Lumboperitoneal shunts

Review of 34 cases

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A series of 34 lumboperitoneal shunts performed at Children's Hospital Medical Center, Boston, for communicating hydrocephalus is reviewed. The ease of placement and revision of this shunt, the relatively benign complications that occurred, and the fact that 21 of these 34 patients are still using lumboperitoneal shunts with good control of the hydrocephalus have justified continuing use of this method as the initial bypass procedure in the treatment of communicating hydrocephalus.

Key Words cerebrospinal fluid shunt · communicating hydrocephalus · Silastic

A review of lumboperitoneal shunts performed at the Children's Hospital Medical Center since 1964 was undertaken to determine objectively whether this procedure was an effective primary shunt in the treatment of communicating hydrocephalus. Our clinical impression had been that the ease of insertion and relatively benign complications, when compared to jugular or ureteral shunts, warranted its use as the initial bypass procedure in the treatment of communicating hydrocephalus.

Although we have performed lumboperitoneal shunts intermittently since the early 1950's, the year 1964 was selected as a starting point because by then Silastic shunts were uniformly used, replacing the polyethylene shunts formerly used. Polyethylene tubing repeatedly kinked and cracked, and adhesions around the tip of the abdominal catheter were more frequent, necessitating revision to other forms of shunts; this had been the experience of many other groups.

2,3,9,12,13,16,18 A valveless Silastic shunt placed in the lower abdomen is what we have evaluated in this report.

Shunting of cerebrospinal fluid into the peritoneal cavity in hydrocephalus was first performed by Ferguson7 in 1898, who placed a silver wire in a canal drilled through a lumbar vertebra, connecting the subarachnoid space with the abdominal cavity; the patient died within 24 hours of the procedure. In 1908, Cushing5 reported 12 cases of transvertebral lumboperitoneostomies in which he used a silver cannula; two of the patients developed intussusception and died, and he abandoned the procedure. In 1914, Heile10 reported the use of venous and rubber shunt material, which was not successful. Davidoff6 then attempted experimentally to circumvent the shortcomings of the material used by Heile by first producing an autogenous graft of rolled skin to serve as the bypass from the lumbar subarachnoid space to the peritoneal cavity. This was used in dogs.
but was not further reported in human patients. Eighteen years later, Ingraham and his group published their work on the experimental applications of polyethylene in neurosurgical procedures. This material was then used successfully by Matson in his first lumboureterostomy in 1948. Cone and coworkers (cited by Jackson) then presented a paper on the use of polyethylene in lumboperitoneostomies in 1949. However, polyethylene and the lumboperitoneal shunt were virtually abandoned by this and other groups because of the marked frequency with which kinking, fracture, and obstruction occurred.

In an attempt to maintain patency at the peritoneal end, Harsh in 1954 reported using a lumbofallopian tube procedure; six of his eight patients with lumbosalpingostomies were doing well after a follow-up period of 3 to 12 months, with five requiring revisions. Using polyethylene tubing, Jackson and Snodgrass in 1955 could report only 22 of 62 patients alive after 4 years. A total of 112 procedures were performed in this group, 62 of which were lumboperitoneal shunts and their revisions.

Picaza attempted to rectify the frequency of abdominal obstruction by placing the tube in the retro-omental space, and in a preliminary report in 1955 had obtained good results in arresting the hydrocephalus in a small series of patients. Scott and coworkers, using rubber, vinyl plastic, and polyethylene assemblies, obtained a 9% control of hydrocephalus in 32 cases which included 19 primary lumboperitoneal and 10 ventriculoperitoneal shunts followed over a 4-year period.

The introduction of Silastic brought new attempts at this form of shunting. Jones in 1967, presumably utilizing Silastic, reported that of 25 females with lumbofallopian shunts 23 had arrested hydrocephalus, four had died, and 13 required revisions. Of 38 males with lumboperitoneal shunts, 34 had arrested hydrocephalus, five had died, and 14 required revisions. Murtagh and Lehman described 53 patients with peritoneal shunts, 31 of whom were considered to be controlled in a follow-up of 1/2 to 9 years; 46 of these patients had lumboperitoneal shunts. The majority of their shunts were performed percutaneously with the lumbar tubing inserted via a No. 16 needle puncture of the subarachnoid space through a stab wound over the lumbar spine. A slit-tip was used in the peritoneal cavity as a one-way valve. Failures in the immediate postoperative period were due to malplacement, kinking, and suture strangulation. Late obstruction was present most frequently at the abdominal end and included migration of the entire shunt into the abdominal cavity.

Summary of Cases

Etiology and Incidence

Thirty-four children with communicating hydrocephalus and lumboperitoneal shunts were the subjects of this study. Diagnosis was made by ventriculography followed by the demonstration of air in the lumbar theca. Thirty of these children had primary shunts; four had secondary shunts following the removal of a malfunctioning ventriculoatrial shunt. Twenty-four patients were male and 10 were female; the age at the time of the first shunt varied from 7 weeks to 20 years. The possible etiologies of the hydrocephalus in this series were variable although by far the largest group were patients with idiopathic communicating hydrocephalus. Other causes were: myelodysplasia (2), achondroplasia (1), head injury including birth trauma (10), central nervous system infection (2), occipital encephalocele (1), and intraventricular operations (2). A total of 63 operations were performed including revisions and primary procedures.

Procedure

With the availability of silicon tubing such as the Holter atrial catheter, there has been a decrease in the incidence of peritoneal end obstruction. However, the size of the tubing was greater than that of the polyethylene tubing, and we occasionally saw patients with root signs including leg pain, limitation of straight leg raising, and muscle atrophy. To reduce the frequency of this complication we have recently been using a shunt composed of the smaller Holter tubing which is placed in the lumbar subarachnoid space, anastomosed to a stepped connector, and then to the standard size atrial tubing which can negotiate the subcutaneous course to the
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abdominal incision without danger of occlusion.

The patient is positioned in the lateral decubitus position and the operative sites are prepared and draped in continuity. Through a small longitudinal incision, a hemilaminectomy is carried out at the second lumbar level. The shunt is fully prepared before opening the dura. Approximately 4 cm of the smaller catheter is used in the lumbar subarachnoid space. The silk ties that hold the tubings to the connector are left long for later use. When the shunt is ready, the dura is opened, and holding sutures of No. 4-0 silk are placed on each margin. The arachnoid is then opened, with care taken to maintain a hold on it with smooth forceps, lest the catheter be inadvertently placed in the extra-arachnoid space. The small tubing is then passed downward until the lower half of the connector is inside the dura. With a small empty needle, the holding suture on the lower end of the connector is passed from within out so that the connector will be held by a sling stitch to the undersurface of the dura. The shunt is irrigated with saline to be sure that it is in proper position and passes fluid both in and out readily. Before closing the dura from above downward, the suture on the upper half of the connector is loaded on an empty needle and passed through the dura adjacent to the incision. Before tying this suture, a watertight closure of the dura is carried out with No. 5-0 silk. The suture placed previously is then tied so that the connector is held down to the outer side of the dura, thus preventing it from tilting down into the cauda equina with possible impingement on nerve roots (Figs. 1 and 2).

The larger atrial tubing is then positioned in a lazy curve cephalad and toward the abdominal incision. The paraspinal muscles are incised for about 2 cm so that the angulation of the tubing is less as it turns this corner. It is then tunneled subcutaneously to the abdominal opening, which is a small McBurney-type incision in the left lower quadrant. Through a small opening in the peritoneum, the catheter, trimmed to a length adequate to take it across the abdominal cavity, usually 10 to 12 cm, is passed intraperitoneally along the anterior abdominal wall. So far there have been no root signs or scoliosis which we could attribute to shunts placed in this manner.

Results

Of the 34 patients, 21 are still using lumboperitoneal shunts (Table 1). Seventeen of these have not required any revisions. The hydrocephalus in each of these 21 patients
remains in good control as measured by head growth curves and clinical examination. Six revisions were performed in four patients who still have lumboperitoneal shunts, and 13 of the original 34 patients ultimately required revision to another form of shunt, either ventriculojugular or ventriculoperitoneal. Of 14 patients who, except for hydrocephalus, were completely normal both physically and functionally prior to shunting, eight still have lumboperitoneal shunts. By subjective assessment, all continue to have normal psychomotor skills. There was one death in the series.

Complications. Obstruction requiring revision or a different shunting mechanism developed at a variety of sites. These included lumbar end obstruction in seven instances, peritoneal obstruction in five, obstruction with site unknown in six, and fractured tubing in three (Table 2). The large abdominal cysts noted by other authors using polyethylene tubing,7,8,16,18 the bowel perforations reported by Wilson and Bertan,19 and subdural hematomas14,16 have not occurred as complications in our series. We were unable to correlate obstruction or other malfunction with an elevated spinal fluid protein as indicated by Murtagh and Lehman.16

Problems due to small ventricles and linear growth were eliminated. Hernia and hydrocele were complications within 6 months of the shunting procedure in four infants and were corrected without further problem. Root signs and symptoms occurred transiently in two patients, and in another two were of sufficient severity to require shunt removal. These symptoms and signs included leg and back pain, positive straight leg raising, and a weak foot, which cleared after revision. They occurred before the sling stitch and tapered tubing were in use. One of the patients was achondroplastic. In view of the marked narrowing of the lumbosacral canal in these dwarfs, we feel that the lumboperitoneal shunt is contraindicated in this condition.4,4 One case each of peritonitis, ventriculitis, aseptic meningitis, suture occlusion, dural leak, connector separation, intra-abdominal migration, and dehiscence occurred in the immediate postoperative period, the dehiscence due to an unsuspected problem with wound healing.

Aside from the one operative death, the preceding list of complications and the obstructions were readily rectifiable in each instance. With each revision, small but important improvements in surgical technique were made; these have become part of the operation described, whose success leads us to hope that the full potential of this shunting procedure is yet to be realized.

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References


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