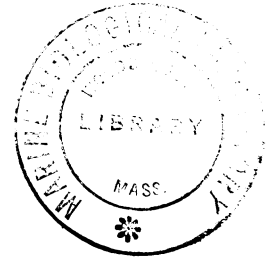


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Management of Acute Stress Ulcer after Cardiac Surgery

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ACUTE STRESS ULCERATION of the stomach and duodenum is being reported with increasing frequency after severe injuries, major burns, prolonged hypotension, during episodes of sepsis, while on steroid therapy, and after surgical procedures on the brain, major arteries and the heart. Frequently, massive hemorrhage from single or multiple stress ulcers occurs in patients who are in the early recovery period after major surgical procedures or who have been weakened by complications such as sepsis, cardiorespiratory insufficiency, renal failure, or cerebrovascular accident. The resultant mortality and morbidity from an additional surgical procedure in patients with stress ulcers have been high, ranging from 40% to 60% or higher in many reported series.^{1-3,6,7} At present there is no standard or uniformly effective approach to this serious complication, partly because the underlying pathophysiology has not been clearly defined.

At the Cleveland Clinic, we have had a large experience with stress ulceration which occurred after cardiac surgery. We believe early surgical intervention is indicated in cases of hemorrhage unresponsive to intensive medical therapy. Since the stress-provoking situation may be only temporary, and because these patients often have a weakened physiologic reserve, we believe that conservative operations, whenever possible, may be the definitive surgical treatment.

Clinical Material

From 1964 through 1970 more than 5000 cardiac surgical procedures were performed at the Cleveland

Clinic Hospital. This particular group of patients was selected for study because they represent an homogeneous type of stress and were subject to common stress factors during the early recovery period. Acute stress ulceration of the stomach or duodenum developed in 38 patients during the early postoperative period; 26 required emergency surgical intervention, and 12 patients were given intensive medical treatment only. Patients who had a history of peptic ulcer disease were not excluded from this study. The patients were from 14 to 65 years old (average 53 years). There were 29 men and 9 women (Table 1).

Previous Ulcer History. Twelve of the 38 patients had a definite history of previous peptic ulcer disease. In most patients, however, the symptoms had subsided years before cardiac surgery. Table 1 summarizes the above data with the 38 patients classified into medical and surgical groups.

Cardiac Diagnosis and Operation. In 28 patients (73.6%) myocardial revascularization procedures for coronary artery disease were performed. Nine patients (23.6%) had open-heart surgery for valvular disease, and one patient underwent correction for tetralogy of Fallot. Twenty-two (57.9%) of the cardiac procedures required extracorporeal circulation during the operation (Table 1). Table 2 lists the specific cardiac operations performed.

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TABLE 1. *Stress Ulcer in 38 Patients after Cardiac Surgery—Comparison of Medical and Surgical Groups*

	Surgical Treatment, 26 Patients	Medical Treatment, 12 Patients	Total Group %
<i>Average Age</i>	52	53	
<i>Sex</i>			
Men	19	10	76.3
Women	7	2	23.7
<i>Previous Ulcer History</i>	6	6	31.5
<i>Cardiac Diagnosis</i>			
Coronary artery disease	18	10	73.6
Valvular heart disease	7	2	23.6
Congenital heart disease	1	0	2.8
<i>Pump Cases</i>	16	6	57.9

Stress Factors

Psychological Stress. Patients undergoing cardiac surgery are subject to considerable emotional stress. Although mortality rates are low, particularly with myocardial revascularization procedures, many patients fear that they may not survive the operation. The added stress of modern postoperative intensive care units, with the almost constant stress-provoking activity and the temporary dissociation from normal day and night sequences, serve to compound the emotional stress experienced by each patient.

Physiological Stress. Although open-heart surgical procedures have been greatly simplified and operative time significantly shortened, the necessity of extracorporeal circulation, the operative manipulation of the heart or its arteries, and the occasional need for large quantities of transfused blood place a definite physiological stress on each patient.

Postoperative Complications. Other stress factors identified in the 38 patients in whom stress ulcers developed are summarized in Table 3. Postoperative myocardial infarction (diagnosed by electrocardiographic

TABLE 2. *Heart Operations—38 Patients*

	Number of Patients
<i>Myocardial Revascularization</i>	
Internal mammary artery implantation	15
Saphenous vein bypass	7
Direct coronary artery dilation	2
Ventricular aneurysmectomy	4
<i>Surgery for Valvular Heart Disease</i>	
Open mitral commissurotomy	1
Mitral valve replacement	3
Aortic valve replacement	2
Open mitral commissurotomy plus aortic valve replacement	1
Mitral valve replacement plus aortic valve replacement	2
<i>Congenital Heart Disease</i>	
Tetralogy of Fallot	1
Total	38

TABLE 3. *Stress Factors after Heart Operations*

Factors	Number of Patients
Postoperative myocardial infarction	8
Reoperation for bleeding	6
Respiratory insufficiency	5
Congestive heart failure	3
Arrhythmia with hypotension	2
Peripheral arterial embolization	2
Thrombophlebitis	1
Postoperative cerebrovascular accident	1
Sepsis and leaking valve prosthesis	1
None	13

findings and elevated cardiac enzymes) developed in eight patients; in most instances, they did not have significant episodes of hypotension. Seven patients required reoperation, six for continued bleeding from within the chest during the early hours after cardiac surgery and one patient because of the development of a septic prosthetic valve with secondary periprosthetic leak. Postoperative respiratory insufficiency and pneumonia developed in five patients, in four of whom tracheostomy and respiratory assist devices were required. Three patients were receiving heparin at the onset of bleeding, one patient because of thrombophlebitis and two patients because of peripheral arterial embolization (one patient required embolectomy). Thirteen of the 38 patients had an uncomplicated postoperative course until stress ulcers developed. Long-term use of steroid drugs could not be incriminated as contributing to the development of any stress ulcer in this group of patients.

Pathology

The variation in number, location, and severity of ulcers found at operation was impressive. In this group of patients, slightly more than a third of the patients had multiple ulcers, the majority occurring in the stomach (Table 4). Another third had single ulcers, usually in the duodenum. In two patients with single duodenal ulcers, perforation was found at operation. One of these ulcers had eroded into the gastroduodenal artery and operation was performed to control massive hemorrhage.

TABLE 4. *Stress Ulcers Found at Operation*

	Number of Patients
<i>Multiple Ulcers</i>	10
Gastric	8
Duodenal	2
<i>Single Ulcers</i>	8
Duodenal	7
Gastric	1
<i>Erosive Gastroduodenitis</i>	7
<i>Erosive Jejunitis</i>	1
Total	26

In the second case, there was no associated bleeding and exploratory laparotomy was undertaken because of an acute surgical abdomen with intraperitoneal air. Seven patients had diffuse erosive gastroduodenitis. One patient with sudden, massive bleeding had an erosive, ulcerative process in a 3-foot segment of jejunum. Careful inspection at operation did not reveal any erosions in the stomach or duodenum.

Medical and Surgical Treatment

Onset of Symptoms. In 16 patients, the onset of upper gastrointestinal bleeding occurred during the first 5 days after cardiac surgery. In 17 patients, bleeding began during the second postoperative week (6 to 10 days). In the remaining five patients, bleeding did not begin until after the 10th day (11 to 27 days), one patient had no signs of bleeding until the 27th postoperative day.

In 12 patients the bleeding was controlled by medical treatment; of these patients eight had melena alone, but four also had associated hematemesis. An average of four units of whole blood were required for the patients treated medically.

The gastrointestinal bleeding was more severe, with associated hematemesis and frequent bloody bowel movements, in the majority of the 26 patients who required operation. The average transfusion requirement prior to operation was six units of whole blood. Twenty-one of these 26 patients were operated on within 24 hours after the onset of bleeding or perforation. In five patients, the rate of bleeding was less rapid and initially appeared to respond to medical treatment. These patients required surgical intervention from 2 to 5 days after the onset of bleeding. It was interesting that complaints of epigastric pain or distress were almost nonexistent in the 38 patients.

Medical Treatment. When the diagnosis of stress ulcer was made, an intensive medical program in accordance with the severity of bleeding was begun. If, at the outset, the bleeding appeared to be moderately severe or massive, a large lumen nasogastric tube was used for iced saline lavage and the administration of antacid solutions. The tube also served as an important monitoring device to assess the degree of continuing hemorrhage and to prevent vomiting and aspiration. Unless contraindicated, all patients were given large doses of tranquilizers. Whenever possible, *fresh* whole blood was used for volume replacement. Vitamin K was frequently given parenterally, even though a coagulation defect was not suspected or demonstrated clinically. When the bleeding subsided the nasogastric tube was removed, and as soon as tolerated, a strict hourly antacid program consisting of interval feedings of a bland diet was begun.

TABLE 5. Operations Performed in 26 Patients

Operation	Number of Patients
Vagotomy and pyloroplasty plus oversewing ulcer	17
Vagotomy and pyloroplasty plus wedge gastrectomy	1
Vagotomy and pyloroplasty plus resection of jejunum	1
Vagotomy and gastric resection	4
Subtotal gastrectomy	3
Total	26

Surgical Treatment. When it became apparent that the patient was not responding to medical treatment and was continuing to bleed beyond a reasonable number of blood transfusions, immediate surgical intervention was undertaken. As a general rule, we have considered the replacement of six units of whole blood (roughly one-half body blood volume) given during a 24 to 48 hours period to be an indication for surgical intervention. In some patients severe hemorrhage required immediate operation; in other patients bleeding persisted for 48 hours before operation.

The specific operative procedures performed on the 26 patients who required surgical control of the ulcer diathesis are listed in Table 5. It is apparent that we have preferred truncal vagotomy and pyloroplasty with oversewing of the ulcer or limited resections as a faster and "lesser" surgical procedure in the majority of these patients (19 patients), although seven subtotal gastric resections were performed, four with vagotomy.

When possible, vagotomy was performed before the stomach was opened. A long gastrotomy incision was made (Fig. 1) for inspection of the entire gastric mucosa. When multiple bleeding ulcers were found, these were suture-ligated. After an adequate Kocher maneuver, a longitudinal incision was made across the pylorus to visualize the distal antrum, pyloric channel, and duodenum. Any bleeding ulcers were again suture-ligated and the pyloric incision was closed transversely in a Heineke-Mikulicz pyloroplasty with a single layer of interrupted silk sutures. The gastrotomy opening was closed in two layers. When the ulcerative process could not be controlled by vagotomy and pyloroplasty with suture-ligation of bleeding ulcerations or when the erosive process seemed unusually severe, a gastric resection was performed. Postoperatively, a sump type of nasogastric tube, connected to low Gomco suction or gravity drainage, was used with limited irrigation of the stomach to prevent further irritation and bleeding from the friable gastric mucosa.

Results

The overall mortality (30 days or in-hospital death) for these 38 patients after medical and surgical treatment

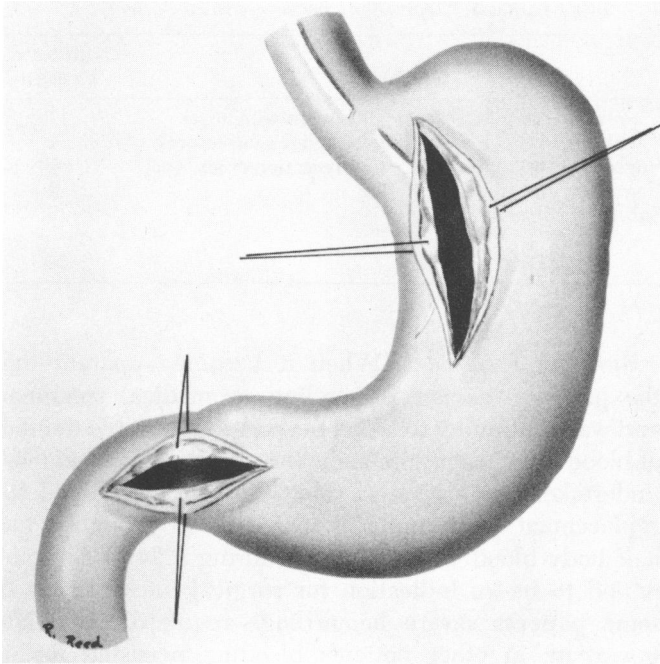


FIG. 1. Artist's drawing showing gastric and pyloric incisions following truncal vagotomy. It is important to inspect all of the gastroduodenal mucosa for discrete bleeding ulcers.

was 23.6% (Table 6). Only one patient, severely bleeding and comatose from a massive cerebrovascular accident, died during medical therapy. In the 11 other patients treated medically, the bleeding stopped promptly.

There were eight deaths after surgical treatment, an operative mortality of 30.7%; seven of these eight patients died from cardiovascular or pulmonary complications. Only one patient in the surgical group died from continuing or uncontrolled hemorrhage. This patient had a vagotomy and pyloroplasty followed by a 95% gastric resection; he continued to bleed and died of a pulmonary embolus.

Reoperation was necessary in two other patients; one patient required a gastric resection for a second, massive bleeding episode 1 week after vagotomy and pyloroplasty, and reoperation was performed in the other patient, who initially had gastric resection, because of leakage from the suture line of the anastomosis. The

TABLE 6. *Mortality after Medical and Surgical Treatment of Acute Stress Ulcers in 38 Patients*

	Mortality,	
	Patients	Per cent
Overall mortality	9/38	23.6
Medical treatment	1/12	8.3
Surgical treatment	8/26	30.7
Vagotomy and pyloroplasty	6/19	31.6
Gastric resection with or without vagotomy	2/7	28.6

latter patient died of a myocardial infarction after the second procedure.

Seven other patients had minor recurrent bleeding after surgical treatment (all had vagotomy and pyloroplasty) but none of these patients required reoperation. An average of two to three whole blood transfusions were given for these bleeding episodes.

The major cause of death in each of the eight patients who died after their gastric operation was cardio-pulmonary insufficiency secondary to congestive heart failure, pneumonia, and sepsis. Recurrent gastrointestinal bleeding was a factor in only one of these patients. For the entire group of patients, mortality as a result of recurrent or uncontrolled bleeding was 5.3%; death resulted from cardiorespiratory complications in 18.4%.

Discussion

These cases represent a homogeneous group of patients with a true stress ulcer diathesis. All of the patients underwent major cardiac surgical procedures and a significant number had secondary complications prior to the onset of the stress ulcer syndrome. During the last 2 years, the morbidity and mortality of cardiac surgery has continued to decline. The incidence of stress ulcers has also markedly declined.

Whatever factors combine to cause stress ulceration of the stomach or duodenum, it is our distinct clinical impression that these factors are temporary. Prolonged hypotension, sepsis, and cardiac or pulmonary insufficiency contribute to the stress of any major surgical procedure. If such complications can be controlled or alleviated in a short period, mild or even moderate stress bleeding may be brought under control by medical means. Only emergency surgical intervention may save the patient if massive hemorrhage requiring rapid or major blood volume replacement develops.

In our experience with stress bleeding after cardiac surgery, we have found that vagotomy and pyloroplasty with oversewing of the bleeding ulcers stopped the bleeding and controlled the ulcer diathesis in the majority of patients. We have reserved vagotomy and gastric resection for those patients who continued to bleed after vagotomy and pyloroplasty or who had an unusually severe erosive process. This conservative approach has resulted in a lower mortality and morbidity than has been generally reported. We found that recurrent bleeding after a conservative operation was a problem in only two patients who required reoperation; in seven additional patients it was minor and ceased after a day or two. Only one of the 26 patients who underwent surgical treatment died as a result of continuing hemorrhage.

Many surgeons have advocated a subtotal, or total gastrectomy as the standard surgical approach to all

stress ulcers.^{1,5-7} We do not feel that this operative approach, with its potentially higher morbidity and mortality, is justified for all patients with stress ulcers, even though the present study does not document a higher mortality for gastric resection in this series. Vagotomy and gastric resection may be indicated as the primary operative procedure in patients who develop stress ulcers after a major burn or a severe injury, both of which represent a continuing stress.

We agree with Kirtley, Scott, Sawyers *et al.*,⁴ that the etiology of stress ulcer remains unknown and that surgical treatment is empiric. Most studies have emphasized the role of vagotomy in decreasing blood flow to the gastric mucosa. On the basis of our clinical experience, we continue to advocate conservative ulcer operations, vagotomy and pyloroplasty with suture ligation of the ulcers or, when necessary, vagotomy and antrectomy in the treatment of stress ulcers.

Summary

In this report, 38 patients are discussed who developed stress ulcers after cardiac surgery. Twenty-six patients required surgical intervention for control of massive hemorrhage or perforation; in 12, the bleeding subsided with intensive medical treatment. Because we believe whatever factors combine to provoke the stress ulcer syndrome are generally temporary, we have favored

the more conservative operative approach of vagotomy and pyloroplasty with oversewing of the bleeding ulcers as opposed to the more extensive procedure of gastric resection which may result in a higher morbidity and mortality. In this group of patients, the incidence of recurrent bleeding following vagotomy and pyloroplasty with oversewing of bleeding ulcers was not a significant problem.

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