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Gastrointestinal complications after cardiac surgery

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Abstract *Objective.* Gastrointestinal (GI) complications after cardiac surgery with cardiopulmonary bypass (CPB) are uncommon complications with significant morbidity and mortality rates.
Methods. From 1988 to 1995, 36 GI complications were identified in 3158 patients who underwent cardiac surgery (1.14% incidence). The mortality rate was 13.9%. Complications included hemorrhage in the GI tract in 22, perforated ulcer in 3, acute cholecystitis in 3, pancreatitis in 2, mesenteric ischemia in 3, diverticulitis in 1 and liver failure in 2 patients.
Results. Clinical risk factors included advanced age, combined coronary artery bypass grafting (CABG)-valve operation, postoperative low cardiac output (LCO), prolonged ventilation time, re-exploration of the chest, sternal infection and a positive history of peptic ulcer. Patients with a prolonged pump time had an increased risk of GI complications ($P<0.001$).
Conclusions. Gastrointestinal complications, although of low incidence, carry a significantly high mortality, and the clinician must be alert to institute early appropriate treatment.
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Key words Cardiac surgery · Cardiopulmonary bypass · Gastroinestinal complications · Pancreatitis · Cholecystitis

Introduction

The incidence of gastrointestinal (GI) complications after cardiac surgery is low, but the mortality and morbidity, as well as the cost in terms of prolonged hospitalization, are all considerable [4, 6–8, 12]. Delayed recognition of these complications leads to a high incidence of morbidity and mortality, therefore prompt diagnosis and treatment are essential. The purpose of this review was to examine the incidence, clinical features, treatment, and outcome of patients having GI complications after cardiac surgery and to profile patients at greatest risk in order to facilitate early diagnosis and optimal treatment.

Material and methods

The records of 3158 consecutive mostly adult patients who underwent cardiac surgery with the aid of cardiopulmonary bypass (CPB) during the 6-year period 1990–1995 were reviewed in the Gülhane Military Medical Academy. Of these, 2158 patients underwent coronary artery bypass grafting (CABG), 425 patients valve procedures, 73 patients valve and CABG, and 502 patients congenital cardiac defect procedures. Of these with congenital cardiac defect, 83 patients were cyanotic. Most of these patients were adult with an average age of 20.6 years (range 3–54 years). The data regarding postoperative complications was retrieved from patient records. The preoperative characteristics of patients are summarized in Tables 1 and 2. Of the patients, 74.8%, were male with a mean age of 58.7 years (range: 7–85 years).

H_2-blocking drugs were not employed prophylactically, but were continued in those patients already taking them and given to patients with a past history of GI bleeding. All patients received antibiotic prophylaxis with cefataxim, 1 g every 12 h for 48 h. Nasogastric tubes were not inserted routinely. A standardized anesthetic and operative technique was employed for all patients. Myocardial protection during CPB was achieved by cross-clamping and the infusion of cold cardiplegic Saint Thomas' solution into the aortic root. In addition patients were cooled to 28 or 25 °C during CPB and received non-pulsative flow at rates of 2.4 l/min per m^2, with a mean perfusion pressure of 55–65 mmHg.

Postoperative low cardiac output (LCO) was defined by a low cardiac index (usually under 2.5 l/min per m^2), peripheral vasocon-

striction, hypotension, and metabolic acidosis. The aims of pharmacologic therapy for LCO included: to increase contractility, decrease afterload, and optimalize preload. Infusions of epinephrine, dopamine or dobutamine were commonly administered to improve contractility. When pharmacologic support alone was inadequate to reverse the LCO syndrome, mechanical circulatory support (intra-aortic balloon pump: IABP) was added. The use of the pharmacologic or mechanical support was continued until the patient was fully improved.

Only patients with GI complications that arose within 30 days of their cardiac procedure and on their initial hospitalization were considered for this study. Postoperative GI complications were documented by clinical, and the appropriate biochemical, hematologic, roentgenographic or endoscopic examinations. Significant GI complications were defined as: GI bleeding manifested by hematemesis or melena associated with a decrease in the hemoglobin level of 2 g; pancreatitis evidenced by abdominal pain, tenderness, nausea, vomiting and an elevated urinary or serum amylase level; signs and symptoms of acute calculous or acalculous cholecystitis; liver failure manifested by progressive cholestatic jaundice, rising liver function test values and uncorrectable coagulopathy; mesenteric ischemia, the diagnosis of which was based on a combination of clinical signs and laboratory data (i.e. elevated serum potassium, white blood cell and serum lactate levels); and signs and symptoms of perforated ulcer [7, 8]. Patients with medication-induced nausea, vomiting or diarrhea were excluded. Also excluded were those with transient abdominal distension and those with transient hyperbilirubinemia without signs and symptoms of hepatic failure.

Statistical analysis was performed by means of the χ^2 test for dichomatous data and one-way analysis of variance with multiple-range comparison for continuous data. A probability value of less than 0.05 was considered significant.

Results

Thirty-six GI complications occurred in 3158 patients who underwent cardiac surgery requiring CBP. The incidence of GI complications was 1.14%. The characteristics of this group of patients and their complications are summarized in Table 1. Of the 36 patients, 27 were male and 9 female ($P>0.05$). The average age was 67.3±19 years (range 26–84 years). The incidence of complications was 2.56% in those aged more than 65 years compared with 0.7% in those less than 65 years of age ($P<0.01$). There were five deaths, giving a 3.9% motality rate. The mortality rate from GI complications represented 5.9% of all deaths that occurred after cardiac operations requiring CPB during this time ($P<0.001$). The incidence of GI complications in those patients who had undergone combined CABG and valve operations was 9.6% compared with 1.11% for CABG patients, 0.94% for valve operations and 0.3% for congenital cardiac defect operations, which was a significant difference ($P<0.01$). Mean pump time was 123±36 min in patients with GI complications, compared with 78±42 min for patients undergoing similar cardiac procedures ($P<0.01$).

Analyses of the preoperative and postoperative risk factors after cardiac surgery of those with and without GI complications were also undertaken, and the results are presented in Table 2. In comparison, patients with GI complications were older ($P<0.02$) and had a higher incidence of known peptic ulceration ($P<0.001$). Diabetes, alcohol abuse and use of anticoagulant and/or antiaggregant preoperatively did not differ significantly between the two groups. Subsequent administration of anticoagulants in the postoperative period also did not differ significantly. There was a significantly higher incidence of LCO ($P<0.001$), the need for IABP ($P<0.001$) and the requirement of long-term ventilator support ($P<0.05$) for those patients in whom GI complications subsequently developed. Re-exploration of the chest was required in 9 of 36 (25%) patients with GI complications for pericardial tamponade, bleeding or sternal dehiscence compared to 83 of 3122 (2.6%) patients without such a complication ($P<0.001$). Two patients (5.5%) in the complication group and 19 patients (0.6%) in the control group developed sternal infections ($P<0.03$). While the postoperative hospitalization was 17.6±9.5 days for the patients with GI complications, it was 7.3±2.1 days for the control group ($P<0.00$).

Table 1 Profile of patients with GI complications (*CABG* coronary artery bypass grafting, *CPB* cardiopulmonary bypass, *GI* gastrointestinal, *F* female, *M* male)

	No. of patient	Age (years)		Sex		Operation				CPB time (min ± SD)	Mortality no. –(%)
		≤65	>65	M	F	CABG	Valve	CABG + Valve	Congenital		
Total	3158	2417	741	2361	797	2158	425	73	502	78 ± 42	85–2.7
GI complications	36	17	19	27	9	24	4	7	1	123 ± 36	5–13.9
GI hemorrhage	22	12	10	17	5	16	3	3	–	120 ± 39	0
Perforated ulcer	3	–	3	3	–	1	–	2	–	137 ± 43	2–66.6
Cholecystitis	3	2	1	1	2	3	–	–	–	87 ± 35	0
Pancreatits	2	1	1	1	1	2	–	–	–	118 ± 10	0
Diverticulitis	1	1	–	1	–	–	–	–	1	36	0
Mesenteric ischemia	3	1	2	2	1	1	1	1	–	132 ± 10	1–33.3
Liver failure	2	–	2	2	–	1	–	1	–	143 ± 21	2–100

Table 2 Preoperative and postoperative profile of patients with and without GI complications after cardiac surgery

Variable	Patients with GI complications (*n*: 36)	Patients without GI complications (*n*: 3122)	*P* value
Preoperative			
Mean age (years)	67.3 ± 3	58.7 ± 21	<0.02
Sex (F/M)	27/9	2334/788	NS
Diabetes	4	324	NS
Alcohol abuse	3	260	NS
Anticoagulants and/or antiplatelets	27	2356	NS
Peptic ulcer and/or gastritis	9	178	<0.001
Postoperative			
Low cardiac output	11	165	<0.001
Intra-aortic ballon pump	8	41	<0.001
Sternal infection	2	19	<0.03
Re-exploration of chest	9	83	<0.001
Ventilation for >24 h	5	128	<0.05
Use of anticoagulants postoperatively	2	161	NS
Mean hospitalization (days)	17.6 ± 9.5	7.3 ± 2.1	<0.001

Twenty-two patients had GI hemorrhage and diagnosis was made 4.8 days, on average, after cardiac operation. Seven of the patients with GI hemorrhage had a history of peptic ulceration. Twenty of the 22 bleeding episodes were gastroduodenal in origin. The other two were distal to the ligament of Treitz. All of these patients initially received nasogastric intubation, that was continued as long as necessary to raise the intragastric pH to greater than 5 and until bleeding ceased. Anti-acid and H_2 blocker were continued throughout the duration of hospitalization. One patient required operative intervention. The mortality for patients with GI hemorrhage was zero. Three patients had a perforated duodenal ulcer. Perforated ulcer was treated by simple omentopexy in one patient, who later died as a result of peritonitis and multiple organ failure, and truncal vagotomy and pyloroplasty in the second. The third patient died suddenly due to cardiac arrest and the diagnosis was made on postmortem examination. Each of these patients had received medical treatment before the duodenal ulcer was perforated. The highest mortality in our series was for patients with perforated ulcer. Duodenal ulcer was diagnosed a mean of 4.8 days postoperatively compared with a mean of 12 days (range 6–20 days) for perforated duodenal ulcer. Cholecystitis developed in three patients (1 man and 2 women). All three patients had undergone CABG with a mean pump time of 87±35 min. The mean pump time of these patients was less then other patients with GI complications (P<0.05) (Table 1). No patient had a known history of symptomatic cholelithiasis. All presented with acute cholecystitis and in two this was calculous. All patients were surgically treated at a mean of 8 days postoperatively with no mortality. Pancreatitis was diagnosed in two patients and was treated conservatively. One patient with atrial septal defect had diverticulitis, manifested by fever and left lower quadrant abdominal pain. The diagnosis was made endoscopically at 8 days postoperatively and the patient was successfully treated with antibiotics. Three patients developed mesenteric ischemia. Two had suffered prolonged LCO postoperatively, and one had atrial fibrillation. All three patients had an abdominal exploration. One patient with atrial fibrillation, who had not been anticoagulated, underwent a superior mesenteric embolectomy and two had intestinal resections. The only mortality was a 73-year-old male who had melena which developed on the 14th postoperative day and who underwent immediate right hemicolectomy. Liver failure occurred in two patients 1 week after undergoing CABG and CABG-valve operations. In each instance this was thought to represent a terminal phase of multisystem organ failure and preceded death by a brief period.

Table 3 Management and outcome of patients with GI complications (Numbers in parentheses are deaths)

Complications	Medical treatment		Surgical treatment	
	Number	(Mortality)	Number	(Mortality)
Total (36)	27	(3)	9	(2)
GI hemorrhage (22)	21	(–)	1	(–)
Perforated ulcer (3)	1	(1)	2	(1)
Mesenteric ischemia (3)	–	(–)	3	(1)
Pancreatitis (2)	2	(–)	–	(–)
Cholecystitis (3)	–	(–)	3	(–)
Diverticulitis (1)	1	(–)	–	(–)
Liver failure (2)	2	(2)	–	(–)

The management and outcome of patients with GI complications are summarized in Table 3.

Discussion

Gastrointestinal complications have been reported to occur after 0.3%–3% of cardiac surgery with CPB and are

associated with mortality rates of 11%–67% [1–6]. The 1.14% incidence of GI complications in this study is similar to the rates in the literature. The mortality rate in this series, 13.9%, is also similar to those in the literature. Gastroduedonal ulcers, either perforated or bleeding, account for the greatest number of complications; this is followed by acute cholecystitis, pancreatitis, mesenteric ischemia or infarction, perforation or bleeding elsewhere in the GI tract, and a variety of miscellaneous complications, including ileus, splenic infarct and liver failure [6]. The high mortality in these patients has been attributed to delayed diagnosis and treatment of GI complications, which often precipitates multisystem organ failure. In addition, these patients frequently have serious associated medical problems and limited physiologic reserved, and this diminishes their ability to survive a major septic or hemorrhagic insult. The major factor in precipitating GI complications after cardiac surgery is likely to be low flow with hypoperfusion of end organs [11]. Perioperative hypotension, hypovolemia, prolonged CPB, the use of vasoconstrictor inotropic agents, postoperative arrhythmias, hemorrhage and preexisting vascular disease all combine to produce mucosal injury and subsequent organ damage [4–6, 7, 11]. Hypoperfusion can be responsible not only for gastric and duodenal ulceration and their complications, but also for mesenteric ischemia, pancreatitis, paralytic ileus and liver failure [1, 6, 8, 10]. Hypoperfusion may play a role in the etiology of acalculous cholecystitis, biliary stasis, and prolonged distension of the gallbladder may also be important in the development of this condition [3]. Other factors, such as advanced age, emergency operation, sternal infection, re-exploration of the chest, narcotics use, previous history of peptic ulcer disease, parenteral nutrition and the nature of cardiac surgery are also relevant [6, 7, 9].

In this study, we have demonstrated that advanced age (65 years or older), LCO syndrome, re-exploration of the chest, sternal infection, prolonged mechanic ventilation, prolonged CPB time and previous history of ulcer disease were important risk factors for the development of GI complications. The nature of cardiac surgery, whether CABG or valve procedures, did not appear to be significant with relation to GI complications. However there was a significantly high incidence of GI complications in the combined CABG and valve operations. Combined operations tend to have a long CPB time with a greater incidence of LCO and a need for inotropic use and IABP. Interestingly, in the group with congenital cardiac defect there was only one GI complication. In these patients, there were a significantly younger age and shorter CPB time compared with the other procedures.

The most common GI complication in this series was GI tract hemorrhage. Seven of the 22 patients with GI hemorrhage had a previous history of peptic ulceration. In addition, two of the patients with perforated ulcer had a previous history of peptic ulcer. These observations lead us to the conclusion that aggressive perioperative ulcer prophylaxis should be instituted in such patients, particularly those at high risk from their cardiac surgery. Although many patients with GI hemorrhage can be treated conservatively, we recommend early surgical intervention for hemorrhaging gastroduedonal ulcers that fail to respond quickly to appropriate medical therapy such as in one of our patients.

Although the incidence of postoperative hyperamylasemia has been reported to be as high as 32%, the incidence of severe pancreatitis is usually much lower, and less than 1% [2]. Clinical factors related to the development of acute pancreatitis include postoperative hypotension and the perioperative administration of calcium chloride [2]. Two patients had pancreatitis in this series and were managed by nasogastric aspiration and intravenous fluids with no mortality. Acute cholecystitis occurred in 8.3% of the patients with GI complications and all patients were managed surgically with no mortality. Two of these patients had acalculous cholecystitis. Diminished gallbladder contractility and biliary stasis, which are features of acalculous cholecystitis, have been associated with parenteral nutrition, prolonged fasting and the use of narcotics. The cause of cholecystitis is believed to be ischemia consequent upon hypoperfusion during bypass [9], although we could not demonstrate any significant differences between CPB time, postoperative low cardiac output and postoperative cholecystitis in these compared to our other patients. Mesenteric ischemia and liver failure were fatal complications in our series as well as in others [6–8]. Many of these patients with mesenteric ischemia are sedated and on ventilators which may mask symptoms and signs of an abdominal catastrophe. Prompt treatment is essential and surgery should not be avoided because the patient has had recent cardiac surgery. In our series, three patients with mesenteric ischemia were managed promptly with surgical treatment and only one patient died. Liver failure as a terminal manifestation of multisystem organ failure occurred in two patients. In this series preoperative alcohol abuse, enzymes and billirubin were not associated with subsequent liver dysfunction, but prolonged CPB time and combined CABG and valve operations were significant risk factors.

In summary, GI complications after cardiac surgery with CPB are uncommon but serious events. The common cause of all these complications is visceral hypoperfusion. Patients who were older than 65 years of age (who had advanced systemic atherosclerosis, which predisposes to visceral ischemia during low flow states), had prolonged CPB time, had a history of peptic ulcer disease, underwent combined CABG and valve procedures and had postoperative LCO syndrome, sternal infection, prolonged ventilation and re-exploration of the chest were shown to be at greatest risk. Therefore in these high risk patients and highly stressed patients aggressive perioperative ulcer prophylaxis should be instituted. In the diagnosis and management of GI complications, a high index of suspicion and early appropriate therapy are most important.

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