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Operative technique

A modified technique for syringo-subarachnoid shunt for treatment of syringomyelia

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Summary Syringo-subarachnoid shunting is a well-established procedure for the treatment of syringomyelia. However, the standard surgical procedure requires a laminectomy and posterior midline myelotomy, which have potential complications. In this study, we describe our clinical experience with a modified technique for syringo-subarachnoid shunt insertion in eight patients between 1998 and 2002. The technique comprises a limited hemilaminectomy, a 2 mm myelotomy at the site of dorsal root entry zone, introduction of a 1.5 mm thick catheter into the syrinx and placement of the distal tip of the catheter in the anterolateral subarachnoid space. Using this technique there was no operative morbidity or mortality. Collapse of the syrinx, in the first post-operative month, was demonstrated by MRI in all cases. There were no relapses in the follow-up period. Although our experience is limited and the results preliminary, this technique is less invasive than commonly used techniques and the results are favorable.

Keywords: Syringomyelia, cerebrospinal fluid shunt, Chiari malformation

INTRODUCTION

Cystic dilatation of the spinal cord was described as early as the 16th century, but controversy regarding its pathogenesis and treatment continues.[1] Posterior fossa decompression with syringo-subarachnoid shunting is a well-established procedure for the treatment of the syringomyelia-Chiari complex.[2] However, the standard technique of syringo-subarachnoid shunting requires a laminectomy and a myelotomy at the posterior median sulcus, both of which have potential complications, including spinal instability and dorsal coloumn dysfunction.[3] In this study, we describe a modified technique for syringo-subarachnoid shunt insertion, performed via a hemilaminectomy and utilizing the dorsal root entry zone as the myelotomy site and report the preliminary results obtained.

PATIENTS AND METHODS

We have used the modified technique for syringo-subarachnoid shunt insertion in eight patients between 1998 and 2002. Five patients were male and three were female, aged between 21 and 43 years (average 32). All patients had Type 1 Chiari malformation and cervical syringomyelia, confirmed on MRI. Five patients had motor weakness, all had sensory disturbance and three had local pain.

At operation, patients were positioned prone under general anesthesia. A midline skin incision extending from the external occipital protuberance to one level below the spinal segment where the syrinx was largest was made. Posterior fossa decompression and C1 laminectomy was performed using a high-speed drill. The dural band at the level of the periosteum of C1 was released. Duroplasty was not performed. Following posterior fossa decompression, the paraspinal muscles at the spinal level where the syrinx was largest were dissected subperiosteally on the side of the maximal syrinx cavity. Hemilaminectomy was performed at a single level and the ligamentum flavum removed. A small durotomy was opened in the centre of the bony window. A 2 mm myelotomy was performed at the dorsal root entry zone and a silicone catheter with an approximate outer diameter of 1.5 mm was inserted into the syrinx and advanced in a cephalad direction. The distal catheter tip was placed in the anterolateral subarachnoid space and the catheter was fixed to the pia matter at the site of myelotomy. The dura was reapproximated in a water-tight fashion and the wound closed (Fig. 1).

All the patients had MRI scans at one, six and 12 months post-operative, and annually thereafter.

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RESULTS

There was no procedure-related morbidity or mortality. Motor weakness improved and pain subsided in all cases. Sensory disturbance resolved in all but one case. All the patients returned to their previous occupation within six weeks of surgery.

The follow-up period ranged from nine months to four years with an average of two years and one month. MRI was performed at one, six and 12 months post-operative, and annually thereafter. Collapse of the syrinx was observed in all cases on the first post operative MRI (Fig. 2). Radiological follow-up demonstrated no recurrence of the syrinx. There were no radiological signs of spinal instability on MRI.

During follow-up there was no shunt malfunction. Follow-up of these patients continues.

DISCUSSION

Cystic dilatation of the spinal cord was first described in the 16th century, and the term "syringomyelia" first proposed by Ollivier in 1827.[1] However, controversy regarding its pathogenesis continues. The most commonly accepted view is that the cavitation of the spinal cord occurs when CSF within the fourth ventricle is forced into the central canal, either as a consequence of a caudally directed pulse wave,[4] or a pressure gradient at the level of the foramen magnum.[5] This theory has shaped treatment strategies

Fig. 1 Post-operative CT scan after insertion of a syringo-subarachnoid shunt using the modified technique described. Note the hemilaminectomy defect and the lateral position of the catheter.

for syringomyelia, and led to the development of several operative procedures. Ventriculoperitoneal shunt insertion,[6] posterior fossa decompression with or without obex plugging,[7] terminal ventriculostomy,[8] percutaneous drainage,[9] myelotomy coupled with lumboperitoneal shunt,[10] syringoperitoneal shunt,[11] syringopleural shunt,[12] and syringo-subarachnoid shunt[3] have all been described with varying success. More recently, posterior fossa decompression coupled with syringo-subarachnoid shunting has become a well-established procedure for the treatment of the syringomyelia–Chiari complex.[2]

The standard operative procedure for syringo-subarachnoid shunt insertion has several disadvantages.[3] A laminectomy is required and this may be a major factor in the development of post-operative spinal deformity, particularly in children. Phillips et al[13] reported four boys with syringomyelia and scoliosis who had undergone syringo-subarachnoid shunting, followed for 8 years. They concluded that laminectomy, by further jeopardizing spinal instability, may worsen the scoliosis. The modified technique for syringo-subarachnoid shunt insertion described in this report requires only a hemilaminectomy, therefore reducing the risk of post-operative spinal instability.

Another disadvantage associated with the standard procedure is dorsal coloumn injury, which may result from the posterior midline myelotomy and shunt tube insertion.[3] Although midline posterior myelotomy is commonly performed, this point is not the thinnest portion of the spinal cord. Milhorat et al,[14] after review of 105 autopsy cases, found that the cavity was always paracentral in syringomyelia associated with Chiari Type 1 malformations and spontaneous rupture occured in 22% of the cases at the dorsal root entry zone. Rhoton et al[15] in 1976, suggested that the entry site into a syrinx should be the dorsal root entry zone, where the spinal cord is thinnest, rather than the posterior median sulcus. In the modified technique described in this report the dorsal root entry zone on the side of the cord where the syrinx cavity is largest, is the standard entry point for insertion of the shunt tubing. Therefore, there were no complications referrable to dorsal column injury. Iwasaki et al,[16] who have described a very similiar technique, have also suggested that use of a dorsal root entry zone myelotomy may further contribute to the relief of local pain.

Delayed shunt malfunction is one of the late complications of syringo-subarachnoid shunting.[3] The most important factor in the occlusion of the shunt system is the development of arachnoiditis

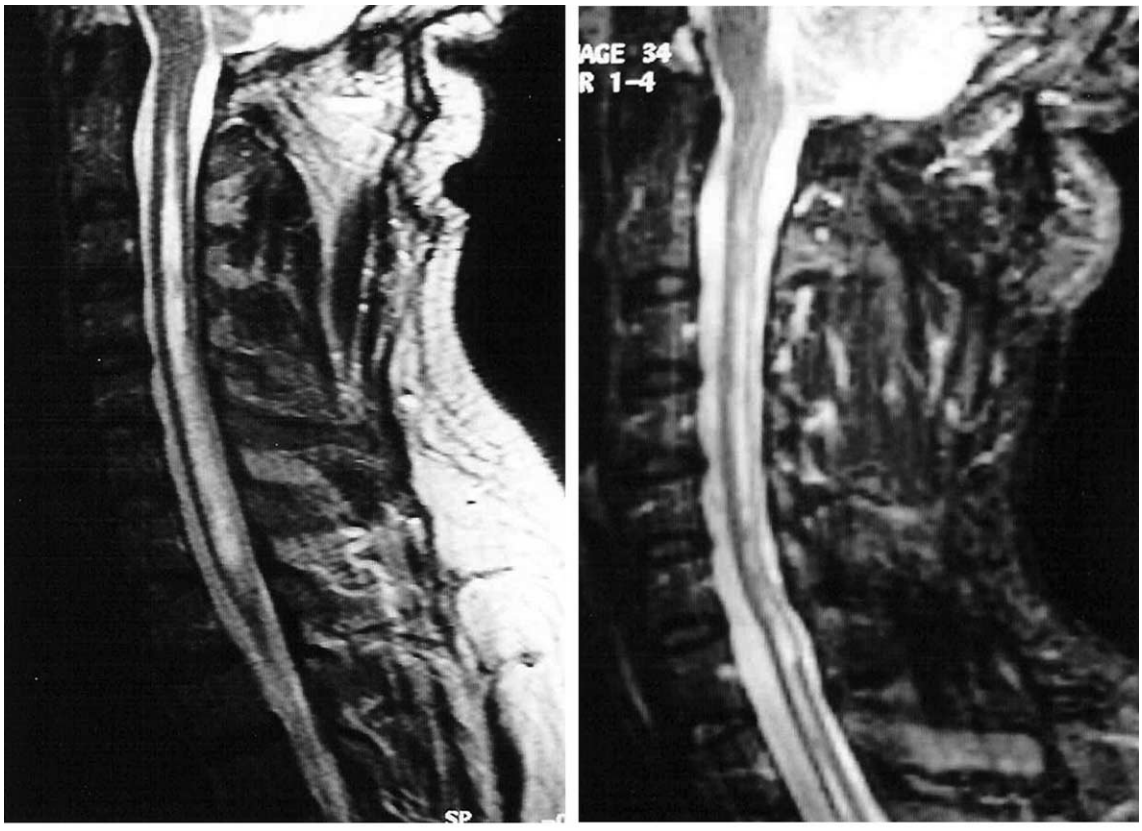

Fig. 2 Sagittal T2-weighted MRI of the spine before (a) and one month after (b) surgery showing improvement of the syrinx after posterior fossa decompression, C1 laminectomy and syringo-subarachnoid shunting.

and adhesions of the arachnoid around tip of the shunt tubing.[17] Anatomically, the dorsal and ventral spinal subarachnoid spaces are different. Many trabeculae exist between the pia mater of the dorsal cord surface and the dorsal arachnoid membrane; however, there are no arachnoid trabeculae on the ventral surface.[18] Using the standard technique for syringo-subarachnoid shunting, the dorsal subarachnoid space is the usual site for distal catheter placement and the anatomy of this space may contribute to delayed shunt malfunction. In the modified technique described here, the shunt is inserted into the syrinx at the dorsal root entry zone and the distal tip is inserted into the anterolateral subarachnoid space. No shunt malfunction occurred in this series, and these results are comparable with the series reported by Iwasaki et al.[16]

We conclude that the modified technique for syringo-subarachnoid shunting described in this report is less invasive than the standard technique and associated with a lower potential complication rate. Although our experience is limited, the outcome seems to be favorable.

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