Percutaneous fibrin glue therapy for meningeal cysts of the sacral spine with or without aspiration of the cerebrospinal fluid

TAO ZHANG, PH.D.,1,2 ZHENHUA LI, PH.D.,1 WEIMING GONG, B.S.,2 BINGWEI SUN, B.S.,2 SHUHENG LIU, M.S.,2 KAI ZHANG, PH.D.,1 DEZHEN YIN, PH.D.,1 PENG XU, PH.D.,1 AND TANGHONG JIA, PH.D.1,2

1School of Medicine, Shandong University; and 2Department of Orthopedics, Jinan Central Hospital, Jinan, Shandong, China

Object. The authors assessed the efficacy of computed tomography (CT)–guided percutaneous injection of fibrin glue to treat meningeal cysts of the sacral spine in patients with back pain, and evaluated the necessity for cerebrospinal fluid (CSF) aspiration before glue injection.

Methods. Of the 31 patients in this study, 15 underwent injection of fibrin glue under CT guidance after aspiration of more than 15 ml of CSF (Group A), and 16 patients were treated with the glue but without CSF aspiration (Group B). Clinical results were evaluated after an average of 23 months of follow-up, and changes on the imaging studies were also evaluated. The clinical outcome and postoperative complications were analyzed.

Results. All 31 patients experienced resolution or marked improvement of symptoms for as long as 28 months after fibrin glue therapy. No patient experienced recurrence of symptoms during the follow-up interval. The postoperative pain relief was statistically significant (p < 0.001) according to evaluations in which a 100-mm visual analog pain scale was used. There were no statistical differences between the two groups (p > 0.05).

Conclusions. Percutaneous CT-guided fibrin glue therapy for sacral arachnoid cysts may be a definitive therapy. It is unnecessary to aspirate the CSF before injection of the fibrin glue. (DOI: 10.3171/SPI-07/08/145)

KEY WORDS • cerebrospinal fluid • computed tomography • fibrin glue • imaging-guided surgery • meningeal cyst • percutaneous therapy • sacrococcygeal region

Acral meningeal cysts, first described by Tarlov in 1938, are extradural CSF collections involving the posterior sacral and coccygeal nerve root sheaths. The prevalence of sacral meningeal cysts in the general population is not known, but they were present in five patients in a series of 500 consecutive individuals undergoing lumbosacral MR imaging; the cysts represented 1% of cases. Although the majority of arachnoid cysts in the sacral canal are asymptomatic, up to one fifth of them can produce severe symptoms, including low-back pain, radicular pain, urinary or bowel dysfunction, or headaches.

Sacral meningeal cyst aspiration has often relieved symptoms and is occasionally curative, although it is often only temporarily effective. Alternative methods, such as reduction of the cyst wall or the insertion of fat into the lesion, have also failed because of cyst reinflation. Surgical treatment usually requires extensive sacral laminectomies with excision of the cyst, sacrificing of the adherent nerves, or partial resection with oversewing. Patel et al. reported an improved method of managing the severe pain occasionally associated with these cysts. Their procedure involves injecting fibrin glue into the cysts with the aid of CT guidance. The main symptoms are often found to be relieved in the follow-up period after this therapy.

Fibrin adhesive has been used to treat CSF leaks by direct application to a dural tear to produce a seal. Transnasal needle placement of fibrin adhesive to treat CSF rhinorrhea that can occur as a complication of transphenoidal pituitary surgery has also been successfully performed, as
has the treatment of postoperative CSF leaks using percutaneous administration of fibrin glue. We compared the aspiration method and the fibrin glue injection method in the treatment of meningeal cysts of the sacral spine. In this study we sought to determine whether injection of fibrin glue into a meningeal cyst after aspiration of CSF might offer a more definitive therapy than the same procedure without aspiration of CSF.

Clinical Material and Methods

Patient Population

There were 12 men and 19 women; the average age was 38.5 years (range 20–66 years). The lesions were manifested clinically by discomfort and dysfunction involving mainly the sacrocccygeal region, perineal region, and lateral posterior aspect of the legs. Twenty-five patients reported mainly pain in the sacrocccygeal region, sciatica, and intermittent claudication. Among them, 15 suffered pain in the perineal region and nine had urinary dysfunction. Two patients had difficulty in defecation. Three patients had muscle atrophy in one of the legs without pain and neurological impairment. The physical signs included tenderness in the lumbosacral region (26 cases), accompanied by radicular pain in the leg or aggravation of pain in the lumbosacral region when percussion of the perineal region was performed (21 cases); sensory disturbance and weakened muscle in the legs (15 cases); and sensory disturbance in the perineal region (16 cases).

Treatment Groups

We sought to evaluate whether the placement of fibrin glue could be more effective after CSF aspiration, because symptoms frequently recurred to some degree after aspiration alone. Thirty-one patients with symptomatic sacral arachnoid cysts were treated with fibrin glue injection. The patients were randomly divided into two groups: 15 patients (Group A) first underwent aspiration of more than 15 ml of CSF before they received the glue placement; and 16 patients (Group B) did not undergo aspiration but only received the glue placement.

In all patients MR imaging studies of the lumbar spine were performed to assess the relationship of the meningeal cyst to the thecal sac and to allow an estimate of the CSF volume contained within the cyst. All patients also underwent CT scanning, which yielded 5-mm-thick contiguous axial images.

Treatment Protocol

All patients were placed prone on the CT table in preparation for the procedure. The value of the CT scans in Hounsfield units was recorded before and after the injection (Table 1, Fig. 1 A–C). The CSF obtained in the patients in Group A was biochemically and microscopically examined postoperatively. All patients had a normal coagulation profile. The sacral meningeal cysts were located using an 18- or 20-gauge spinal needle that would be used only once was placed into the cyst through an attenuated region of bone after induction of local lidocaine anesthesia. The cysts were aspirated slowly to prevent sudden decompression and pain, and if pain occurred in the lower extremities the aspiration was temporarily halted. Aspiration was continued until no more fluid could be removed, using the estimated volume as a guide, with repositioning of the spinal needle if needed.

The fibrin glue was used according to the manufacturer’s instructions (Guangzhou Bioseal Biotech Co., Ltd.). In brief, equal volumes of the cryoprecipitate and thrombin–calcium chloride solution were simultaneously injected quickly as needed (Fig. 1D) until substantial forward resistance was felt, until the solutions aggregated within the syringes because of reflux, or until a volume equal to that aspirated had been injected. Larger amounts of cryoprecipitate were prepared for large meningeal cysts, with a total injection volume ranging from 3 to 15 ml. Six of the 31 patients had multiple cysts; these individuals had undergone one or two operations at the time of this writing. The fibrin glue was injected into the bigger cyst, which was considered to be the main source of pain. If the symptoms were not noticeably relieved, the glue was used again 6 months later. Patients were carefully monitored for any adverse symptoms and neuroimaging studies were repeated to document fibrin glue formation where the two solutions came into contact. Repeated fibrin glue injections were done as needed, with new equipment because of aggregation of fibrin within the stopcock and syringe from reflux. All patients were observed in the hospital for at least 2 days to monitor them for adverse reactions.

Results

Follow-Up Evaluation

Thirty-one patients were observed for 10 to 28 months, with an average follow-up duration of 23 months. The criteria used in evaluation were as follows: excellent, all symptoms and signs disappeared and the patient returned to his or her regular employment; good, symptoms and signs in the legs and perineal region disappeared, but the pain in the lumbosacral region persisted, although it did not interfere with patient’s regular work; fair, no improvement; and poor, exacerbation of the lesions or recurrence. The postoperative pain relief was evaluated according to a 100-mm visual analog pain scale. We selected a doctor who was unaware of group assignment to perform the clinical assessment. The results are shown in Tables 2 and 3.

The mean follow-up duration for Group A was 24
months (range 11–28 months), with fine results (excellent and good categories combined) in 80% of patients, and in Group B the mean duration was 22 months (range 10–27 months), with fine follow-up results in 75% of patients. Follow-up images obtained in one of the patients from each group are shown in Figs. 2 and 3. Results of chi-square or t-tests (SPSS version 14.0) showed no statistical difference between the two groups (p > 0.05).

**Postoperative Complications**

Two patients suffered headache, dizziness, and fever, which are side effects of fibrin glue injection, at 1 to 2 days postoperatively. One of them had mild malaise and moderate fever (38.2 to ~ 39.0°C) and slight nuchal rigidity. The other patient had the more severe symptom of vomiting. After effective therapy, the two recovered completely.

Symptoms in all 31 patients markedly improved after fibrin glue placement with or without aspiration of the CSF. Improvement or resolution occurred within a few days after the procedure, with no evidence of recurrence at follow-up periods ranging from 10 months to more than 2 years after fibrin glue therapy.

**TABLE 2**

Clinical results of follow-up evaluation in 31 patients with meningeal cysts of the sacral spine*

<table>
<thead>
<tr>
<th>Group</th>
<th>No. of Patients w/ Result</th>
<th>Excellent</th>
<th>Good</th>
<th>Fair</th>
<th>Poor</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>4</td>
<td>8</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>15</td>
</tr>
<tr>
<td>B</td>
<td>5</td>
<td>7</td>
<td>3</td>
<td>1</td>
<td>2</td>
<td>16</td>
</tr>
<tr>
<td>total</td>
<td></td>
<td>9</td>
<td>15</td>
<td>5</td>
<td>2</td>
<td>31</td>
</tr>
</tbody>
</table>

* The chi-square and Fisher exact tests showed no statistical difference between the two groups (p = 1.00, p > 0.05).

**TABLE 3**

Recovery from low-back pain and sciatica after a mean follow-up duration of 23 months in 25 patients*

<table>
<thead>
<tr>
<th>Group</th>
<th>No. of Patients</th>
<th>VAS Scores (mean ± SD)</th>
<th>p Value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Preop</td>
<td>Postop</td>
<td></td>
</tr>
<tr>
<td>A</td>
<td>13</td>
<td>83.0 ± 4.2</td>
<td>32.0 ± 7.1</td>
</tr>
<tr>
<td>B</td>
<td>12</td>
<td>83.5 ± 6.4</td>
<td>32.5 ± 3.5</td>
</tr>
</tbody>
</table>

* Recovery was calculated based on the 100-mm VAS scores of the two groups postoperatively. Probability values of less than 0.05 were considered statistically significant. Abbreviation: VAS = visual analog scale.
Discussion

The causes of sacral arachnoid cysts remain unclear. Tarlov\textsuperscript{14} postulated that the cysts occur as a result of blockage of venous drainage in the perineurium and epineurium secondary to hemosiderin deposition after local trauma. On the contrary, most surgeons consider the cysts to be a congenital arachnoidal defect. The mechanism by which the cysts enlarge is through a ball–valve effect, whereby the CSF, in which hydrostatic pressure is increased secondary to increased abdominal pressure or arterial pulsation, is forced to enter the congenital pouch (the cyst) but is unable to return to the thecal dura through the same portal.\textsuperscript{5}

Symptoms related to a sacral arachnoid cyst arise from its compression of other nearby sacral nerves. Approximately 1% of these lesions enlarge and become symptomatic.\textsuperscript{9} Sacral arachnoid cysts are often misdiagnosed as lumbar disc herniation or lumbar spinal stenosis, especially when they are pressing on the S-1 nerve root. However, these cysts carry special clinical characteristics: along with pain in the lumbar spine and legs, the patient tends to suffer from pain due to compression of the sacral nerve plexus or from hypesthesia in the perineal region, bowel or urinary functional disturbance, and sexual disturbance. Candidates for glue injection should be chosen after taking into consideration both the clinical findings and results of imaging studies while meeting the surgical criteria.

Sacral meningeal cysts are usually asymptomatic, but when associated with back pain their management can be problematic because of their temporary response to aspiration. A postulated mechanism involves narrowing or stenosis at the ostium of the nerve root sheath, which communicates with the subarachnoid space through a ball–valve mechanism with no exit. These circumstances likely result in the lack of a definitive therapy among the options of aspiration, cyst wall revision, or fat packing.\textsuperscript{9} Pretreatment MR imaging is useful in determining the relationship of the meningeal cyst to the thecal sac as well as the total volume of fluid within the cyst.

Many methods have been used to treat sacral cysts. Surgical management includes extensive sacral laminectomies, with either partial resection and oversewing of the cyst; total resection, including sacrifice of the cyst; or total cyst excision, including sacrifice of the involved sacrococcygeal nerve roots.\textsuperscript{8} Siqueira et al.\textsuperscript{12} emptied the cyst into the subarachnoid space by applying pressure and shrank the cyst wall by using cautery. Tarlov\textsuperscript{14} removed the domes of cysts or completely excised the lesions along with the dorsal root ganglion; McCrum and Williams\textsuperscript{4} completely excised the cysts after ligating the lesions’ necks, or obliterated the communicating hole by tying it with a suture after opening a big cyst.

More recently, a nonsurgical treatment with single or multiple percutaneous CT-guided sacral meningeal cyst aspirations has been introduced as potentially curative, or more often as a temporary method of alleviating symptoms.\textsuperscript{9} Paulsen et al. reported that patients who underwent sacral meningeal cyst aspiration tended to reaccumulate CSF and become symptomatic again.

It has been proven that fibrin glue placement into a sacral

\begin{figure}[h]
\centering
\includegraphics[width=\textwidth]{fig2.jpg}
\caption{Group A. This 53-year-old man underwent CSF aspiration and fibrin glue placement for a huge sacral meningeal cyst. A and B: Preoperative axial and sagittal T2-weighted MR images demonstrating an expansile meningeal cyst (arrows) of CSF intensity that has caused widening of the sacral foramen. C and D: Axial and sagittal T2-weighted MR images obtained 2 years postoperatively demonstrating that the cyst (arrows) has shrunk markedly.}
\end{figure}
meningeal cyst may be a definitive therapy. Some follow-up MR imaging studies performed in patients with these lesions revealed that the CSF had not reaccumulated in the cysts 6 months after the procedure. This success may be due to the stimulation of fibroblasts and subsequent fibrosis that occurs with fibrin glue resorption. Fibrin provides good tissue adhesion, promotes wound healing, gradually dissolves or is resorbed by fibrinolysis, and may result in subsequent fibrosis. This procedure resulted in marked symptomatic improvement in all of our patients, with no evidence of recurrence to date. Cyst aspiration alone often fails in some patients. Fibrin glue placement seems to seal the communication between the cyst and the subarachnoid space more permanently than can aspiration. In our follow-up evaluations we found that there was no significant distinction between the two groups, with or without initial aspiration of the CSF.

It is not effective to excise the whole cyst completely along with the nerve root. Incising the cyst wall after bone decompression and leaving it unsutured did not eliminate its origin and had no effect except to relieve the pressure of the lesion. Theoretically, the best treatment is complete excision of the cyst wall and ligation to block the communication. In most cases, however, it is impossible to detach the cyst wall completely from the compressed nerve root under the naked eye because of dense adherence. Furthermore, it is unnecessary to detach it by force because CSF cannot flow through the cyst wall. Of course, the longest follow-up duration in this series is 28 months, which might not be long enough to establish the effectiveness of this method conclusively, and perhaps at least 10 years would be needed to reach a conclusion. Also, from these 31 patients we cannot draw a conclusion about any differences in outcome between single- and multiple-cyst cases. We intend to evaluate long-term follow-up and to enroll more patients in future studies.

Conclusions

Although a larger number of patients needs to be studied to determine the efficacy of this procedure, we found that our nonsurgical treatment without CSF aspiration before injection of fibrin glue into sacral meningeal cysts in patients with back pain was very efficacious and did not lead to recurrence.

References


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Address reprint requests to: Tanghong Jia, Ph.D., Department of Orthopedics of Jinan Central Hospital, Jiefang Road 105# Jinan, Shandong Province 250013, China. email: surgery120@163.com.