Laparoscopic Management of Ventriculoperitoneal and Lumboperitoneal Shunt Complications

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ABSTRACT

Background and Objectives: Minimally invasive approaches for the initial placement of ventriculoperitoneal (VP) and lumboperitoneal (LP) shunts have been well described. A laparoscopic approach has multiple advantages over open techniques, including decreased morbidity, more rapid recovery, and ability to visually assess catheter function. However, few series have addressed the role of laparoscopy in the management of VP and LP shunt complications.

Methods: We present here the largest published series of laparoscopic treatment of VP and LP shunt complications in adults, by retrospectively reviewing all cases performed in a 1-year interval by a single surgeon.

Results: Ten patients presented with complications of previous shunting; all were managed laparoscopically. Eighty percent of these patients had a successful single laparoscopic intervention. One patient developed a cerebrospinal fluid leak from the lumbar wound, and 2 patients required additional laparoscopic shunt revisions.

Conclusions: We conclude that laparoscopy has great utility in the assessment of shunt function. Laparoscopic techniques should be considered not only for placement of peritoneal catheters, but also for the management of distal shunt malfunction and diagnosis of abdominal pain in these patients.

Key Words: Laparoscopy, Shunts, Hydrocephalus, Complications, Ventriculoperitoneal, Lumboperitoneal

INTRODUCTION

Peritoneal drainage of cerebrospinal fluid (CSF) is widely used by neurosurgeons to treat hydrocephalus. The first uses of laparoscopy to aid in the abdominal placement of ventriculoperitoneal (VP) and lumboperitoneal (LP) shunts were reported in 1993 and 1999, respectively.1–4 These early series suggested that laparoscopy was safe and effective and provided direct visual confirmation of shunt position and function. Comparative studies of minimally invasive shunt placement versus traditional open techniques have suggested laparoscopy is not only a reliable technique, but it has fewer complications as well.5

Shunt dysfunction still occurs in a substantial number of cases, with reported estimates of abdominal complications ranging from 5% to 47%.6 However, experience with laparoscopy in the diagnosis and treatment of shunt malfunction has been limited. This series reviews our experience with laparoscopy in the management of VP and LP shunt malfunction in adult patients, as well as diagnostic laparoscopy in patients with indwelling shunts who presented with abdominal pain.

METHODS

We conducted a retrospective review of all adult patients undergoing laparoscopic revision of VP and LP shunts or diagnostic laparoscopy for assessment of abdominal complaints or shunt function in patients with a VP or LP shunt. Institutional Review Board approval was obtained from the University of Maryland Human Subjects Research Committee for this study. The results include all consecutive cases from February 2004 through March 2005. Data collected include age, sex, diagnoses, indications for surgery, operative details, and short-term results.

Operative Technique (Abdominal)

For initial assessment, pneumoperitoneum was established to a pressure of 10mm Hg to 15mm Hg by using the Veress needle technique. The peritoneum was then accessed with a 5-mm optical access trocar. Placement of the trocar was dictated by the side of the shunt, and the patient’s previous surgical incisions. This port was used for the position of the camera. An additional 5-mm port
was placed under direct vision in a location that provided easy manipulation of the tip of the shunt catheter. In any case where a new shunt was placed, we used a technique previously described by the senior investigator in this study (JSR) with a percutaneous peel-away sheath serving as an introducer for the shunt catheter. An additional 5-mm port may be placed as necessary to facilitate the conduct of the operation and allow for the 2-handed technique. Patients with VP shunts were placed in a supine position, whereas patients with lumboperitoneal shunts were necessarily placed in a lateral decubitus position.

RESULTS

Ten patients underwent 13 laparoscopic procedures for shunt-related complications of a ventriculoperitoneal or lumboperitoneal shunt. Data from the cases are summarized in Table 1.

All patients in our series were female, with an average age of 42.4 years (range, 29 to 74). Most were also morbidly obese, with an average body mass index (BMI) of 40.7. The most common condition requiring initial shunt placement was pseudotumor cerebri (60% of patients), but other diagnoses included normal pressure hydrocephalus, intracranial hemorrhage, syringomyelia, and spina bifida. Indications for the laparoscopic procedure included suspected shunt failure (n=10), shunt migration (n=1), and abdominal pain (n=2).

The operative time ranged from 35 minutes to 190 minutes and averaged 100.5 minutes. Shunt replacement or revision was ultimately successful in all patients as documented by the laparoscopic visualization of CSF draining from the end of the shunt tubing at the time of the operation (Figure 1). Eighty percent of patients undergoing revisional surgery were treated successfully with a

![Figure 1. Flow of cerebrospinal fluid is confirmed visually after lumboperitoneal shunt placement.](image)

| Patient* | Age | BMI† | Dx† | Prior Shunt Procedures | ASA | OR Time (min) | LOS (days) | 30 Day Complications | 1 Year Complications |
|----------|-----|------|-----|------------------------|-----|---------------|------------|----------------------|---------------------|
| 1        | 32  | 63.4 | PTC | 3                      | 3   | 50            | 3          | None                 | None                |
| 2        | 74  | 28.7 | NPH | 3                      | 3   | 67            | 2          | None                 | None                |
| 3        | 36  | 40.6 | PTC | 1                      | 3   | 185           | 2          | Shunt malfunction     | None                |
| 4        | 51  | 41.3 | PTC | 3                      | 3   | 169           | 2          | Lumbar CSF leak       | None                |
| 5        | 51  | 37.7 | Syringomyelia | 3 | 3  | 69 | 1 | None | None |
| 6        | 30  | 44.8 | PTC | 34                     | 2   | 35            | 2          | Shunt malfunction     | Revised (4, 9, 13 mos) |
| 7        | 29  | 27.1 | Spina bifida | 4 | 3 | 79 | 1 | None | None |
| 8        | 41  | 56.6 | PTC | 2                      | 3   | 190           | 3          | None                 | None                |
| 9        | 48  | 24.7 | SAH | 1                      | 2   | 64            | 2          | None                 | None                |
| 10       | 32  | 42.5 | PTC | 4                      | 3   | 97            | 2          | None                 | Revised (8 mo)       |
| Avg      | 42.4| 40.7 |     | 3                      | 3   | 100.5         | 2          | 30%                  |                     |

*All patients female.
†BMI = body mass index; PTC = pseudotumor cerebri; NPH = normal pressure hydrocephalus; SAH = subarachnoid hemorrhage; CSF = cerebrospinal fluid.
single surgical procedure. In one case, the abdominal portion of the shunt had become detached and was retrieved laparoscopically before insertion of a new shunt catheter (Figure 2). The average length of stay was 2 days.

Complications developed in 3 patients: 1 patient developed a leak from the lumbar wound that required surgical oversewing, and 2 patients required multiple abdominal procedures to establish proper shunt function. One of these patients (patient 3 in Table 1) had migration of her original shunt catheter into the extraperitoneal space (Figure 3). A large extraperitoneal collection of CSF was noted in the right lower quadrant. During the initial procedure, the collection was drained laparoscopically, and the shunt catheter was positioned into the peritoneal cavity. On the second postoperative day, the patient developed recurrent headaches that prompted a computerized tomography scan. The catheter had again migrated into the extraperitoneal space. In the subsequent laparoscopic procedure, the peritoneal portion of the catheter was relocated to a position in the right upper quadrant. This patient then had complete resolution of her neurologic symptoms.

In the second case of postoperative shunt dysfunction (patient 6 in Table 1), the patient had had a total of 34 prior shunt placements and revisions (Figure 4). During the year of this study, she required initial revision, followed by a valve replacement and ultimately a lumboperitoneal shunt placement.

In this series, 2 patients underwent laparoscopy for abdominal pain presumably related to the shunt catheter. In 1 patient, the shunt was noted to be draining adequately at the time of the operation. However, she also had a small incisional hernia at the shunt insertion site, which was repaired laparoscopically. Postoperatively, the patient had complete resolution of her abdominal pain. In the second patient, the diagnostic laparoscopy was unremarkable, but the shunt catheter was noted to be extraperitoneal. This shunt was not revised, as the patient no longer had the neurologic symptoms that resulted in the placement of the original shunt.

DISCUSSION

Shunt malfunction may be caused by ventricular catheter obstruction, valve problems, distal catheter obstruction, pressure mismatch, or component disconnection. Common presenting features of shunt dysfunction include headache, mental status changes or drowsiness, and vomiting. Computerized tomography or magnetic resonance imaging may not show a change in ventricular size, but a comparison to a previous examination must be performed. To evaluate the patency of a ventriculoperitoneal shunt, a “shuntogram” may be performed. This involves injection of a small quantity of nonionic contrast material into the valve of a ventricular shunt system. Serial films are obtained to document forward flow of contrast material and CSF. Patency can also be evaluated via nuclear medicine techniques or manometric evaluations; however, significant variations can occur in shunt flow rates and volumes during the course of the day. As a result, shunt exploration is often required when shunt malfunction is suspected.

The traditional open technique for placement of the shunt involves creating a limited laparotomy and blindly introducing the catheter into the abdominal cavity. Laparoscopy has been well described for the placement of ventriculoperitoneal and lumboperitoneal shunts. The use of laparoscopy facilitates this procedure by allowing for placement of the catheter under direct vision and confirming shunt function by visualization of drainage of CSF from the shunt tubing. However, even the laparoscopic approach is not a guarantee against shunt-related complications.

Numerous techniques have been described in regard to placing these shunts utilizing laparoscopic techniques. Initial reports utilized a 3-trocar technique with good results. The use of a peel-away introducer sheath to insert the tubing through the abdominal wall greatly facilitates the procedure. Single trocar techniques have been described with equal success. However, the addition of a second trocar allows the operator to grasp the catheter and direct it toward an area of the abdomen free of adhesions.
Several authors7,14–16 have advocated the use of mini-laparoscopy in the placement of shunts. In our patients, the median number of prior procedures was 3, and laparoscopy was ultimately successful in all cases. Abdominal access in this patient population was readily obtained utilizing a Veress needle and a direct access trocar without abdominal injury or complications. Other authors4 have reported similar success with the placement of VP and LP shunts in patients with prior surgery.4

In this series, 20% of patients required a second surgical procedure to correct shunt dysfunction. However, each of these difficulties was addressed by subsequent laparoscopy, leading to an ultimate success rate of 100%. Complications may be anticipated, given the typical history and status of the patient population. In addition to the multiple previous shunt procedures, the mean American Society of Anesthesiologists classification status for this patient population was 3, indicating significant systemic disturbance. Our series demonstrates that laparoscopy can be readily performed even in complex neurosurgical patients.

Laparoscopic shunt placement may have its greatest benefit in the morbidly obese patient. A 2-mm to 5-mm incision may be used for access to the peritoneal cavity, rather than the long incision required in open placement for

Figure 3. (A) Computerized tomography image depicting extraabdominal migration of catheter tip with corresponding cerebrospinal fluid collection. (B) Laparoscopic view, fluid collection drained intraabdominally. (C/D) Catheter positioned into the peritoneal cavity as the extraabdominal fluid collection is marsupialized.
patients with a thick abdominal wall. As mentioned earlier, our series comprises morbidly obese patients, with an average BMI >40. However, those patients with pseudotumor cerebri had a BMI >48.

Placement or revision of lumboperitoneal shunts requires patient positioning in the lateral decubitus position. Three patients in our series underwent laparoscopy for LP shunt dysfunction. Although only basic laparoscopic skills are required for VP shunt placement, laparoscopic LP shunt placement requires slightly more advanced skills due to the increased difficulty in abdominal access in the lateral position.

Numerous case reports have described techniques for laparoscopic drainage of CSF pseudocysts, the removal of disconnected distal catheters, and the repositioning of shunts into more favorable locations. In our series, laparoscopy was additionally utilized as a diagnostic tool for abdominal pain in 2 patients. In both patients, a diagnosis was established and appropriate therapy undertaken. One patient was found to have a small incisional hernia that was repaired laparoscopically. In the second patient, the shunt was found to have migrated into an extraperitoneal location. Other authors have similarly utilized laparoscopy in the diagnosis and management of abdominal pain following shunt placement.

In all shunt revisions, the laparoscopic technique provided a minimally invasive approach to the successful manipulation or replacement of the shunt documented by visualization of CSF drainage. The safety and efficacy of this technique has been shown in children, the obese, and the multiply operated on abdomen. This report represents the largest published series on the laparoscopic management of complications of VP and LP shunting in adults.

Ventriculoperitoneal shunting is commonly performed by neurosurgeons without the assistance of an abdominal surgeon. In this series, all procedures were performed under the direction of both a neurosurgeon and a general surgeon. Although basic laparoscopic skills may be taught to neurosurgeons, widespread adoption of the laparoscopic abdominal technique may not be expected. Although it may not be feasible in all centers, it is a safe, reliable, and effective technique at our institution.

CONCLUSION

Laparoscopy is a safe and effective technique for the management of complications following shunt placement, assessment of shunt function, and diagnosis of abdominal complaints. Our series represents the largest published series of laparoscopic management of shunt complications in adults. Laparoscopy may become the procedure of choice for the management of these patients. Future prospective trials will more clearly delineate the roles of laparoscopy in this patient population.

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