SCIENTIFIC PAPER

Laparoscopic Ventriculoperitoneal Shunts: Benefits to Resident Training and Patient Safety

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ABSTRACT

Background and Objectives: Symptomatic hydrocephalus is a surprisingly common clinical condition. Neurosurgeons are expert at ventriculostomy, but minimally invasive peritoneal access is outside the realm of their current training. We have adopted a multidisciplinary approach, with general surgeons positioning the distal shunt. Our objective was to review this recent experience.

Methods: All distal shunts were placed by a single surgeon with resident assistance. After ventriculostomy, the shunt tubing was tunneled onto the anterior abdominal wall. A Veress needle was placed through the tunnel incision and the abdomen insufflated. A 5-mm optical access trocar and camera were introduced via a separate stab incision. The shunt tubing was then directed into the abdominal cavity using a Hickman introducer kit, with flow confirmed visually.

Results: Study patients who had between 0 and 10 previous abdominal operations received 111 consecutive shunts. There was one intraoperative complication, a colon injury during trocar placement. In this case, the colotomy was repaired and the shunt placed in the pleural space. There were no conversions to the open abdominal approach. Postoperatively, there were no wound infections, no cases of shunt malpositioning, and there were no deaths.

Conclusions: Laparoscopic placement of ventriculoperitoneal shunts is feasible, safe, and carries a low rate of complications. The value to resident education in the practice of this procedure has not been previously emphasized. In the era of increased awareness of patient safety, laparoscopic VP shunting serves as a model for accomplishing both goals of improved outcomes and quality surgical education.

Key Words: Surgical education, Laparoscopy, Shunts, Hydrocephalus, Laparoscopy, Ventriculoperitoneal.

INTRODUCTION

Drainage of cerebrospinal fluid (CSF) is widely utilized by neurosurgeons to treat hydrocephalus, and in the setting of most chronic conditions, the preferred route is to the peritoneal cavity. Laparoscopy has been used to aid in the abdominal placement of ventriculoperitoneal (VP) shunts since 1993.[1-3] 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.[4,5]

Although there are some barriers to widespread adoption, a multidisciplinary approach to placement of catheters seems ideal. At our institution, the preferred approach is to have neurosurgeons, skilled and practiced in ventriculostomy, place the proximal catheter. General surgeons, more comfortable with minimally invasive abdominal access, position the distal portion. This technique is not unique to our center, but what has not been appreciated to date is the utility of this procedure in the realm of resident education. We have recognized the value of this procedure for teaching residents, including junior level residents, rather than a specialized procedure to remain in the hands of faculty members. We present here our recent experience with surgical trainees and laparoscopic-assisted VP shunt placement.

MATERIALS AND METHODS

We conducted a retrospective review of all adult patients undergoing laparoscopic placement of VP shunts at a single academic institution over a 2-year period. The results include all consecutive cases from September 2007 through September 2009. Data collected included age, sex, diagnoses, indications for surgery, operative details, and short-term results.

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Operative Technique

Each patient is placed in supine positioning after induction of general anesthesia, with the head turned slightly. A scalp flap is raised, and a burr hole created in the skull. The ventricle is accessed, and the shunt tubing inserted. The tubing is connected via a one-way valve to the distal catheter, tunneled from a 1-cm incision on the abdominal wall just below the costal margin.

Placement is performed with standard technique, a variation of that has been previously reported.[6] Pneumoperitoneum is established to a pressure of 10mm Hg to 15mm Hg using a Veress needle through the tunnel site. After insufflation, a 5-mm optical access camera and trocar are placed through a separate stab incision approximately 10cm away from the tunnel site. Typically, adequate peritoneal surface is confirmed during a brief diagnostic laparoscopy. A 10-French Hickmann peel-away introducer sheath is then used to place the tubing in the peritoneal cavity. The tip position may need to be altered, and can be repositioned through use of the camera tip itself. Flow of CSF through the catheter is then visually confirmed while palpating the proximal valve **(Figure 1)**. The abdomen may be desufflated, and the trocar site and tunnel site closed with absorbable subcuticular stitch.

RESULTS

We performed 111 de novo ventriculoperitoneal shunt placements during the study period. Of our patients, 56% were female, with an average age of 55.2 years (range, 19 to 86). The average body mass index (BMI) was 29.8, but ranged from 15 to 49.6. The indication for shunt placement was always hydrocephalus. The most common condition requiring initial shunt placement was intracranial hemorrhage, but other diagnoses included normal pressure hydrocephalus, intracranial tumor, syringomyelia, and spina bifida, among others.

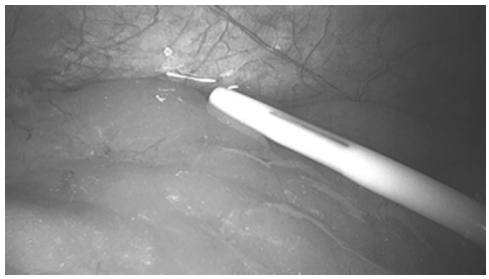

Figure 1. Flow of cerebrospinal fluid is confirmed visually after lumboperitoneal shunt placement.

The operative time for the distal placement was brief, often less than 10 minutes. Shunt placement was 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. Resident participation included all PGY levels (intern through chief resident).

Complications were also minimal. There were no deaths in the series. There were no wound complications, no intraabdominal abscess, and no malpositioned shunts. There were no access-related vascular complications, with no patient requiring a blood transfusion.

In one patient, the trocar violated the right colon. Given that the patient had prior surgery and adhesions, we opted to repair the colotomy in 2 layers using a limited midline laparotomy. The shunt tubing was placed into the pleural space on the right site of the abdomen. The patient had an uneventful recovery, with good drainage of CSF, and no abdominal sequelae.

DISCUSSION

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 shunts, using a variety of techniques. Initial reports utilized a 3-trocar technique with good results.[1,2] The use of a peel-away introducer sheath to insert the tubing through the abdominal wall greatly facilitates the procedure.[4] Single trocar techniques have been described with equal success.[7]

The common denominator in the laparoscopic approach is that it benefits the patient in providing a guarantee of the adequacy of the shunt. First, the shunt tubing is confirmed to be located within the peritoneal cavity. Secondly, shunt function is confirmed by visualization of drainage of CSF from the shunt tubing. Last, the overall rate of wound complications is markedly decreased over more traditional incisions.

For the neurosurgeon, confidence in the placement, position, and flow through the catheter is also important. However, they enjoy a freedom from the procedure outside their area of interest and expertise. Further, this interaction in the operating room builds rapport, and increases collegiality across the disciplines. Some neurosurgeons may prefer to place their own shunts; however, we have found that an available and interested general surgery team has been welcomed.

Most importantly, however, there is the perspective of the general surgery resident. Of course, performing any procedure

adds to the overall experience of the residency. However, there is an aspect of training that has been largely overlooked. There are several characteristics of an ideal teaching exercise: safety, standard of care, rapidity, reproducibility/consistency, frequency, applicability to other procedures.

The VP shunt meets each of these criteria as an optimal learning experience.

At our center, the procedure is safe and supervised. It is a well-established, standardized procedure with an excellent track record both in the literature as well as locally. Further, it occurs frequently enough (approximately one per week) to allow residents the opportunity to learn and then practice the procedure multiple times during a given rotation. It is also rapid, typically taking a few minutes of operative time. This does not interfere with scheduling of other operative cases, or provide a substantial drain on resident manpower.

In the case of VP shunts, the access itself is the essence of the procedure, making this case the closest to the optimal training model for peritoneal access. In the example of a laparoscopic colectomy, port placement and access is a necessary but very initial part of the procedure. There is some element of impatience in the access portion, as the bulk of the procedure remains to occur. The focus on the educational aspect of the case lies in dissection or anastomosis rather than access.

Additionally, the skills required for laparoscopic placement of shunts translate well to other minimally invasive procedures. Of course, this naturally includes the laparoscopic management of shunt complications, which has been previously described by us and others.[8,9] However, this procedure serves as a platform for the broader category of peritoneal access, applicable to most every abdominal procedure. Further, this method of access to the peritoneum may be introduced at an early level of training, at the intern or second-year level, such that it is well practiced by the time residents approach the senior years of residency. It is remarkable that this procedure provides for better resident training while improving patient outcomes and safety.

The disadvantages to this procedure are few. The general surgery team needs to be available on a semi-urgent basis, which leads to occasional practical, logistical difficulties. These problems can largely be resolved by having both the neurosurgeons and general surgeons committed to the procedure and the application of minimally invasive techniques. In addition, there is the potential for loss of ownership of the patients, with the potential between 2 services to each ignore critical data inappropriately. At our institution, we have found that both services tend to be more involved, perhaps providing additional layers of thought and concern toward the individual patient. Finally, we did not formally study the resident attitudes or aptitude in performing the shunting procedure. It is our intent to build on this initial experience by correlating this access procedure with tasks in our simulation center in the future.

CONCLUSION

In the current series, we have confirmed that MIS techniques can be applied toward neurosurgical procedures, specifically the placement of ventriculoperitoneal shunting. Although this has been previously demonstrated, the value to resident education has not been emphasized. In the era of increased awareness of patient safety, laparoscopic VP shunting serves as a model for accomplishing both goals of improved outcomes and quality surgical education.

References:

1. Armbruster C, Blauensteiner J, Ammerer HP, Kriwanek S. Laparoscopically assisted implantation of ventriculoperitoneal shunts. *J Laparoendosc Surg.* 1993;3:191-192.

2. Bausuari L, Selman JM, Lizana C. Peritoneal catheter insertion using laparoscopic guidance. *Pediatr Neurosurg.* 1993;19:109-110.

3. Schievink WI, Wharen RE Jr., Reimer R, Pettit PD, Seiler JC, Shine TS. Laparoscopic placement of ventriculoperitoneal shunts: preliminary report. *Mayo Clinic Proceed.* 1993;68:1064-1066.

4. Cuatico W, Vannix D. Laparoscopically guided peritoneal insertion in ventriculoperitoneal shunts. *J Laparoendosc Surg.* 1995;5:309-311.

5. Schubert F, Fijen BP, Krauss JK. Laparoscopically assisted peritoneal shunt insertion in hydrocephalus: a prospective controlled study. *Surg Endosc.* 2005;19:1588-1591.

6. Roth JS, Park AE, Gerwitz R. Minilaparoscopically assisted placement of ventriculoperitoneal shunts. *Surg Endosc.* 2000;14: 461-463.

7. Fanelli RD, Mellinger DN, Crowell RM, Gersin KS. Laparoscopic VP shunt placement: a single trocar technique. *Surg Endosc.* 2000;14:641-643.

8. Kavic SM, Segan RD, Taylor MD, Roth JS. Laparoscopic management of ventriculoperitoneal and lumboperitoneal shunt complications. *JSLS.* 2007;11:14-19.

9. Klee VM, Kraft RO, Zimmerman RS, Harold KL. A laparoscopic technique for retrieval and prevention of migration of ventriculoperitoneal shunt tubing. *JSLS.* 2009;13:101-103.