Gastrointestinal Cancer Surgery in Patients With a Prior Ventriculoperitoneal Shunt: The Department of Veterans Affairs Experience

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ABSTRACT

BACKGROUND: The estimated prevalence of hydrocephalus in all age groups is between 1% and 1.5%. Placement of a ventriculoperitoneal (VP) shunt in such patients offers them relatively normal lives. There are minimal data concerning the risk of postoperative complications in patients with shunts who undergo subsequent major visceral operations. We hypothesized that healthy adults who had VP shunts placed for acquired conditions and later underwent surgery for gastric or colon cancer would frequently have dense, shunt-related adhesions and high rates of adverse outcomes, particularly infection.

METHODS: We assumed that all veterans were healthy on entry into military service. We searched national Department of Veterans Affairs databases from October 1994 through September 2003 to identify all Department of Veterans Affairs patients with shunts for acquired conditions and a curative-intent operation for stomach or colon cancer. We conducted chart reviews to determine their clinical courses.

RESULTS: Five patients had codes for VP shunt, gastric cancer, and gastrectomy; 3 met our inclusion criteria. Fourteen had codes for VP shunt, colon cancer, and colectomy; 4 met our criteria. One of the evaluable gastrectomy patients had dense, shunt-related adhesions. None of the colectomy patients had notable adhesions. There were no postoperative complications in any of the seven patients.

CONCLUSION: We believe this is the first report analyzing the clinical course of adults with VP shunts who later had major abdominal cancer surgery. The presence of a shunt was associated with dense adhesions in 1 (14%) of the 7 patients in this series, but not with an increased risk of postoperative complications.

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Hydrocephalus is a congenital or acquired condition in which cerebrospinal fluid accumulates in the ventricles and subarachnoid space around the brain. It is typically accompanied by an increase in the intracranial pressure and enlargement of the ventricles. The elevated intracranial pressure can damage brain tissue, producing headache, nausea, vomiting, gross motor disturbances, and cognitive impairment. The estimated prevalence of hydrocephalus is 1% to 1.5% in all age groups.[1]

Before the 20th century, the treatment of hydrocephalus ranged from bleeding, purging, injection of astringents, head wrapping, and application of potions to the head to more sophisticated treatments, such as insertion of ventricular setons or cannulas and lumbar punctures.[2] Most of the invasive procedures resulted in disastrous outcomes, mainly due to infection. In order to decrease the risk of infection, attention then focused on surgical interventions leading to internal drainage of the cerebrospinal fluid. In 1905, Kausch introduced ventriculoperitoneal (VP) shunting as primary treatment for hydrocephalus.[3] This method, which uses the peritoneal cavity for absorption of cerebrospinal fluid, has since become standard therapy. The catheter is introduced into a lateral ventricle through a burr hole. The tubing has an adjacent subcutaneous reservoir. There is generally a unidirectional valve designed to prevent reflux of intra-abdominal fluids into the cerebrospinal fluid.[4] The tubing is tun-

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neled subcutaneously with its distal end lying free in the peritoneal cavity. A variety of materials such as silicone, titanium, synthetic ruby, barium sulfate, stainless steel, and various plastics are used in the construction of shunts.[2] Innovations in shunt technology have revolutionized the care of patients with hydrocephalus.

According to 1988 National Hospital Discharge Survey data, the number of shunts placed in the United States is 18,000/year, costing more than $100 million. There are more than 127,000 patients with cerebrospinal fluid shunts in the United States, of which most are VP shunts.[5] This statistic indicates their therapeutic value in treating hydrocephalus.

Shunts have allowed patients with hydrocephalus to have near-normal life expectancies. Consequently, such patients would be expected to undergo abdominal operations for various conditions at the same rate as individuals without shunts. Operations for various abdominal cancers in adult patients with VP shunts have the potential to cause local and/or ascending infection of the shunt, with grave consequences.

To date, there have been few investigations of complications occurring in patients with cerebrospinal fluid shunts after abdominal operations. Children have been the primary focus of these studies, with 0% to 31%[6–10] developing a VP shunt infection after augmentation cystoplasty. Infections are among the most devastating complications, as they are linked with shunt malfunction, meningitis, seizures, future shunt infection, reduced IQ, and poor school performance.[11–13]

Pittman et al[14] addressed the risk of abdominal operations in children with shunts and concluded that the risk of infection and shunt malfunction was low. The risk was reported to be small, irrespective of prophylactic antibiotic regimen or the procedure performed. None of the patients in his case series of 37 patients developed a documented shunt infection within 1 year of the abdominal procedure. Since most of the patients who need a VP shunt are children, most of the research assessing the risks associated with subsequent major abdominal surgery has been limited to this age group. Life-threatening complications may be encountered in patients with shunts, such as penetration of the shunt into the bowel.[15–18] The lifetime incidence of this event is estimated to be 0.1% to 0.7%.[15] To our knowledge, there has been no study in the English language literature addressing the risk of complications in adults with VP shunts who undergo major surgery for gastric or colon cancer.

Worldwide, gastric cancer is the second most common cause of cancer deaths.[19] Current American Cancer Society data indicate that >20,000 new cases and >10,000 deaths occur annually in the United States from gastric cancer. The incidence of colorectal cancer in the United States is >145,000/year, and the annual death rate is about 50,000.[20]

We hypothesized that the presence of a VP shunt in patients undergoing gastrointestinal surgery would result in increased incidence of bowel penetration and local infection around the intraperitoneal portion of the shunt and also alongside the shunt or through the lumen, leading to meningitis. We also assumed that many patients with shunts would have adhesions sufficiently dense that the cancer surgery would be more difficult than in subjects without shunts. We reviewed the records of adult patients with VP shunts who underwent either gastrectomy or colectomy as curative-intent treatment for cancer and characterized their clinical outcomes. We attempted to identify preoperative, perioperative, and postoperative measures taken by the surgeon to prevent infection and other adverse outcomes.

METHODS

Department of Veterans Affairs Institutional Review Board approval was obtained for this research. A nationwide search of Department of Veterans Affairs databases was conducted to identify all veterans with a VP shunt who later underwent gastrectomy for gastric cancer or colectomy for colon cancer during fiscal years 1994 to 2003 (October 1, 1993–September 30, 2003) at any Department of Veterans Affairs Medical Center. The Patient Treatment File, a centralized database of all Department of Veterans Affairs Medical Center discharges, was used to access data on all patients undergoing VP shunts for fiscal years 1989 to 2003 and gastrectomy or colectomy for fiscal years 1994 to 2003. The International Classification of Diseases, Ninth Revision, Clinical Modification (ICD-9-CM)[21] codes used to identify patients were 02.34 (VP shunt procedure), V45.2 (history of a VP shunt diagnosis), 151.0–151.99 (gastric cancer diagnosis), and 153–153.99 (colon cancer diagnosis). Only those patients who subsequently underwent curative-intent gastrectomy (ICD-9-CM codes 43.5–43.99) or colectomy (ICD-9-CM codes 45.7–45.899) were considered eligible for the study. Inclusion in the study required that a VP shunt be in place at the time the patient underwent curative-intent surgery for gastric or colon cancer.

The two primary sources of mortality data were the Beneficiary Identification and Records Location System, which is the primary mortality information source in the Department of Veterans Affairs, and the Patient Treatment File, which documents deaths of inpatients in Veterans Affairs Medical Centers. Patients with no death record in either system were presumed to be alive.

Charts, including operative notes, pathology reports, medical oncology reports, and discharge summaries were next requested from each Department of Veterans Affairs Medical Center where an identified patient underwent cancer surgery. Data on patient demographics, preoperative tests, surgical procedures performed, information concerning shunt management during surgery, clinicopathological features of tumors, and postoperative course in the hospital were extracted from each patient's medical charts. Patients were excluded from the study if the shunt had been placed subsequent to the cancer surgery, the cancer surgery had been performed outside the fiscal years 1994 to 2003, the cancer surgery had been performed for palliative purposes, or the cancer was a recurrence from another primary site. Operative notes were carefully scrutinized to determine if there were any technical difficulties, particularly adhesions, faced during surgery that could be attributed to the presence of the shunt. If the operative note mentioned adhesions, we interpreted it to mean that they were extensive enough to interfere with the surgery. If there was no mention of the adhesions in the operative note, we assumed that none were present or, if present, that they did not pose a problem during surgery.

Table 1. Our patient population

	Gastric cancer ($n = 3$)	Colon cancer ($n = 4$)
Mean age, years	68	77
Sex	All male	All male
Race	1 Hispanic, 1 Caucasian, 1 African-American	3 Caucasians
Comorbid conditions	Hypertension, CKD, ASCVD, DM, prostate cancer, UTI, COPD, hypothyroidism, dementia	Hypertension, CKD, ASCVD, DM, prostate cancer

Abbreviations: COPD = chronic obstructive lung disease; CKD = chronic kidney disease; ASCVD = atherosclerotic cardiovascular disease; DM = diabetes mellitus; UTI = urinary tract infection.

RESULTS

During the fiscal years 1993 to 2003, there were 2,213 patients identified from the Patient Treatment File with ICD-9-CM codes for gastric cancer and subsequent gastrectomy and 16,514 unique patients with codes for colorectal cancer who underwent subsequent colectomy. A total of 4219 unique inpatients and 795 unique outpatients were identified with codes for VP shunt or a history of VP shunt during the fiscal years 1989 to 2003. Merging the three files showed 5 patients treated in the Department of Veterans Affairs system with ICD-9-CM codes for VP shunt, gastric cancer, and gastrectomy. There were 14 patients identified with codes for VP shunt, colon cancer, and colectomy. We excluded subjects who had been miscoded (for example, no diagnosis of colon or stomach cancer), those who did not have surgery with curative intent (for example, resection of the colon cancer in the presence of unresectable liver metastases), those who did not have a VP shunt at the time of the cancer surgery, and those who had surgery, but not within the defined period.

Chart review revealed that 2 gastrectomy patients were incorrectly coded, leaving 3 patients evaluable. All were males, including 1 with a gastrointestinal stromal tumor, 1 with adenocarcinoma of the stomach and 1 with adenocarcinoma of the esophagogastric junction (Table 1).

Nine of the 14 colectomy patients were not evaluable for our study because they did not have a VP shunt in place at the time of the colectomy, because the cancer was a recurrence, because the tumor was benign, or because the colectomy was a palliative procedure. One patient was excluded because his medical records were unavailable for review, leaving 4 evaluable patients. All were males with a mean age of 77 years. All had adenocarcinomas (Table 1).

Reasons for placement of the shunt in the colon cancer patients were normal-pressure hydrocephalus and dementia in 3 and obstructive hydrocephalus in 1. One gastric cancer patient had obstructive hydrocephalus due to a posterior fossa epidermal cyst; another had a brain stem glioma; and the third had dementia and normal-pressure hydrocephalus. The mean length of hospitalization was 27 days for the gastrectomy patients and 16 days for the colectomy patients.

The operative note of one gastrectomy patient described multiple clinically significant adhesions apparently related to the VP shunt. The taking of special precautions to isolate the VP shunt from the surgical field was not mentioned in the operative note for any gastrectomy patient. There was no mention of abdominal adhesions in any patient undergoing colectomy, but precautions (wrapping the shunt in a sponge and placing the shunt in left lower quadrant to isolate it from surgical field) were mentioned in the records of 2 who underwent colectomy. The operative blood loss documented was 100 to 300 mL for all patients except 1. The intraoperative blood loss for 1 gastrectomy patient was 1500 mL due to an iatrogenic injury to his otherwise normal spleen, which was removed to achieve adequate hemostasis; this patient did not have adhesions.

All patients in our study had an uncomplicated postoperative course. None of the patients had mechanical VP shunt problems, mental status deterioration, intra-abdominal infection, or meningitis. There was no mention of tests to measure postoperative VP shunt function. All surgeons apparently assumed shunt function was intact if there were no mental status changes, headaches, or nausea. These symptoms did not occur in any patient. The 30-day morbidity and mortality rates for this study were both 0%.

DISCUSSION

There are recent reports documenting the safety of surgery for appendicitis and gallbladder disease in patients with prior VP shunts.[22,23] We believe this is the first report describing adult patients with VP shunts who later received curative-intent surgery for gastrointestinal cancers. The scanty available literature on pediatric patients with shunts mentions instances of important complications such as cerebrospinal fluid pseudocysts that may render intra-abdominal surgery difficult, but we found none in our study. The population we reviewed differs in important ways from those in prior reports. All patients in Department of Veterans Affairs Medical Center data sets had been judged to be healthy before their entry into military service. Preexisting hydrocephalus, dementia, and/or shunt would have excluded candidates from entering the service, according to military criteria. Thus, the indications for shunt placement in this series included only acquired conditions and not the congenital conditions that comprise most subjects in pediatric series. This report relied on information derived from chart reviews. To be conservative, we excluded patients whose medical records gave no indication that they had a VP shunt in place at the time of their cancer surgeries, even if they had a code for a history of VP shunt in the computerized record. The Department of Veterans Affairs Medical Center system provides a population-based, rather than a referral-based, sample drawn from about 25 million eligible veterans, of whom about 5 million sought care at Department of

Veterans Affairs Medical Center each year during the study period. The population in the system is predominantly male, and the subjects in our study were all male. However, in the absence of other reports on this topic, we feel it is reasonable to generalize the conclusions of this report to females with VP shunts placed in adult life for acquired conditions and who undergo curative-intent surgery for gastric or colon cancer. As is typical of record-based studies, it is possible that some of the information was not appropriately cited in the hospital records. This possibility is a limitation of our study. Also, for some patients there was no mention of how shunts were managed during surgery, which presumably could affect the complication rate. Although our study includes a small number of patients, it represents the entire population of patients in the Department of Veterans Affairs Medical Center database nationwide who underwent gastrectomy or colectomy as curative-intent treatment for gastric or colon cancer subsequent to the placement of a shunt. The U.S. Food and Drug Administration maintains registries of patients with implanted medical devices. These could be useful for future research on this topic.

These results were consistent with a previous report by Collure et al,[4] who described the clinical course of four adult patients who underwent laparoscopic cholecystectomy. Two of the patients in the study were treated in the Department of Veterans Affairs healthcare system, and all four had characteristics (age, sex, comorbidities) similar to the patients in our study. One of the laparoscopic operations was converted to an open procedure because of extensive inflammation. None of the patients in that report suffered infectious complications after their operations, and the authors suggested that a normal postoperative course can be expected for adult patients with VP shunts who undergo abdominal procedures.

Menzies and Ellis[24] reported that the rate of intra-abdominal adhesions in patients undergoing first-time laparotomy is approximately 10%, as compared with 93% in patients who have had one or more previous intra-abdominal operations. Only 1 (14%) of the 7 patients in our series was found to have extensive adhesions. The operative note indicated that the adhesions appeared to be due to the presence of the shunt. This rate of adhesions in our series was comparable to that found by Menzies and Ellis.

It is noteworthy that the patient with dense, shunt-related adhesions in our series had had two reoperations for shunt malfunction. We did not find data about either episode of shunt revision. Modern shunts do not often require revision. Revision may involve only the intracranial segment of the shunt, which may become clogged with debris. Another common problem is malfunction of the one-way valve. The intra-abdominal portion of the shunt occasionally becomes the focus of a pseudocyst, which impedes the flow of cerebrospinal fluid. The etiology of such pseudocysts is not clear, but infection by an unculturable organism of low virulence has been implicated.

In conclusion, this review of a large database indicates that presence of a VP shunt does not pose an increased risk of postoperative complications in patients undergoing gastrectomy or colectomy. However, it seems reasonable to take precautions to minimize the risk of infection. According to the Centers for Disease Control and Prevention, concurrent infection elsewhere in the body at the time of an operation increases the risk of postoperative infection, and it should be eradicated before elective surgery, if possible.[25] If overt shunt infection is suspected before surgery, management options include removal or externalization. Some surgeons contemplating gastrectomy or colectomy have converted an existing VP shunt to a ventriculoatrial shunt. Taylor et al[26] recommend that a new VP shunt not be placed during abdominal surgery, based on a retrospective analysis of percutaneous endoscopic gastrostomy in patients receiving a simultaneous VP shunt. Sarguna and Lakshmi[27] evaluated the antibiotic sensitivity pattern of the most common cerebrospinal fluid pathogens and recommended prophylactic use of third-generation cephalosporins or quinolones to prevent or treat VP shunt infection. Intraoperative isolation of the shunt away from the operative field is a simple step surgeons can take to prevent contamination of the shunt. Finally, we recommend teaching patients about the signs and symptoms (eg, headache, photophobia) of diminished shunt function, which is sometimes seen with postoperative shunt infection. Burns and Dippe[28] reported that 53% of postoperative surgical site infections are identified after a patient is discharged from the hospital. If patients are able to recognize the symptoms of diminished shunt function in its early stages, timely treatment can prevent serious complications.

We hope the current report stimulates others to search other large data sets to expand the evidence base. The number of adults with VP shunts is expected to rise as a result of injuries sustained in current combat situations, and some of them will predictably undergo gastrointestinal surgery for gastric or colon cancer.

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Disclosures of Potential Conflicts of Interest

The authors indicated no potential conflicts of interest.