Continuous Postoperative Lavage in the Treatment of Peritoneal Sepsis*

WILLIAM C. JENNINGS, M.D., C. DOUGLAS WOOD, M.D.,
JAMES M. GUERNSEY, M.D.

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The problem of peritonitis after perforation or trauma to the colon continues to be an important one for colon and rectal surgeons. Treatments vary, but mortality and morbidity have always been high. For these reasons, the usefulness of continuous peritoneal lavage as adjuvant therapy in the treatment of peritonitis was examined. Twenty patients with gross peritoneal contamination were treated with continuous postoperative peritoneal irrigation for 17 to 72 hours. No patient died of sepsis or developed an intra-abdominal abscess. Three patients died: two of advanced cancer and one of a pulmonary embolus. Three additional patients developed complications: mild congestive heart failure in two and transient respiratory failure in one. [Key words: Irrigation, peritoneal; Sepsis, surgical; Peritonitis; Abscess, intra-abdominal]

From the Departments of Surgery, University of Oklahoma, Tulsa Medical College, and the Veterans Administration Medical Center Muskogee, Oklahoma

THE PROBLEMS OF sepsis and abscess formation after gross contamination of the peritoneal cavity have long been familiar to most surgeons.[1–3] In particular, peritonitis following perforation of the colon has traditionally been associated with significant mortality and morbidity.[3] Although not all deaths in this group result directly from sepsis, it is a major contributor. Numerous studies have addressed the problems of continuing intraperitoneal sepsis, and various procedures have been advocated from time to time as solutions.[4–6] These include simple drainage, irrigation with and without antibiotics, mechanical débridement, as well as a number of more innovative techniques, such as radical peritoneal débridement.[7] In spite of much attention, no method has been found entirely satisfactory.

While some form of intraoperative peritoneal irrigation is now universally accepted, the impossibility of adequately draining the peritoneal cavity and the controversy surrounding mechanical peritoneal débridement render decision-making at the clinical level difficult. From time to time, suggestions have been made that a continuous hydraulic débridement of the contaminated peritoneum might be of value.[8]

This study examines the value of continuous postoperative irrigation in the prevention of septic complications after gross peritoneal contamination.

Materials and Methods

Twenty patients were considered to be candidates for continuous postoperative peritoneal lavage. All were seriously ill and suffered from either (1) gross contamination, diffusely involving the abdominal cavity with an infectious process, or (2) progressive, life-threatening pancreatitis with diffuse peritoneal involvement. Table 1 lists the disease processes involved. All patients were in imminent danger of developing overwhelming sepsis.

The technique of irrigation is relatively simple. Prior to closing the abdomen, two peritoneal dialysis catheters* are placed in the most dependent portion of the abdomen through separate stab wounds and secured in place. The exit wounds should be watertight. Irrigation is started immediately in the intensive care unit. Ringers' lactate is used as the irrigant. In a 154 pound man, this would consist of infusing 1 liter of Ringers' lactate through each of the two catheters entering the abdomen over approximately 20 minutes. At the end of this time, the containers are dropped to a dependent position to allow drainage over the next 40 minutes of the one-hour cycle. This sequence is repeated hourly until macroscopic clearing occurs, usually within 17 to 72 hours. This treatment is given in the intensive care unit, and serum

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Address correspondence and reprint requests to Dr. Wood: Department of Surgery, University of Oklahoma, Tulsa Medical College, 2808 South Sheridan, Tulsa, Oklahoma 74129.

* Tenckhoff.

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TABLE 1. *Disease Processes Treated by Postoperative Peritoneal Lavage*

Ruptured diverticular abscess	4
Ruptured tubo-ovarian abscess	2
Ruptured appendix	8
Late perforated duodenal ulcer	3
Pancreatitis	1
Perforated gastric ulcer	1
Necrotic small bowel secondary to mechanical obstruction	1

electrolytes and fluid balance are monitored closely. Respiratory function is also closely followed, and smaller patients have proportionately less fluid infused, thus avoiding impairment of diaphragmatic action.

Results

Of the 20 patients studied, none developed refractory sepsis or intra-abdominal abscess (follow-up four to 24 months). There were two late deaths from abdominal carcinoma and one early death from a pulmonary embolus (Table 2).

There were several complications related to lavage, each of which responded to appropriate therapy. Two of these complications were mild congestive heart failure, and one involved an episode of respiratory insufficiency in a patient whose abdomen became distended with irrigating fluid.

Thus, while overall mortality in this group of critically ill patients was 15 per cent, septic complications were nil, and no death was caused by sepsis.

Several case reports demonstrate the application of this treatment.

Report of Cases

Patient 1: A 60-year-old black women was brought from a nursing home in a semicomatose condition. Her history included congestive heart failure and diabetes. She was found to have a perforated sigmoid diverticulum with disseminated pus throughout the abdomen. Resection of the involved colon and colostomy with a Hartmann pouch were performed. Lavage was continued for 33 hours postoperatively, and she remained afebrile throughout her hospital course. Recovery was uneventful.

Patient 2: A 52-year-old white woman had increasing abdominal pain for three days. She presented with an "acute abdomen." She had had a myocardial infarction seven years before with intermittent congestive heart failure. She also had significant chronic obstructive pulmonary disease. She was found to have a ruptured appendix with multiple intraloop abscesses and free pus. Postoperative lavage was continued for 37 hours. Borderline chronic heart failure was controlled with Digoxin® and diuretics. She was discharged on the tenth postoperative day.

Patient 3: An 80-year-old black woman, reportedly acutely ill for three days, was brought to the emergency room. She would respond only to deep pain and was hypotensive. Her abdomen was rigid and distended. After resuscitation, celiotomy revealed a perforated peptic ulcer with purulent material throughout the abdomen. A gram stain showed multiple organisms. After closure of the perforation, intraoperative lavage was carried out, and catheters were placed in the pouch of Douglas and right colonic gutter. Macroscopic clearing of the irrigant required 24 hours. The patient had an uneventful recovery and remained afebrile throughout her hospital course.

Patient 4: A 20-year-old white woman was admitted with pancreatitis. Despite nasogastric suction and hyperalimentation, she continued a progressive downhill course. On the 13th hospital day, with a diagnosis of hemorrhagic pancreatitis, she underwent a cholecystostomy, gastrostomy, and jejunostomy. Twenty hours of postoperative lavage were required for macroscopic clearing. Jejunostomy feedings were started on the fifth day, and a slow, uneventful recovery followed.

Discussion

Irrigation of the peritoneal cavity in a grossly contaminated situation has become a widely accepted concept. This practice was initially described in 1905 by Price[9] and shortly thereafter by Torek,[1] but it was not until 1957, with Burnett and collaborators'[4] publication of their experimental work on guinea pigs, that the use of abdominal lavage became widespread. Artz *et al.*,[10] in 1962, published data showing markedly improved survival rates of laboratory animals, if irrigation was used after standard fecal contamination of the abdomen. Since that time, numerous animal studies have been published showing a significant benefit with use of abdominal lavage. The primary objection to irrigation of the abdomen, whether intraoperative or postoperative, is that of disseminating otherwise localized areas of contamination. However, a study by Hovnanian and Saddawi[11] in 1972, utilizing dog models, showed no difference in mortality with localized versus diffuse contaminant.

Many surgeons who utilize irrigation techniques add antibiotics to the solutions. Keflin® and kanamycin are two which have gained wide popularity. This is not a new idea: in 1934, Behan[12] utilized a 70 per cent ethanol irrigant solution. Pickard[13] and many other investigators in the United Kingdom have used the

TABLE 2. *Morbidity and Mortality in Patients Treated with Peritoneal Lavage*

Patients	Deaths	Septic Deaths	Septic Complications	Other Complications
20	3 (15 per cent)	0 (0 per cent)	0 (0 per cent)	3 (15 per cent)

antibacterial agent noxythiolin, which decomposes into formaldehyde. Noon *et al.*[14] and others feel that a definite decrease in the instance of wound infection has been shown with antibiotic irrigation, but it has not been well demonstrated in man that a decreased instance of intraabdominal abscess or serious sepsis can be achieved by the addition of antibiotics to abdominal irrigants. This suggests that irrigation is the important factor. Interesting experimental work continues in the use of anticoagulants and chemotactic agents in peritonitis, but precise clinical applications are still being determined.[15,16]

If one concludes that irrigation of the abdomen does act to dilute the contaminated materials and débride the peritoneal cavity, then the logical extension of this technique would be to continue the irrigation postoperatively. The peritoneal cavity can eliminate up to 10^5 organisms per gram of wet tissue. Residual foreign matter decreases this ability to 10^2 organisms per gram of wet tissue. Thorough débridement, therefore, is a critical factor in prevention of peritoneal sepsis. This can be accomplished by continuous peritoneal lavage. While several case reports of postoperative irrigation have been in the literature for years, Aune and Normann,[17] from Norway, were among the first to publish a significant series using continuous peritoneal lavage postoperatively. They described 38 patients and reported two deaths due to continued fecal soiling. No intra-abdominal abscesses were recorded in the survivors.

A number of more recent studies by McKenna *et al.*[8] Hunt,[18] and others have tended to confirm the benefit of continuous postoperative peritoneal lavage in cases of generalized peritoneal contamination. While exact protocols have varied, mortality and morbidity rates were generally improved, and the incidence of intra-abdominal abscess was reduced over groups not using continuous irrigation.

In the current study, the incidence of septic complications was reduced to nil with continuous postoperative irrigation, although those complications unrelated directly to sepsis persisted. The methods used, while simple, require vigilance to prevent the sequela of fluid overload. Particular attention must be paid to the drainage phase of the cycle since large volumes of residual fluid not only serve to increase cardiorespiratory complications but almost certainly compromise the physiologic intraperitoneal defense mechanisms, as indicated by Ahrenholz and Simmons.[19]

It is our conclusion that, when serious peritoneal contamination has occurred, significant benefit will be realized from using continuous postoperative irrigation and that this benefit outweighs the slightly increased effort involved.

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