Original Article

Gastrointestinal Complications in Patients Undergoing Coronary Artery Bypass Grafting

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Purpose: Gastrointestinal complications (GICs) such as gastroduodenal ulcer, enterocolitis, and ischemic colitis after coronary artery bypass grafting (CABG) are rare, but are associated with high mortality and morbidity. The present study was performed to detect risk factors and to investigate outcomes following GICs after CABG.

Methods: Between January 1992 and December 2001, 17 of 549 patients (3.1%) developed GICs after CABG with cardiopulmonary bypass, presenting with gastrointestinal bleeding due to gastroduodenal ulcer, enterocolitis, or ischemic colitis. We conducted a retrospective analysis of these patients.

Results: All patients required emergent treatment for hemorrhage by means of blood transfusion and endoscopic ablation and/or clipping. The following possible predictors of GICs were identified by logistic multivariate analysis: age over 70, diabetes mellitus (particularly insulin-dependent diabetes), history of cerebrovascular disease or history of renal failure and postoperative low output syndrome (LOS).

Conclusion: Our results suggested that GICs after CABG with cardiopulmonary bypass are rare but can be lethal. Early diagnosis and prompt intervention can be difficult but are potentially life saving for patients in whom GICs develop. (Ann Thorac Cardiovasc Surg 2005; 11: 25–8)

Key words: gastrointestinal complications, coronary artery bypass grafting, gastroduodenal ulcer, ischemic colitis, enterocolitis

Introduction

The incidence of gastrointestinal complications (GICs) in patients undergoing coronary artery bypass grafting (CABG) is increasing as the population ages. Gastroduodenal ulcer, enterocolitis, and ischemic colitis appear to be the most common abdominal complications after CABG, with the reported incidence of such complications ranging from 0.3% to 3.7%.[1-9] On the other hand, although frequency of melena due to enterocolitis and bowel ischemia is lower, at around 0.02% to 0.3%,[2] this symptom is associated with high mortality and morbidity. If GICs develop, it is necessary to perform intravenous fluid replacement, blood transfusion and endoscopic ablation and/or clipping, thus increasing in-hospital costs. It is therefore important to predict GICs based on relevant risk factors and to treat these complications promptly; however, they can pose a diagnostic challenge.

The following predictors are reported in the literature: age greater than 70 years, long duration of cardiopulmonary bypass, blood transfusion, re-operation, ischemic heart disease, arteriosclerosis obliterans, renal failure, and low cardiac index.[8-12] As many patients in whom these complications occur are ventilated and sedated, signs and symptoms are masked. Hence it is difficult to determine

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Table 1. Preoperative risk factors

	Control (532 cases)	GICs (17 cases)	p
Clinical characteristics			
Age (y)	64.3±9.4	70.0±8.9	0.01
Age ≥70	170	13	0.02
Sex (male/female)	406/126	15/2	
Cardiac data			
No. of diseased vessels	2.9±1.0	2.7±0.7	0.15
Emergent operation	89	1	0.075
LV ejection fraction (%)	50.5±14.2	42.4±11.3	0.01
LV ejection fraction ≤40	108	11	0.01
NYHA ≥III	121	9	0.04
Coronary risk factors			
Hypertension	69	8	0.32
Diabetis mellitus	156	13	0.001
Cerebrovascular disease	45	8	0.005
Arteriosclerosis obliterans	35	8	0.002
COPD	78	2	0.50
Smoking	352	8	0.28
Renal failure	11	3	0.04

the timing and treatment of GICs. The purpose of this study was to investigate predictors of development of GICs in order to protect against these complications.

Methods

Between January 1992 and December 2001, 17 of 549 on pump CABG patients (3.1%) developed GICs after surgery. The definition of GIC included gastroduodenal bleeding due to peptic ulcer, perforated ulcer, acute pancreatitis, melena due to enterocolitis, and ischemic colitis. In the present study, we investigated gastrointestinal bleeding in patients undergoing CABG with cardiopulmonary bypass. Data were analyzed with the Statview statistical package. Results are given as mean ± SD. To evaluate independent risk factors for GICs, significant multivariate risk factors were examined using stepwise logistic regression analysis. P-values of less than 0.05 were considered statistically significant.

All of the patients were followed up by telephone interview with the patient or their physician or with both. Mean follow-up period was 62.9±38.7 (range, 8-128) months. The end point of follow up was the occurrence of death.

Results

For patients undergoing CABG with cardiopulmonary bypass, we compared various risk factors between those who developed GICs (GIC group, n=17) and those who did not (control group, n=532). When compared to the control group, patients in the GIC group were significantly older, and were significantly more likely to have low ejection fraction and NYHA functional classification of more than III. Moreover, of the risk factors for coronary disease, diabetes mellitus, and history of cerebrovascular disease, history of arteriosclerosis obliterans and history of renal failure were significantly more common in the GIC group (Table 1). On the other hand, no significant differences were observed between the groups in terms of operative parameters. However, regarding postoperative parameters, low output syndrome (LOS) treated with high dose catecholamines occurred in 13 patients in the GIC group, compared to 56 in the control group (p=0.002) (Table 2). Using logistic multivariate analysis, we identified 5 possible predictors of GICs: age over 70, diabetes mellitus (particularly insulin-dependent diabetes), history of cerebrovascular disease and history of renal failure (hemodialysis dependent) and postoperative LOS (Table 3).

Symptoms were hematemesis in 10, black tarry stool in 3, melena (frank blood in stool/ red or maroon discoloration of stool) in 4 (Table 4). Of the 17 patients with GICs, the following diagnoses were confirmed: multiple gastric ulcers n=9; multiple duodenal ulcers, n=4; ischemic colitis, n=3; and enterocolitis n=1. No cases of single peptic ulcer were observed. Moreover, the onset of hematemesis due to peptic ulcer was earlier (13.1±9.3 day) than that of melena due to enterocolitis or ischemic colitis (27.3±8.0 day, p=0.03) (Table 5). In this series, no in-hospital deaths or late deaths (follow up 62.9±38.7 months) occurred in patients with GICs, due to treatment

Table 2. Operative and postoperative data

	Control (532 cases)	GICs (17 cases)	p
No. of anastomosis	2.9±0.9	2.7±0.7	0.15
ECC time (min)	146.7±151.0	101.7±30.8	0.17
Aortic cross clamp time (min)	73.9±27.8	56.0±15.5	0.07
Major complication			
LOS	56	13	0.002
IABP use	33	0	0.5
Postoperative stay (day)	35.1±17.7	64.9±27.9	0.005

Table 3. Risk factors for gastrointestinal complications determined by multivariate analysis

	OR	(95% CI)	p
Age ≥70	2.79	(1.9, 8.6)	0.02
Diabetis mellitus	5.06	(1.6, 15.9)	0.005
Renal failure	4.23	(1.2, 15.5)	0.03
Cerebrovascular disease	7.23	(1.7, 12.7)	0.01
Postoperative LOS	3.74	(1.3, 10.7)	0.002

OR = odds ratio, CI = confidence interval

Table 4. Diagnosis, treatment and outcomes in 17 patients who developed gastrointestinal bleeding

Symptoms		Treatment	Outcome
Gastric ulcer			
Single lesion	0		
Multiple lesion			
Hematemesis	7	Endoscopic ablation and/or clipping	All alive
Tarry stool	2		
Duodenal ulcer			
Single lesion	0		
Multiple lesion			
Hematemesis	3	Endoscopic ablation and/or clipping	All alive
Tarry stool	1		
Ischemic colitis			
Melena	3		
Enterocolitis			
Melena	1	Endoscopic ablation and/or clipping	All alive
Acute pancreatitis	0		
Perforation	0		

soon after onset (7.3±2.8 hr). All patients with GICs required prompt endoscopic ablation and/or clipping with blood transfusion (hematemesis: 7.4±5.2 u / melena: 15.5±11.7 u). These procedures were essential to predict risk factors and treat promptly.

Discussion

GICs such as gastrointestinal bleeding, acute pancreatitis, cholecystitis, ischemic colitis, and enterocolitis after cardiopulmonary bypass have been reported to be rare (0.3-3.7%).[1-9] However, such complications have also been associated with high mortality and morbidity (17-63%).[1-9] In particular, acute pancreatitis is reported as being very rare after CABG (less than 0.1%).[13] In the present series, the 17 cases of gastrointestinal bleeding after on pump CABG were due to gastroduodenal ulcer, enterocolitis or ischemic colitis; however, pancreatitis was not observed. In the present study, the incidence of GICs after CABG was 3.1%; higher than that seen after other

Table 5. Onset and status at the time of GICs

	Gastroduodenal ulcer (13 cases)	Ischemic colitis, enterocolitis (4 cases)	p
Onset (day)	13.1±9.3	27.3±8.0	0.03
Blood transfusion (u)	7.4±5.2	15.5±11.7	0.26

operations requiring cardiopulmonary bypass. GICs can increase mortality rate and lead to prolonged hospital admission. However, as it is difficult to predict these complications because many signs and symptoms are masked following CABG, it is important to demonstrate risk factors. Risk factors for GICs reported in the literature are older age, increased duration of bypass, sepsis, renal failure, prolonged ventilation, low cardiac index, and emergent surgery.[8-12] In the present study, 5 possible predictors of GICs after CABG were identified: age over 70, diabetes mellitus (particularly insulin-dependent diabetes), history of cerebrovascular disease, history of renal failure (use of hemodialysis) and postoperative LOS. In our series, no cases of single peptic ulcer were observed. However, we gave medicine such as H2-blocker or proton-pump inhibitor to many patients who underwent cardiopulmonary bypass surgery, preventively. Therefore, H2-blocker or proton-pump inhibitor might prevent patients from single peptic ulcer. Moreover, no in-hospital deaths occurred, due to prompt treatment with blood transfusion and endoscopic ablation and/or clipping. Bacterial overgrowth, mucosal atrophy, loss of barrier function, and bacterial translocation are reported to occur due to intestinal changes following cardiopulmonary bypass.[14-16] Recently, urine intestinal fatty acid binding protein has been reported to be elevated in the presence of GICs and it has also been suggested that steroids can prevent the intestinal microcirculatory alterations that occur after cardiopulmonary bypass. By performing blood transfusion and emergent endoscopic ablation and/or clipping, it appeared that mortality was avoided among the present cases. We concluded that prediction of GIC from relevant risk factors and treatment with blood transfusion and prompt endoscopic ablation and/or clipping are essential.

References

1. Ohri SK, Desai JB, Gaer JA, et al. Intraabdominal complications after cardiopulmonary bypass. *Ann Thoracic Surg* 1991; **52**: 826–31.
2. Sakorafas GH, Tsiotos GG. Intra-abdominal complications after cardiac surgery. *Eur J Surg* 1999; **165**: 820–7.
3. Ghosh S, Roberts N, Firmin RK, Jameson J, Spyt TJ. Risk factors for intestinal ischaemia in cardiac surgical patients. *Eur J Cardiothorac Surg* 2002; **21**: 411–6.
4. Zacharias A, Schwann TA, Parenteau GL, et al. Predictors of gastrointestinal complications in cardiac surgery. *Tex Heart Inst J* 2000; **27**: 93–9.
5. Moriyama Y, Toyohira H, Shimokawa S, et al. Gastrointestinal complications after open cardiac operation. *Kyobu Geka* 1993; **46**: 1122–5. (in Japanese)
6. Huddy SPJ, Joyce WP, Pepper JR. Gastrointestinal complications in 4473 patients who underwent cardiopulmonary bypass surgery. *Br J Surg* 1991; **78**: 293–6.
7. Reath DB, Maull KI, Wolfgang TC. General surgical complications following cardiac surgery. *Am Surg* 1983; **49**: 11–4.
8. Gonzalez OA, Orozco MA, Barrera ZL, et al. Abdominal complications after cardiopulmonary procedures. *Rev Gastroenterol Mex* 1999; **64**: 61–9.
9. Aouifi A, Piriou V, Bastien O, et al. Severe digestive complications after heart surgery using extracorporeal circulation. *Can J Anaesth* 1999; **46**: 114–21.
10. Krasna MJ, Flancbaum L, Trooskin SZ, et al. Gastrointestinal complications after cardiac surgery. *Surgery* 1988; **104**: 773–80.
11. Valentine RJ, Hagino RT, Jackson MR, et al. Gastrointestinal complications after aortic surgery. *J Vasc Surg* 1998; **28**: 404–12.
12. Byhahn C, Strouhal U, Martens S, Mierdl S, Kessler P, Westphal K. Incidence of gastrointestinal complications in cardiopulmonary bypass patients. *World J Surg* 2001; **25**: 1140–4.
13. Feiner H. Pancreatitis after cardiac surgery: a morphologic study. *Am J Surg* 1976; **131**: 684–8.
14. Baue AE. The role of the gut in the development of multiple organ dysfunction in the cardiopulmonary patients. *Ann Thoracic Surg* 1993; **55**: 822–9.
15. Sack FU, Reidenbach B, Dollner R, Schledt A, Gebhard MM, Hagl S. Influence of steroids on microvascular perfusion injury of the bowel induced by extracorporeal circulation. *Ann Thoracic Sur*g 2001; **72**: 1321–6.
16. Holmes JH IV, Lieberman JM, Probert CB, et al. Elevated intestinal fatty acid binding protein and gastrointestinal complications following cardiopulmonary bypass: a preliminary analysis. *J Surg Res* 2001; **100**: 192–6.