

Infection

Perioperative management of ventriculoperitoneal shunts during abdominal surgery

Gordon Li, MD^{a,*}, Sanjeev Dutta, MD, MA, FRCSC^b

Departments of ^aNeurosurgery and ^bSurgery, Stanford University Medical Center, Stanford, CA 94305, USA

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Abstract

Background: Patients with ventriculoperitoneal shunts (VPSs) inserted for a variety of disorders may subsequently undergo gastrointestinal or urologic operations, and surgeons must determine the appropriate perioperative management to minimize the risk for shunt malfunction or infection. There is currently no established set of guidelines for this scenario. The objective of this study was to determine the risks and standard of practice for patients with VPSs undergoing abdominal surgery.

Methods: A retrospective review of the charts of patients with VPSs who underwent abdominal or urologic surgery at the Stanford University Medical Center between 1995 and 2003 was performed. Data regarding type of abdominal surgery, level of contamination, choice of antibiotic therapy, perioperative management of the VPS, and outcomes were obtained.

Results: Twenty-six patient charts were reviewed, for a total of 39 operations (5 urologic, 23 upper gastrointestinal, and 11 lower gastrointestinal). Of these, 3 were clean, 34 were clean-contaminated, and 2 were dirty operations. Seven cases were laparoscopic, whereas 32 were open. Thirty-four cases required opening the bowel or urologic system. No patient had preoperative shunt externalization. All except one patient received pre- and postoperative antibiotics, but the duration and type of antibiotics were widely variable. The remaining patient had an inguinal hernia repair and received only one preoperative dose of cephalexin. Purulent fluid was found in 2 cases. One VPS found lying in purulent material next to an anastomotic leak was externalized and subsequently revised. However, in another patient, a VPS found lying next to a purulent jejunal tear was not externalized. This patient returned 2 months later with a VPS malfunction. In the remaining 35 cases, no VPS infection or malfunction was noted over 2 to 10 years of follow-up.

Conclusions: The data suggest that there is minimal risk for VPS malfunction or infection among patients undergoing routine clean and clean-contaminated abdominal and urologic surgeries. Patients with VPSs undergoing these operations do not need externalization of their shunt. None of the patients in this study had a contaminated procedure. For dirty procedures, surgeons should opt to externalize the shunt. Future studies will aim to better standardize the perioperative management of VPSs during abdominal surgery.

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Keywords: Ventriculoperitoneal shunt; Infection; Abdominal surgery

Abbreviations: ICP, intracranial pressure; LGI, lower gastrointestinal; PND, pelvic inflammatory discharges; UGI, upper gastrointestinal; VPS, ventriculoperitoneal shunt.

* Corresponding author. Tel.: +1 650 520 8891; fax: +1 650 725 5577.

E-mail address: gordonli@stanford.edu (G. Li).

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1. Introduction

Ventriculoperitoneal shunts (VPSs) are often the best treatment modality for neurologic disorders such as hydrocephalus, normal pressure hydrocephalus, and pseudotumor cerebri. Although these shunts are widely used, numerous

Table 1

Types of operations performed on patients with VPSs (some patients underwent surgery for more than one location at the same time)

Operative site	No. of operations	Operation
Urologic	5	Kidney transplant, ileal conduit formation, and ureteral reimplantation
UGI	23	Laparoscopic cholecystectomy, small bowel resection, open jejunostomy tube placement, esophagectomy, lysis of adhesions, gastric bypass, pyloroplasty, and herniorrhaphy
LGI	11	Large bowel resection, colostomy, rectal prolapse repair, and enterocele repair

complications have been reported, including obstruction, disconnection, and infection. Untreated shunt malfunction or infection can lead to peritonitis or ventriculitis, septicemia, and uncontrolled hydrocephalus leading to altered mental status and even death.

When a patient with VPS undergoes abdominal or urologic surgery, the operating surgeon must determine the appropriate perioperative shunt management; in addition, neurosurgeons are frequently consulted owing to concerns over shunt infection and malfunction. The risk for infection depends on the type and location of surgery performed, whether there is an active infection or purulent material present, use of antibiotics, and shunt externalization [6,14]. There have been studies of VPSs in patients with appendicitis [3,12], patients undergoing gastrostomy [4,13,15], and patients undergoing laparoscopic surgery [1,7,9,16]. However, no standard current set of guidelines for perioperative management of VPSs exists for patients undergoing general gastrointestinal or urologic procedures with varying degrees of contamination. This 10-year retrospective study looked into patients with VPSs who underwent abdominal and urologic procedures at our institution to determine the risks and standard of practice for this clinical scenario.

2. Patients and methods

Charts of patients with VPSs who underwent abdominal or urologic surgery at the Stanford University Medical Center between 1995 and 2005 were reviewed retrospectively. The following data were obtained: initial diagnosis requiring VPS placement, the type and location of the subsequent abdominal operation performed, the infection risk classification of the procedure, perioperative management to decrease chance of shunt infection (type and

length of antibiotics or shunt externalization), and whether there was a subsequent shunt infection or malfunction requiring shunt revision or externalization. Follow-up ranged from 2 to 10 years and was available for 23 of the 26 patients reviewed.

3. Results

Twenty-six patient charts were reviewed, for a total of 39 operations (Table 1). The median age of the patients was 47 years (range, 2–79 years). Seven procedures were performed with the use of the laparoscopic approach (4 cholecystectomy and 3 gastric bypass surgeries), whereas 32 were open surgeries. Operations included 5 urologic, 23 upper gastrointestinal (UGI), and 11 lower intestinal (LGI) surgeries. Thirty-four cases required opening the bowel or urologic system, whereas 5 did not (all of which were herniorrhaphy). Overall, there were 3 clean, 34 clean-contaminated, and 2 dirty operations (Table 2).

3.1. Perioperative antibiotics

All patients except one received pre- and postoperative antibiotics, but the duration and type of antibiotic were widely variable. Patients in whom the bowel or urologic system was not opened (clean cases) received only one dose of preoperative cephalosporin and no more than 1 day of postoperative cephalosporin.

Antibiotic use in patients who required opening of the bowel or urologic system (clean-contaminated cases) could be broken up into 2 groups. One group of patients required prolonged pre- and postoperative antibiotics regardless of their VPS owing to their underlying disease. For example, there were patients with cholecystitis who received pre- and postoperative metronidazole and cefepime, whereas there were other patients who developed postoperative pneumonia and received piperacillin/tazobactam for treatment. These patients were treated with antibiotics appropriate for their disease process regardless of having a VPS. The other group of patients did not require a prolonged antibiotic regimen secondary to a concomitant infectious process.

Clean-contaminated cases without concomitant infection were treated in 1 of 2 ways. Some patients received one dose of preoperative antibiotics with gastrointestinal coverage, such as cefepime and metronidazole, followed by 3 days of the same postoperative antibiotics. Others were given one dose of preoperative antibiotics and only 24 hours of postoperative antibiotics, similar to the case of patients in whom the bowel or urologic system was not opened. Most of

Table 2

Cases classified by location as well as level of contamination and outcome of shunt

Case	LGI	UGI	Urologic	Combined	Shunt infection or malfunction	Shunt externalized
Clean	0	2	0	1	0	0
Clean-contaminated	7	18	1	8	0	0
Dirty	2	0	0	0	1	1

these patients received preoperative cephalosporin, such as cephalexin and cefepime, or preoperative vancomycin if they were allergic to penicillin or cephalosporin. Postoperative antibiotic choice was widely variable, ranging from cephalexin for 1 day for a simple herniorrhaphy to postoperative piperacillin/tazobactam, metronidazole, and vancomycin for weeks after a complicated bowel case that required a prolonged intensive care stay. No patient with a clean-contaminated case had preoperative externalization. One patient had a simple herniorrhaphy and received only one preoperative dose of cephalexin.

3.2. Shunt externalization

Two patients had their shunts externalized. In one case (laparoscopic gastric bypass for morbid obesity), the patient returned 2 weeks later with a jejunojejunal anastomotic leak. The VPS, which was placed for pseudotumor cerebri, was lying in purulent material and required externalization with shunt revision after 3 weeks of intravenous vancomycin and ciprofloxacin. The patient ultimately did well and has had no further complication from the VPS. In another patient, the VPS was lying next to purulent material from an iatrogenic jejunal tear that was primarily repaired. The shunt was not externalized, and the patient presented 2 months later with a VPS malfunction requiring revision.

3.3. Follow-up

Long-term follow-up ranging from 2 to 10 years was available via a computer charting system in 20 of the 26 patients. Of these 20 patients, 8 had a recent follow-up with the neurosurgery department documenting no VPS-related complication. As described, 2 patients required externalization of their shunt for reasons related to their abdominal process. Three patients had subsequent medical attention secondary to VPS malfunction but unrelated to their abdominal surgery. One of these 3 patients is a developmentally delayed child with small ventricles but intermittent irritability. He has been admitted to the neurosurgical service on more than one occasion for workup of possible VPS malfunction that had been ruled out. One patient had a VPS for pseudotumor cerebri and developed low-pressure headaches more than 2 years after her gastric bypass. The shunt was removed in this patient because she was overdraining from her VPS. The last of the 3 patients had a VPS malfunction 19 months postoperatively from colon resection and required revision.

Two patients died soon after their procedures for reasons unrelated to the VPS. One patient with widely metastatic ovarian cancer died of multiorgan system failure, and a second patient with a ruptured intracranial aneurysm died of bleeding complications. Five patients have since died from other medical causes but did not have shunt-related complications before their death.

Of the remaining 6 patients who had no computer-charted follow-up, 3 were contacted by telephone: all reported no

VPS malfunction since their abdominal surgery, and 3 were entirely lost to follow-up.

4. Discussion

Although there is literature regarding the complications of VPSs [6,14] and those of VPSs after abdominal or urologic surgery [2,10–12], there are still no recent guidelines for perioperative management of VPSs in patients undergoing abdominal or urologic surgery with varying degrees of contamination.

Much of the literature on patients with VPSs undergoing gastrostomy tube placement shows that there is minimal risk for VPS complications. Gassas et al [4] described a possible small increase in the risk for ascending meningitis in pediatric patients with brain tumors and VPSs requiring gastrostomy tube placement, especially if there are immediate (<6 weeks) postoperative complications of the gastrostomy tube. The largest series of this patient population studied by Roeder et al [13] demonstrated no increase in shunt infection or decreased survival in children.

This study is the only review of patients with VPSs undergoing all types of gastrointestinal and urologic procedures. The data from the current study suggest that there is minimal risk for VPS malfunction or infection among patients undergoing routine abdominal and urologic surgeries, even for clean-contaminated cases. Externalization of the shunt in these patients is not necessary. All but one of the patients in this study received pre- and postoperative antibiotics; therefore, we cannot determine the utility of perioperative antibiotics in the management of these patients. However, there does not seem to be a difference in rates of shunt malfunction or infection between urologic surgery and abdominal surgery, UGI surgery and LGI surgery, as well as surgeries that required opening of the urologic system and those that did opening of the gastrointestinal system. Only if there is purulent material in the surgical field (ie, a dirty procedure) should externalization be performed. Failing to do so may risk subsequent shunt infection or malfunction.

Recent literature on patients with VPSs who present with appendicitis support the current work. In 1998, Pumberger et al [12] evaluated 6 children treated at the University of Vienna between 1987 and 1995. Three of the patients had an unruptured appendix and were treated with appendectomy and antibiotics. These patients did not develop any complication. Of the 3 patients with a ruptured appendix, 1 was treated with antibiotics, appendectomy, and externalization with future revision to a ventriculoatrial shunt. Two of the patients with a ruptured appendix received antibiotics with appendectomy but no externalization. One of these 2 patients subsequently developed VPS infection and malfunction requiring VPS revision. Ein et al [3] performed a 30-year retrospective review at the Hospital for Sick Children in Toronto reviewing 8 children with VPSs who underwent appendectomy. Three of the 8 patients had a ruptured appendix. The surgeons externalized the shunts in each of

these cases with future revision. The 5 patients with an unruptured appendix who did not have externalization of their shunt experienced no shunt complication.

In this retrospective study, the administration of antibiotics was highly variable, and often the indication for antibiotics was as much to treat the underlying condition as to prevent shunt malfunction. In general, however, prolonged antibiotic treatment in a patient with a VPS undergoing clean or clean-contaminated surgery without a serious concomitant infectious process seems unwarranted for the prevention of VPS infection or malfunction. Unfortunately, only one patient in this group did not receive pre- and postoperative antibiotics; therefore, we cannot make any conclusion regarding whether perioperative antibiotics help decrease the rate of shunt infections as compared with no antibiotic treatment. Gossner et al [5] performed a study that suggests a decreased shunt infection rate with prophylactic antibiotics during percutaneous gastrostomy tube placement. Further studies comparing groups of patients who have received antibiotics with those who have not are necessary.

In the recent age of laparoscopic surgery, there has been debate over whether laparoscopy is safe in the treatment of patients with VPSs. Uzzo et al [16] monitored intracranial pressure (ICP) intraoperatively during laparoscopic bladder augmentation and noted rapid onset and sustained increases in the ICP of greater than 12 mm Hg above baseline to a maximum of 25 mm Hg. They removed cerebrospinal fluid in these patients to lower the ICP and noted no neurologic sequela. The ICP is hypothesized to increase secondary to pneumoperitoneum. Increased intra-abdominal and intrathoracic pressures from pneumoperitoneum cause venous outflow obstruction and increase resistance to outflow through the distal peritoneal catheter leading to partial or complete shunt obstruction. Miele et al [8] described the cases of 3 patients who presented with VPS dysfunction secondary to increased intra-abdominal pressures from ileus and small bowel obstruction. However, Neale and Falk [9] performed *in vitro* studies showing no retrograde failure of the valve system in VPSs with increased back pressure. Moreover, there have been many studies evaluating patients with VPSs undergoing laparoscopic surgery with no shunt complication [1,7]. There was no laparoscopy- or pneumoperitoneum-related complication in the 7 patients who underwent laparoscopic procedures in our study.

In summary, clean and clean-contaminated abdominal surgeries performed on patients with VPSs do not require externalization of the shunt. For patients without other concomitant infections, there was no difference between one preoperative dose followed by 24 hours of postoperative antibiotic therapy for clean and clean-contaminated cases and prolonged antibiotic therapy. For dirty cases, shunt externalization with prolonged antibiotic therapy is recommended. There does not seem to be a difference in rates of shunt malfunction or infection between urologic surgery and abdominal surgery, UGI surgery and LGI surgery, as well as surgeries that required opening of the urologic system and

those that did opening of the gastrointestinal system. Laparoscopic surgery does not seem to increase the rate of shunt malfunction. Large prospective studies will be necessary to delineate the role of perioperative antibiotics in preventing future shunt malfunction.

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Commentary

There is no consensus as to how to manage a VPS in a patient undergoing elective or emergent abdominal surgery.