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Syringosubarachnoid shunting using a myringotomy tube

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Abstract

Background: Syringomyelia results from obstruction of cerebrospinal fluid (CSF) flow due to a multitude of causes. Often symptoms of pain, weakness, and sensory disturbance are progressive and require surgical treatment. We present here a rare technique for syringosubarachnoid shunting.

Case Description: We present the case of a 38-year-old male who suffered a traumatic cervical spinal cord injury due to a motor vehicle accident. With progressive pain and motor decline, a magnetic resonance imaging was obtained and showed a new syrinx extending cervical multiple segments. A unique surgical procedure using a myringotomy tube to shunt CSF into the subarachnoid space was employed in this case. The patient's examination stabilized postoperatively, and at 2 months and 6 months follow-up visits, his strength and sensation continued to improve.

Conclusion: We used a myringotomy tube for syringosubarachnoid shunting for the surgical management of a posttraumatic syrinx with good results. This technique minimizes suturing and may minimize shunt-related complications.

Key Words: Cerebrospinal fluid, shunt, spinal cord injury, syringomyelia, syrinx

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BACKGROUND

Syringomyelia is caused by the pathologic obstruction of pulsatile cerebrospinal fluid (CSF) flow that occurs at any point caudal to the foramen magnum. The result is a fluid filled, gliosis lined cavity. The cavity itself can manifest as central canal dilation or can lie within spinal cord parenchyma.[19] There is a multitude of causes including arachnoid scarring secondary to Chiari 1 malformation, hemorrhage, infection, inflammation, trauma, malignancy, or prior surgery.[5,16,17,19]

Clinically relevant syringomyelia will often present with intractable pain and central cord deficits that can be progressive.[28] Risk factors for syrinx enlargement and clinical deterioration are arachnoiditis, cord compression, a narrowed spinal canal, bony deformity, and kyphosis among others.[1,21,23,27] In the setting of trauma, 3–4% of spinal cord injury is complicated by syringomyelia with myelopathy as the typical presenting symptom.[18]

Surgery is the preferred treatment for syringomyelia regardless of the operative technique.[12,17,22] This is, especially true with a multi-level lesion, progressive symptoms, and an expanding diameter. Neurologic deficits usually stabilize after intervention and sometimes

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improve. Overall, pain tends to be more responsive to intervention than are motor symptoms.[6,15,27]

Given the variability of clinical presentation, diverse pathophysiology, and provider preference, surgical treatment of syringomyelia is highly individualized. Historically, laminectomy, intradural exploration, lysis of adhesions, and duraplasty has been a favored option offering the most complete exposure.[3-5,13]

In the pediatric population, some have performed simple aspiration, and others have decompressed the posterior fossa to approximate normal CSF dynamics both with and without plugging of the obex.[7,8] Irrespective of age, Chiari malformations will often require foramen magnum decompression.[14] Not surprisingly, the degree of invasiveness tends to correlate with complications such as epidural fibrosis, spinal instability and deformity, and nerve root compression.[11,33]

Shunting syrinx fluid to the subarachnoid space, peritoneal cavity, or pleural space using a fluid diversion catheter is a less invasive surgical alternative that has gained favor.[2,20,25,31,32] For the syringomyelia-Chiari complex, posterior fossa decompression with syringosubarachnoid shunting is a well-established procedure.[25] For traumatic syringomyelia, syringosubarachnoid shunting has been utilized with good results.[29]

Less invasive techniques such as endoscopic strategies and key-hole laminectomy with syringosubarachnoid shunt using a microscope boast limited removal of bone structures and ligamentum flavum. They argue preservation of normal anatomical structures and fewer complications.[2,9,10] Ultimately, individual surgeon preference is a principal determinant of operative technique.

Unfortunately, in many patients, the benefits of surgery are not sustained, and repeat surgery is common due to cavity expansion and shunt failure–in particular with extraspinal shunts.[3,24,30] For subarachnoid shunts, preserving the integrity of the arachnoid membrane and the subarachnoid space is thought to significantly impact shunt success. Procedures and materials used for shunting introduce a foreign body and alter the characteristics of the subarachnoid space itself. The result is a propensity toward arachnoiditis. The degree of injury, location of injury, and subarachnoid space-intrasyringeal pressure differential appear to influence shunt success on an individual patient basis as well.[26]

In this study, we will describe a case in which we employed a rare technique for syringosubarachnoid shunting using a myringotomy tube in place of a flow diverting catheter. To our knowledge, only a single publication has reported a similar technique.[30]

CASE DESCRIPTION

A 38-year-old male was involved in an all-terrain vehicle crash and sustained a C6–C7 spinal cord injury with locked facets and underwent anterior/posterior cervical decompression and fusion. At the time of his initial injury, he had complete loss of motor function in his lower extremities as well as distal upper extremities. Strength was preserved in his biceps and deltoids, and a high thoracic sensory level was present.

Six months postinjury, the patient reported neck pain and loss of strength and sensation in the right arm for 3 weeks in duration. There was new right-sided weakness involving most notably his biceps and triceps muscles. Sensory function was diminished in the right arm with a C6 level on the left.

Magnetic resonance imaging of the cervical spine was performed and showed the appearance of a new large posttraumatic syrinx extending from C2 through the visualized upper thoracic spine [Figure 1]. The patient elected to proceed with surgery once conservative management including physical therapy and analgesics had failed.

Fluoroscopy was used to mark the planned incision site at the point where the syrinx was most prominent. Dissection was then carried down the midline to the inferior aspect of the targeted lamina. A small laminectomy was then performed, and the ligament was removed. The microscope was then brought into the operated field. Under high magnification, a midline durotomy was performed with the dura then tacked backward and retracted with 4-0 nylon sutures. With increasing magnification, we then identified an area of the spinal cord that was noted to be thinned out and white color and devoid of arteriovenous blood vessels. This was then opened with an 11 blade scalpel, and a gush of fluid suggested that the syrinx had been entered.

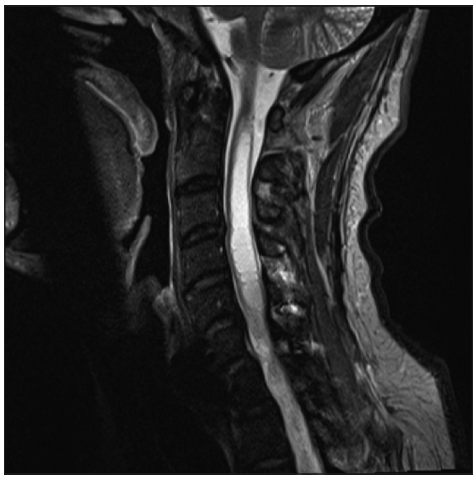

Figure 1:T2-weighted magnetic resonance imaging cervical spine

A small spool-shaped myringotomy tube [Figure 2] was then positioned within the opening maintaining the newly created communication now present from the intrasyrinx compartment to the subarachnoid space. Pulsatility in the spinal cord was restored indicating successful drainage and decompression of the syrinx and spinal cord. Valsalva maneuver was employed to verify that there was continued drainage through the newly placed syringosubarachnoid shunt. Subsequently, the dura was closed with a locked 4-0 nylon stitch, and Valsalva maneuvers were repeated to ensure there was no further CSF leak from the dural closure site. There was no change in intraoperative somatosensory evoked potentials and motor evoked potentials at this point. The operative site was then closed in a standard fashion.

Postoperatively, the patient strength examination was stable compared to his preoperative exam. At 2 months and 6 months follow-up visits, his strength and sensation continued to improve progressively. Strength in his biceps, triceps, and wrists was full on the left with only small weakness comparatively on the right–which was much improved from his preoperative exam. Finger flexors had regained movement as well. At 1 year follow-up, symptoms were stable, and no imaging was indicated. He was instructed to follow-up as needed, and no repeat imaging was performed.

CONCLUSIONS

As we have described, various techniques are utilized for the surgical treatment of syringomyelia with varying success. No technique has demonstrated superior results when compared to the others; therefore, various shunting procedures such as syringoperitoneal, syringopleural, and syringosubarachnoid are practiced and can be used in different settings. In this study, we presented a rare technique for shunting CSF into the subarachnoid space using a myringotomy tube.

Figure 2: Myringotomy tube

On review of literature, Ventureyra and Tekkök have reported the only other known report on a technique of this nature. Our technique broadly mirrors this one in terms of approach and concept. They report the use of a myringotomy tube through a small myelotomy for syrinx drainage without insertion of a catheter bulk into the syrinx. However, in contrast to our technique, the myringotomy tube used in their report employs perpendicular flanges that rest on the cord surface which are then secured to pia mater by 8-0 nylon sutures. At a mean follow-up of 11.5 months, 4/5 children (80%) had greater than or equal to a 30% decrease in maximum diameter of the syrinx.[30]

The advantage of using the spool-shaped myringotomy tube for shunting is that the hollow spool shape fixes the tube sturdily at the incision site. More importantly, without the perpendicular flanges, this shape avoids the need for suturing to the pial surface. We argue that this prevents a nidus for inflammation and resultant arachnoiditis, which may prove to offer higher success rates with further investigation.

In addition, as expected, the incision is small, and the surgeon will not have to tunnel a shunt catheter to a distant location. This allows for a significant degree of minimalism at and adjacent to the spinal cord itself, both periprocedurally and long-term.

One of the most important contributors to shunt malfunction is occlusion from arachnoiditis and adhesions around the catheter tip. We have mentioned that this is influenced by the integrity of the arachnoid membrane and the individual characteristics of the arachnoid space itself, ultimately determined by the underlying pathology. We suspect that our technique can further minimize scarring and prevent this feared complication. Furthermore, the use of the myringotomy tube by its nature avoids shunt-induced complications at distant body cavities.

The treatment of syringomyelia remains a difficult endeavor due to a multitude of factors. This study presents a rare technique that we have increasingly utilized with success and reliability. In the future, we plan to present our complete patient series.

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Conflicts of interest
There are no conflicts of interest.

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