Original Article

Syringosubarachnoid Shunting by Using the Tube of a Lumbo-Peritoneal Shunt in Primary Syringomyelia

Mohammed A. El Wardany, Tarek H Elserry*
Department of Neurosurgery, Ain Shams University, Cairo, Egypt

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ABSTRACT

Background: The proper management strategy for syringomyelia has not been established. Primary spinal syringomyelia is most commonly associated with spinal trauma but is also encountered as a consequence to intra-dural inflammatory process (infection, or chemical) and as a delayed response to surgical procedures. Aim of the work: Reviews the results of (syringosubarachnoid shunting by using the tube of lumbo-peritoneal shunt) for the treatment of primary syringomyelia in 27 patients operated upon during a 10-years period. Patients and Method: this study was carried out at the Department of Neurosurgery of Ain-Shams University hospitals (Cairo-Egypt) between 2001 and 2011 and the data was collected retrospectively. 27 patients with primary syringomyelia were operated upon via a myelotomy and insertion of lumbo-peritoneal shunt. All patients underwent preoperative and post-operative MRI scans and were studied clinically and radiologically. Follow up ranged from (3-8) years with a mean follow up of (5.1) years. Results: Twenty seven patients (12 males and 15 females) underwent (syringosubarachnoid shunting by using the tube of lumbo-peritonealshunt). 15 post-traumatic (7 males and 8 females), 9 idiopathic (4 males and 5 females) and 3 post inflammatory (one male and two females). No mortality and nearly 63% showed complete recover of the neurological presentation. Conclusion: Usage of the lumbo-peritoneal tube as syrinx-subarachnoid shunt is a safe, effective and technically simple technique in treating syringomyelia.

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INTRODUCTION

Variability in the pathogenesis and natural history of syringomyelia has generated much controversy regarding its treatment1,2,5,6. The treatment of syringomyelia due to abnormalities originating within the spinal canal remains a subject of ongoing discussion and investigation4. The longitudinal cavitation of the spinal cord that feature syringomyelia may be associated with or secondary to several pathological conditions: downward migration of the lower part of the cerebellum via the foramen magnum, craniocervical junction deformities such as basilar impression or invagination, hydrocephalus, tumors of hind brain area or cord tumors23,11,17,20,22. Syringomyelia is most commonly associated with spinal trauma but is also encountered as a consequence to intra-dural inflammatory process (infection or chemical) and a delayed response to surgical procedures5.

*Corresponding Author:
Tarek H Elserry
Department of Neurosurgery, Ain Shams University, Cairo, Egypt
E-mail: elserry@yahoo.com, Tel: +2/01223211156

The spinal level at which the arachnoid lesion lies (cervical, high thoracic or low thoracic) may also have some bearing on the development of a syrinx cavity, in as much as the CSF dynamics vary in each region7,13,23. Magnetic resonant imaging (MRI) has facilitated the diagnosis of syringomyelia in recent years, providing sharp delineation of syrinxes. Syringomyelia cannot be ascribed to a single pathophysiological mechanism, and its etiology and natural history are quiet variable9. Several hypotheses have been proposed to explain its pathophysiology, one explanation for syrinx formation, which has recently been reported by old Field et al.15, requires no communication between the fourth ventricle and the upper pole of the syrinx, and is based on pressure acting on the cord and syrinx at the surface of the cord, not from within the cord. The perivascular spaces of the central nervous system act as conduits for drainage of extra-cellular fluid by bulk flow to the subarachnoid space. Cerebrospinal fluid (CSF) enters the cord through these dilated perivascular spaces to produce syringomyelia by multiple microscopic connections with the subarachnoid space, rather than the single channel from the fourth ventricle. The predominant involvement of the cervical segments of the cord may be related to the fact that maximum pulsatile pressure waves in the spinal subarachnoid...
space occur in the upper portion of the canal and are dissipated with increasing distances down the canal.\textsuperscript{18}

This might be a milestone of inspiration for targeting the subarachnoid space as the estuary and the use of a relatively wide caliber tube to shunt.

**PATIENTS & METHODS**

This is a retrospective study done at the neurosurgery Department of Ain Shams University from 2001 to 2011.

This study concerned with spinal syringomyelia that is unrelated to Chiari malformation or hind brain descent. 27 patients, (12) males and (15) females were included in this study. Post traumatic syringomyelia included (15) cases (7 males and 9 females), idiopathic syringomyelia included 9 cases (4 males and 5 females), post inflammatory syringomyelia (arachnoiditis) included 3 cases (1 male and 2 females). The age ranged from 14 years to 67 years with a mean of 34 years.

All patients had full general and neurological examination. Preoperative studies included plain x-ray (antro-posterior and lateral) to assess the alignment of the spinal vertebra. Magnetic resonance imaging (MRI) with gadolinium contrast of the spine done to all cases to assess the site, extent, and size of the syrinx, also computed tomography (CT) which offers a valuable data to the boney boundaries of the battle field. Brain MRI was done in all cases to show any hind brain related condition especially chiaramalformation to exclude any hind brain related syringomyelia from this study.

**Surgical technique and approaches:**

In all patients, the surgical procedure was performed with the patient in prone position. Two levels laminectomy was done at a level centered on the middle portion of the syrinx. Midline durotomy was done to open the dura matter by using the operating microscope. (Zeiss, OPMI Vario/S88 System) To preserve the arachnoid membrane and careful attention was directed to have intact arachnoid layer.

Microscopical identification of arachnoid was done; the arachnoid was then opened in the midline. A midline small myelotomy was then done in the center of the syrinx; the extent of myelotomy is only few mms which is sufficient to introduce the lumbo-peritoneal tube. (Medtronic lumbo-pritoneal shunt, Codmanlumbo-pritoneal)

To be inside the syrinx cavity, firstly the proximal end of the shunt tube which has the fenestrated pores, this proximal end was directed cranially, then the other end of the shunt tube was carefully introduced in the subarachnoid space in a caudal direction.

Then, the shunt tube was fixed to prevent its migration either caudally or cranially, this shunt tube was fixed either by stay-suture (3-0 silk) to the dura or by 3-0 silk sutures to the anchors of the shunt tube. The length of the tube is about 7 cms, half of the tube is inserted into the syrinx cavity which was cut from the shunt tube provided that the cut is distal to the proximal end by 7 cm. Finally the dura was closed by 3-0 vicryl.

The patients were followed up clinically and radiologically. Assessment of neurological condition was performed for the time-period that the patients were followed in. MRI spine was done within 3 months after surgery to evaluate for residual syrinx. Further MRI follow up was then done every year to review the residual syrinx as regard size and extent.

**RESULTS**

Patients’ demographics as shown in table (2): 27 patients were included in this retrospective study. Fifteen patients (55.5%) were females and twelve patients were (44.4%) were males. Ages ranged from 14 to 67 years (mean 34 years).

The incidence of syringomyelia according to the spinal level is dorsal syringomyelia (14) patients, cervical syringomyelia (9 patients) and dorsolumbar syringomyelia (4 patients). Fig.: 1(a,b).2.

![Fig. 1](image_url)

**Fig. 1:** a; T2W1 sagittal MRI showing high cervical syringomielia, b; T1W1 axial MRI for the same case
The mean duration of symptoms prior to surgery was 7 years with a range from 1 month to 25 years. All the patients showed significant and continuing neurological deterioration at the time of operation.

In table (1), the main symptoms and sign are reported. Marked weakness was the most common symptom. Spastic leg weakness was found in (25) patients. Sensory loss of the dissociated type was found in (20) patients. Pain was a major complain in (14) patients. (5) Patients showing variable degrees of scoliosis. Other presenting symptoms included bowel or bladder dysfunction (3) patients, gait ataxia patients.

All patients have been followed up for at least (3) years (range 3-8 years; mean 5.1 years. No operative mortality was encountered in these 27 patients. Mild temporary neurological deterioration was seen in the early postoperative period in 4 patients. However within a few weeks 2 patients had improved to their preoperative neurological state but 2 patients had not reached their preoperative condition. 6 patients had transient paresthesia, 2 patients had a sphincterdisturbance postoperatively, and both of them were improved within few weeks. No cardiac or respiratory disorders had seen in this study.

All patients were reassessed with full neurological examination and spinal MRI within the first postoperative 3 months then, every 6 months in the first 2 years then every year. No patients has suffered recurrent or progressive neurological symptoms or signs (except 2 patients were neurologically deteriorated less than their preoperative neurological state, one patient had sphincter disturbances postoperatively which is not present preoperatively).

Postoperatively MRI demonstrated that the syrinx had significantly diminished its volume or had collapsed except in 2 patients who showed neurological deterioration postoperatively with no radiological improvement.

All patients were reexamined in the outpatient clinic postoperatively and in the follow up period.

17 patients (62.9%) showed complete recovery of neurological deficit together with collapse of syrinx cavity, 8 patients (29.6%) showed only radiological improvement with stabilization of their neurological status, and 2 patients (7.4%) showed deterioration as regards their preoperative neurological status with no radiological improvement. Neurological outcome (mainly motor weakness and spasticity) shown in table (4).

<table>
<thead>
<tr>
<th>Table 1: Preoperative clinical state in 27 patients:</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Clinical state</strong></td>
</tr>
<tr>
<td>Weakness</td>
</tr>
<tr>
<td>Spasticity</td>
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<tr>
<td>Dissociated sensory loss</td>
</tr>
<tr>
<td>Pain</td>
</tr>
<tr>
<td>Scoliosis</td>
</tr>
<tr>
<td>Sphincteric disturbances</td>
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<tr>
<td>Gait ataxia</td>
</tr>
</tbody>
</table>
### Table 2: Patient’s demographics (age and sex):

<table>
<thead>
<tr>
<th></th>
<th>Syringomyelia Post-traumatic</th>
<th>Idiopathic</th>
<th>Post inflammatory</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Age (years)</strong></td>
<td>14-50</td>
<td>19-67</td>
<td>15-34</td>
</tr>
<tr>
<td><strong>Range</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Mean</strong></td>
<td>30</td>
<td>32</td>
<td>27</td>
</tr>
<tr>
<td><strong>Sex</strong></td>
<td>Female</td>
<td>Male</td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>8(29.6%)</td>
<td>7(25.9%)</td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>5(18.5%)</td>
<td>4(14.8%)</td>
<td>1(3.7%)</td>
</tr>
</tbody>
</table>

### Table 3: Number of spinal region operated

<table>
<thead>
<tr>
<th>Spinal region</th>
<th>Number</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cervical</td>
<td>9</td>
<td>33.3%</td>
</tr>
<tr>
<td>Dorsal</td>
<td>14</td>
<td>51.8%</td>
</tr>
<tr>
<td>Dorsolumber</td>
<td>4</td>
<td>14.8%</td>
</tr>
</tbody>
</table>

### Table 4: Neurological outcome after surgery:

<table>
<thead>
<tr>
<th>Syringomyelia</th>
<th>Improvement</th>
<th>Stabilization</th>
<th>Deterioration</th>
</tr>
</thead>
<tbody>
<tr>
<td>Post-traumatic 15</td>
<td>11</td>
<td>4</td>
<td>-</td>
</tr>
<tr>
<td>Idiopathic 9</td>
<td>5</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>Post-Inflammatory 3</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
</tbody>
</table>

### DISCUSSION

Syringomyelia is a general term for pathological cavitations of the spinal cord, the pathogenesis and pathology of syringomyelia remain controversial. In syringomyelia, pressure and extension of the syrinx causing internal destruction of the spinal cord. So the main aim of surgery is to relieve any increased pressure within the syrinx by means of direct drainage of the fluid. That was the main theme in almost all the studies that had adopted the surgical management for syringomyelia. Several surgical approaches have been advocated for the treatment of syringomyelia. This study is an attempt to evaluate our surgical techniques. In our work we adopt the strategy of using the lumbo-peritoneal tube, aiming of better drainage through its multiple opening slots at its thecal end and the wider caliber which not only offers a generous avenue to the CSF but also permits better control fixing technique.

Promising outcome in our study; with a (62.9%) patients showed complete recovery of neurological deficits together with collapse of the syrinx cavity, 8 patients (14.8%) showed only radiological improvement with stabilization of their neurological status, with proximity better outcome using the syringosubarachnoid shunt by Hida et al. and Isu et al. as they show improvement in (87%) of their patients. Isu et al. used catheter of an end inserted into the syrinx root in a cephalic direction and then the other end into the subarachnoid space. The catheter was then secured to the piamater. The catheter made of non-reactive silicon material, was soft and thin, with an external diameter of 1, 2 mm and was 0.25 mm thick and 6 cm long with multiple fenestrations at each end. A proximity tube diameter makes a proximity outcome, and can face the Subjective and objective improvement in (31%) of cases in Padavoni et al. series who used a fashioned tube with a groove-shaped drain by cutting longitudinally the small silastic tube, 3 cm in length, tapered at both ends, half the drain was then inserted in the cyst through the myelotomy. The other half was inserted in the subarachnoid space. With the considerable up grade outcome in Isu et al. we still do recommend the midline myelotomy rather than the dorsal entry zone myelotomy adopted by Isu et al.

In our study, as regard the intra-operative difficulties during the surgical procedure, we found that, identification of the arachnoid membrane and creating a room in the subarachnoid space was difficult in some cases due to arachnoid adherence (arachnoiditis) which demand adequate sectioning of the arachnoid trabecular. Also in some cases, the syrinx cavity was septated, and this leaded to interrupt the smooth passage of the tube. Assessment of patency of shunting tube and water tight closure of the dura were difficult in some cases.

The better fixation facility offered by the lumbo-peritoneal tube is a considerable option that can give a lasting drainage needed and can be detected in the follow up images with (62.9%) complete recovery of neurological deficit together with collapse of syrinx cavity and (29.6%) showed only radiological improvement with stabilization of their neurological status.

We are facing 27 patients population in our study facing the 98 patient population of Matsumoto et al.
and the 59 patient population of Hida et al.\textsuperscript{10}, which push toward further study for a more reliable evaluation.

Motor weakness is the first ranked presenting symptom in our study 25 (92.6%) patients, as well as in Padovani et al.\textsuperscript{16} who reported in their series that motor weakness in (100%) with a decline in Isu et al.\textsuperscript{12} who reported motor weakness in (61%) of cases. A noticeable decline in the presenting motor deficit in Matsumoto et al.\textsuperscript{14} reported in their study (24.5%) of cases.

Sensory loss might come in the second rank presenting symptom with a competing other presenting symptom which is the spasticity as in Padovani et al.\textsuperscript{16} (74.1%) patients reported for the sensory loss and Spastic weakness was found in (97%). Isu et al.\textsuperscript{12} reported sensory loss in all cases in their study and a descend in Matsumoto et al.\textsuperscript{14}; they reported (34.7%) who suffered from sensory disturbance mainly localized numbness.

Pain was a major driving complain in 14 (51.8%), with a proximity to Padovani et al.\textsuperscript{16} reported (45%) patients, with another descending proximity in Matsumoto et al.\textsuperscript{14} of (39.8%) of cases. Follow up was done of all patients for at least 3 years (range 3-8 years) with mean of (5.1) years, and we consider it a sufficient period facing the follow up period in Padovani et al.\textsuperscript{16} and Matsumoto et al.\textsuperscript{14}

CONCLUSION

Finally usage of the lumbo-peritoneal tube as syringosubarachnoid shunt is a safe effective and technically simple technique in treating 1ry syringomyelia. The presence of a considerable intramedullary syrinx is considered to be a favorable indication for shunting the syrinx to the subarachnoid space by lumbo-peritoneal tube.

REFERENCES


