Identified studies were specifically reviewed for surgically managed idiopathic ISAC cases with myelopathic findings, which are listed in Table 4.

RESULTS

Baseline Clinical and Radiologic Findings

Between September 2010 and October 2016, 14 consecutive patients underwent surgical management for myelopathy-associated ISACs at The Ohio State University Wexner Medical Center. The baseline clinical and radiologic characteristics of the patients are shown in Table 1. Average patient age at presentation was 52.1 years (range 35—68). There were 5 (35.7%) female and 9 (64.3%) male patients. The mean body mass index was 32.8 ± 6.7 kg/m^2. Four patients (28.6%) were smokers. Patients presented with a constellation of history and examination findings typically indicating myelopathy with a combination of extremity weakness ($n = 11$), gait disturbance ($n = 14$), and paresthesias ($n = 12$), whereas 4 patients (28.6%) also reported urinary incontinence. A total of 10 of 14 (71.4%) patients were noted to have upper motor neuron (UMN) signs on examination. The median (interquartile range) preoperative modified Japanese Orthopaedic Association (mJOA) score was 13.0 (12.0—14.8).

Thoracic level ISACs were noted in 12 of 14 (85.7%) patients, whereas a single patient each (7.1%) had either a cervicothoracic or thoracolumbar ISAC. A total of 8 of 14 (57.1%) patients had cysts spanning a single intervertebral level, 1 patient (7.1%) had a 2-level cyst, and 5 patients (35.7%) patients had long segment (extending over greater than 3 levels) cystic involvement. Dorsal ISACs were noted in 12 patients (85.7%), whereas one each (7.1%) was located either ventrally or occupied the entire canal. All patients had idiopathic or primary ISACs with no identified history of significant trauma, infection, or spinal deformity. ISACs were multiloculated in 3 patients (21.4%). Eight (57.1%) patients had an associated syrinx, of whom 4 had a syrinx at levels caudal to the cyst, 3 had a syrinx rostral to the cyst, and 1 patient had a syrinx at the same level as the cyst. Syrinxes were located within the thoracic spine except for 1 syrinx that extended to the brainstem