Pain outcomes after surgery in patients with intramedullary spinal cord cavernous malformations

HAREL DEUTSCH, M.D.

Department of Neurosurgery, Rush University Medical Center, Chicago, Illinois

Object. The objective of the study was to quantify the improvement in pain levels for patients who have undergone surgery for intramedullary spinal cord cavernous malformations (SCCMs).

Methods. The author reviewed medical records of patients who underwent surgery for an intramedullary SCCM between 2003 and 2010. Numerical pain scores (range 0–10) were recorded preoperatively and at follow-up. The follow-up period exceeded 1 year. Neurological status and subjective outcomes were assessed. Each patient underwent follow-up MR imaging.

Results. Five patients were identified with SCCMs who underwent surgery: 4 with thoracic and 1 with cervical lesions. Patients had been conservatively managed for an average of 5 years prior to surgery, and none had a history of acute hemorrhage or neurological deterioration during the observation period. The primary indication for surgery in each patient was pain, although 4 of 5 patients had some evidence of myelopathy on examination. Pain improved from a mean preoperative score of 8.6 to mean score of 2.0 (p < 0.01) at 1 month. Pain scores then increased to 3.7 (p < 0.01) at 1 year. All patients had some improvement in pain. No new motor weakness was noted, but all patients had increased symptoms of posterior-column dysfunction and numbness after surgery.

Conclusions. Spinal cord intramedullary cavernous malformations are increasingly being diagnosed early with patients presenting with mostly pain symptoms. Removal of the lesion is reliably associated with improvement in pain scores but often the pain improvement is transient. While long-term worsening of pain scores occurs, at 1-year follow-up, patients reported pain scores were improved over preoperative scores. In all patients some degree of postoperative posterior-column dysfunction was present. Some of the immediate pain relief may be due to analgesia related to the myelotomy of newly described posterior column pain pathways. In patients with severe pain, surgery to remove SCCMs reduced the overall pain level at 1 year. (DOI: 10.3171/2010.6.FOCUS10108)

Key Words • intramedullary spinal cord cavernous malformation • cavernous malformation • pain

Spinal cord cavernous malformations are increasingly detected with the widespread availability of MR imaging. Initially, most cavernomas were detected in patients with significant neurological deficits. With even more widespread availability of MR imaging, SCCMs are more frequently detected in patients presenting with axial pain. Natural history studies have shown the rate of hemorrhage in SCCMs is low and progression of neurological deficit is slow. Most SCCMs can be managed conservatively. Recent studies have cast doubt whether resection of an SCCM significantly affects overall pain in the long term. While initial results in pain improvement are noted, puzzlingly, long-term pain often recurs. In patients with relatively intact neurological status but severe pain, the treatment decision is difficult. The morbidity related to surgical removal and postoperative posterior-column dysfunction must be weighed against the desired pain improvement. The purpose of this study was to quantitatively evaluate the effectiveness of pain relief with surgery for SCCMs.

Methods

The charts of 5 patients who had undergone resection of SCCMs were reviewed retrospectively. Patients underwent surgery at our institution between 2003 and 2009. All patients had pain as the primary complaint, although 4 had evidence of myelopathy on physical examination. The SCCMs were localized in the thoracic spine in 4 patients and in the cervical spine in 1 patient. All patients had a McCormick Scale grade of I or II on presentation. Extensive nonoperative pain management failed in all patients. Magnetic resonance imaging with and without contrast medium was performed in all patients (Fig. 1). Patients underwent a thoracic or cervical laminectomy and lesion resection via a midline posterior myelotomy. The operative microscope was used. Both somatosensory evoked potentials and motor evoked potentials were monitored. Gross-total resection was achieved.
in each case. The diagnosis of an SCCM was confirmed on pathology reports. Postoperative MR images were obtained in all patients. Table 1 lists patient demographic data. Pain score data are listed in Table 2.

Numerical pain scale scores were collected preoperatively and following surgery at 2 weeks, 3 months, and 1 year. A paired t-test was used to assess the statistical significance of the numerical pain scores. We compared immediate postoperative and the baseline scores. Baseline and 1-year scores were also compared. The NPS scores are verbal patient-reported pain scores that range from 0 to 10. The 11-point NPS was used instead of a visual analog scale 100-mm scale. Studies have shown a high correlation between the 11-point NPS scale and the visual analog scale. Some questions exist whether patient cognitive issues and cognitive issues in the perioperative period affect visual analog scale precision.9

**Results**

Patient characteristics are listed in Table 1. Five patients were identified with intramedullary SCCMs who underwent surgery. Four patients had thoracic intramedullary lesions and 1 had a cervical lesion. Patients had received conservative treatment for an average of 5 years prior to surgery and no patients had a history of an acute hemorrhage or neurological deterioration during the observation period.

The primary indication for surgery in each patient was pain although 4 of 5 patients had some evidence of myelopathy on examination. Pain improved from a mean NPS score of 8.6 prior to surgery to 2.0 (p < 0.01) at 1 month. Pain scores then increased to 3.7 (p < 0.01) at 1-year follow-up. (Fig. 2) All patients had some quantitative improvement in pain scores. No new motor weakness was noted, but all patients had increased symptoms of posterior-column dysfunction and numbness after surgery. McCormick Scale scores at 1 year were all unchanged, but 4 of 5 patients worsened immediately after surgery by 1 grade due to posterior-column deficits.

**Discussion**

Spinal cord cavernous malformations are increasingly diagnosed in patients presenting with primarily pain symptoms because of increased MR imaging usage.3 Natural history studies of SCCM suggest a low risk of neurological symptom progression.11 Kharkar et al.5 reported on the conservative management of intramedullary cavernomas in 10 patients over an average on 42 months. While 50% of patients presented with motor weakness and 30% exhibited myelopathy, there was no significant progression of neurological deficit in the patients followed.

In patients with neurological deficits, improvement is often noted in less than 50% of patients. Deutsch et al.3 noted modest neurological improvement in 57% of patients in a literature meta-analysis. Park et al.12 noted no improvement in sensory symptoms after surgery for SCCMs. In this series, while patients did not have a new motor deficit, significant posterior-column deficits after surgery resulted in a transient increase in the McCormick Scale score after surgery in 4 of 5 patients. Considering the morbidity associated with surgery for a SCCM, nonoperative treatment is preferable in most cases of axial pain.12

**Fig. 1.** Sagittal midline (A) and axial (B) T2-weighted MR images of a C7–T1 SCCM.

**TABLE 1: Patient characteristics**

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>mean age (yrs)</td>
<td>56</td>
</tr>
<tr>
<td>male/female ratio</td>
<td>3:2</td>
</tr>
<tr>
<td>mean symptom duration (mos)</td>
<td>62</td>
</tr>
<tr>
<td>mean NPS score</td>
<td></td>
</tr>
<tr>
<td>preop</td>
<td>8.6</td>
</tr>
<tr>
<td>1 yr postop</td>
<td>3.7</td>
</tr>
</tbody>
</table>

**TABLE 2: Summary of results by case**

<table>
<thead>
<tr>
<th>Case No.</th>
<th>Age (yrs)</th>
<th>Baseline</th>
<th>1 Mo</th>
<th>3 Mos</th>
<th>1 Yr</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>37</td>
<td>8</td>
<td>3</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>2</td>
<td>75</td>
<td>7</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>3</td>
<td>58</td>
<td>9</td>
<td>0</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>4</td>
<td>65</td>
<td>10</td>
<td>5</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>5</td>
<td>45</td>
<td>9</td>
<td>0</td>
<td>3</td>
<td>3.5</td>
</tr>
</tbody>
</table>

**Fig. 2.** Graph showing the NPS scores (range 0–10) versus time.
Pain outcomes in spinal cord cavernous malformations

In patients with severe axial pain, the question arises whether SCCM excision will relieve pain-related symptoms. Literature regarding SCCMs is limited to case reports and small case series because SCCMs are relatively rare. In the series reported by Kharkar et al., 40% of patients presented with significant pain. Of the 4 patients who underwent surgery, all had pain as a significant finding. After surgery, 1 of 4 patients had complete pain relief and the other 3 had some degree of residual pain.

Kim et al. reported on 23 patients with spinal cord cavernoma who had pain as part of their presentation. Only 6 patients had pain as a primary complaint. Twelve patients had axial pain while the rest had some form of radicular pain. Pain improvement was noted in 78% of patients acutely, but only 52% of patients had sustained improvement after 1 year. Transient motor weakness was noted in 35% of patients. Neurological improvement after surgery was rare (20%). Visteh and colleagues initially reported good outcome with regard to pain resolution in several patients, but Kim et al. presented longer-term outcome for the same patients. Long-term pain improvement was not sustained in 2 patients. The reason pain returned several months after surgery was unclear.

While transient results for pain relief are good, long-term pain recurrence has been noted in the literature. The small series presented here supports the transient pain relief may be that the midline myelotomy and dissection around the SCCM yields disruption of a newly reported dorsal midline pain pathway. Dorsal midline visceral pain pathways were recently described in rat anatomical studies. Nauta et al. recently described the use of a midline dorsal-column myelotomy to effectively treat oncological visceral pain. The transient improvement and timeframe noted is consistent with pain improvement results obtained in the past for percutaneous cordotomy procedures.

Previous SCCM series reported in the literature have been mainly focused on neurological outcome. Pain outcomes were reported in a categorical fashion. Patients either have pain or they do not have pain. In this series, numerical pain scores were used to evaluate patient-expressed pain. The results indicate that while 4 of 5 patients had persistent long-term axial pain, patients felt pain was improved at 1 year. Pain improved from NPS score of 8.6 to 3.7 at 1-year follow-up. Some of the long-term pain complaints are related to dysesthetic pain mediated by permanent posterior-column loss of function. Understanding the postoperative morbidity and likely outcome with regard to pain improvement will better allow surgeons and patients to make choices regarding surgery for SCCMs.

Conclusions

Patients with SCCMs frequently present with axial pain as a significant complaint. The natural history of SCCMs indicates a low risk for further neurological deterioration. Resection of an SCCM can carry significant morbidity. Therefore, most SCCMs are best managed nonoperatively. Previous studies have shown that improvement in pain with SCCM surgery may be transient. This study demonstrates while pain worsens with long-term follow-up, patients report improvement in overall pain levels with surgery. The transient improvement in pain perception after surgery may be related to disruption of newly described posterior-column pain pathways.

Disclosure

The author reports no conflict of interest concerning the materials or methods used in this study or the findings specified in this paper.

References

13. Vishteh AG, Zabramski JM, Spetzler RF: Patients with spinal cord cavernous malformations are at an increased risk for multiple neuraxis cavernous malformations. Neurosurgery 45:30–33, 1999