

Simultaneous operation for cardiac disease and gastrointestinal malignancy

Teruo Komokata, Mikio Fukueda, Mamoru Kaieda, Takayuki Ueno, Yoshihumi Iguro, Yutaka Imoto, Ryuzo Sakata

Teruo Komokata, Mamoru Kaieda, Takayuki Ueno, Department of Surgery, Kagoshima Medical Center, National Hospital Organization, Kagoshima 892-0853, Japan

Mikio Fukueda, Yoshihumi Iguro, Yutaka Imoto, Cardiovascular and Gastroenterological Surgery, Kagoshima University Graduate School of Medical and Dental Sciences, Kagoshima 890-8520, Japan

Ryuzo Sakata, Cardiovascular Surgery, Kyoto University Hospital, Kyoto 606-8397, Japan

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Correspondence to: Teruo Komokata, MD, PhD, Department of Surgery, Kagoshima Medical Center, National Hospital Organization, 8-1 Shiroyama, Kagoshima 892-0853, Japan. komokata@kagomc2.hosp.go.jp

Telephone: +81-99-2231151 Fax: +81-99-2269246

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long-term outcomes were evaluated.

RESULTS: Postoperative complications occurred in 5 patients (33.3%), including strokes ($n = 1$), respiratory failure requiring re-intubation ($n = 1$), hemorrhage ($n = 2$), hyperbilirubinemia ($n = 1$) and aspiration pneumonia ($n = 1$). There was 1 hospital death caused by the development of adult respiratory distress syndrome after postoperative surgical bleeding followed aortic valve replacement plus gastrectomy. There was no cardiovascular event in the patients during the follow-up period. The cumulative survival rate for all patients was 69.2% at 5 years.

CONCLUSION: Simultaneous procedures are acceptable for the patients who require surgery for both cardiac diseases and gastrointestinal malignancy. In particular, the combination of a standard cardiac operation, such as coronary artery bypass grafting or an isolated valve replacement and simple gastrointestinal resection, such as gastrectomy or colectomy can therefore be safely performed.

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Abstract

AIM: To investigate the safety of performing simultaneous cardiac surgery and a resection of a gastrointestinal malignancy.

METHODS: Among 3664 elective cardiac operations performed in adults at Kagoshima University Hospital from January 1991 to October 2009, this study reviewed the clinical records of the patients who underwent concomitant cardiac surgery and a gastrointestinal resection. Such simultaneous surgeries were performed in 15 patients between January 1991 and October 2009. The cardiac diseases included 8 cases of coronary artery disease and 7 cases with valvular heart disease. Gastrointestinal malignancies included 11 gastric and 4 colon cancers. Immediate postoperative and

Key words: Simultaneous operation; Cardiac disease; Gastrointestinal malignancy; Gastric cancer; Colon cancer

Core tip: Simultaneous surgical interventions for cardiovascular and gastrointestinal pathology have not been well adapted so far. Staged procedure, depending on the clinical priority is usually preferred. Concomitant cardiac and gastrointestinal surgery holds a bundle of advantages with some challenges. We reviewed the outcome in 15 patients who underwent simultaneous cardiovascular and gastrointestinal surgery at Kagoshima University Hospital. Postoperative complications were noted in 5 cases, with 1 death. No adverse cardiovascular events were noted during follow up. The cumulative survival rate for all patients was 69.2% at 5

years. Synchronized cardiovascular and gastrointestinal procedures can be safely performed when needed.

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INTRODUCTION

The prevalence of cardiovascular disease and malignant disease has been increasing as the proportion of elderly individuals in the general population increases in developed countries^[1]. Therefore, physicians may encounter a patient with concomitant occurrence of cardiovascular disease and malignant diseases. In general, patients with both cardiovascular disease that requires surgery and a surgically resectable malignancy are treated in a staged procedure depending on the clinical priority. Simultaneous procedure are rare because the surgeon's anxiety that the incidence of complications may be higher in patients undergoing a simultaneous procedure than in those undergoing isolated cardiac surgery or gastrointestinal resection. However, a simultaneous approach would be attractive for such patients, because limiting them to a single exposure to anesthesia and one recovery period remove the potential opportunity for perioperative cardiovascular events, and moreover provide economic benefits. The recent advances in anesthesia, surgical techniques and perioperative management have allowed for combined operations to be conducted, so several studies have validated the concept that a simultaneous operation can be safely performed in a limited population of patients^[2-9].

Most of them are reports concerning a combined procedure that includes a pulmonary resection and cardiac operation^[2-5], and there are a few studies on the combination surgery of the heart and a gastrointestinal malignancy^[6-9]. This report presents a series of 15 patients who underwent concomitant cardiac surgery and gastrointestinal resection to assess the safety of a simultaneous procedure.

MATERIALS AND METHODS

There were 3664 elective cardiac operations performed in adults at Kagoshima University Hospital from January 1991 to October 2009. This study reviewed the clinical records of the patients who underwent concomitant cardiac surgery and a gastrointestinal resection. Fifteen of these patients (0.4%) underwent a simultaneous procedure. The records of the patients were reviewed for the type of surgical procedure, complications, and the duration of the stays in the intensive care unit (ICU) and hospital. The long-term outcome was determined using hospital records and through direct contact with the patients

and their family physicians. The values are expressed as the mean \pm SD. Survival was estimated by the Kaplan-Meier method using the date of the combined procedure as the starting point and the date of death or last follow-up as the end-point.

RESULTS

Clinical presentation

The preoperative characteristics of the patients are summarized in Table 1. The subjects included of 11 males and 4 females with an average age of 72.3 ± 7.4 years, of whom 8 were treated for coronary artery disease (CAD) and 7 impaired valvular heart disease. CAD involved two vessels in 2 patients, three vessels in 4 patients, and the left main trunk in 2 patients. Valvular heart diseases included aortic stenosis in 4 patients, mitral stenosis accompanying with left atrial thrombus in 2 patients, and severe mitral regurgitation in one patient. The left ventricular ejection fraction assessed by ventriculography or echocardiography ranged from 36% to 81% with an average of $63.6\% \pm 12.1\%$.

Gastrointestinal malignancies included 11 patients with gastric cancer and 4 patients with colon cancer. Only one gastric cancer was located in the fundus, the other 10 lesions were in the body or antrum of the stomach. All gastric cancers were preoperatively diagnosed as early stage and no distant metastasis or multiple lymph nodes metastasis was detected radiologically. All 4 colon cancers (transverse 1, descending 1, sigmoid 1, cecum 1) were in advanced stages and one of them had multiple liver metastases preoperatively. The most common symptoms associated with the gastrointestinal malignancies were anemia, weight loss, and gastrointestinal tract bleeding. Five patients were first diagnosed as having cancer and cardiac disease was discovered during the preoperative assessment. The remaining 10 patients presented with cardiac symptoms, resulting from myocardial ischemia or valvular heart disease, classified as NYHA functional class from I to III, and thus were found incidentally to have an asymptomatic gastrointestinal cancer.

Preoperative comorbidities included renal failure in 2 patients (1 patient required hemodialysis), diabetes controlled by oral agents in 2 patients, and chronic obstructive pulmonary disease (COPD) in one patient, in which the percentage of vital capacity was 81.1% and the forced expiratory volume at 1 s was 54.9%.

Surgical procedures

The surgical procedures carried out are listed in Table 2. All were elective procedures. The simultaneous procedures included aortic valve replacement (AVR) plus gastrectomy in 4 patients, mitral valve replacement plus gastrectomy in 3 patients, AVR plus colectomy in 1 patient, off-pump coronary artery bypass grafting (OP-CAB) plus gastrectomy in 4 patients, and coronary artery bypass grafting (CABG) plus colectomy in 3 patients. The cardiac surgery was performed first in all but 1 (case

Table 1 Preoperative characteristics

No.	Age (yr)	Sex	Cardiac disease	EF (%)	Gastrointestinal cancer		Comorbidities
					Type	Stage	
1	63	F	MS + LA thrombus	69	Gastric	I B	CVD
2	73	F	MR + TR	78	Gastric	I A	-
3	78	M	CAD (LMT)	61	Colon (T)	III B	-
4	76	M	CAD (2) ¹	47	Colon (D)	II	DM
5	61	M	MS + LA thrombus	65	Gastric	I A	CRF (HD)
6	81	M	AS	78	Gastric	I A	-
7	66	M	CAD (3)	65	Gastric	I A	CVD
8	62	M	CAD (3)	70	Gastric	II	CVD, DM
9	85	M	AS	64	Gastric	II	COPD
10	72	F	CAD (3)	36	Gastric	I A	-
11	76	M	CAD (2)	55	Gastric	I A	-
12	73	M	CAD (LMT)	54	Gastric	I A	CRF
13	65	M	CAD (3)	60	Colon (C)	IV	Liver metastasis
14	79	F	AS	81	Gastric	I B	-
15	74	M	AS	71	Colon (S)	III B	-

¹Parenthetic figure shows number of involved coronary artery. EF: Ejection fraction; CVD: Cerebrovascular disease; DM: Diabetes mellitus; CRF: Chronic renal failure; LMT: Left main trunk disease; HD: Hemodialysis; COPD: Chronic obstructive pulmonary disease; T: Transverse; D: Descending; C: Cecum; S: Sigmoid; CAD: Coronary artery disease; AS: Aortic stenosis; MS: Mitral stenosis; TR: Tricuspid regurgitation; MR: Mitral regurgitation; LA: Left atrial.

Table 2 Surgical procedures and results

No.	Cardiac procedures	Abdominal procedures	Postoperative complications	Follow-up (mo)	Results	Causes of death
1	MVR + TAP	Total gastrectomy	-	81	Dead	Cancer recurrence
2	MVR + TAP	Distal gastrectomy	-	135	Dead	Renal failure
3	CABG (2)	Right hemicolectomy	-	150	Alive	-
4	CABG (3)	Left hemicolectomy	-	53	Dead	Cancer recurrence
5	MVR	Partial gastrectomy	-	84	Dead	Suffocated
6	AVR	Distal gastrectomy	-	90	Alive	-
7	OPCAB (4)	Distal gastrectomy	-	72	Alive	-
8	OPCAB (5)	Distal gastrectomy	-	84	Alive	-
9	AVR	Distal gastrectomy	Bleeding	2	Dead	Respiratory failure
10	CABG (4)	Distal gastrectomy	Cerebral infarction	28	Alive	-
11	OPCAB (2)	Distal gastrectomy	-	25	Alive	-
12	OPCAB (3)	Distal gastrectomy	Aspiration pneumonia	21	Alive	-
13	OPCAB (3)	Ileocecal resection	-	17	Dead	Liver failure
14	AVR	Total gastrectomy	Bleeding	8	Alive	-
15	AVR	Sigmoidectomy	Hyperbilirubinemia	3	Alive	-

CABG: Coronary artery bypass grafting; AVR: Aortic valve replacement; OPCAB: Off-pump coronary artery bypass grafting; CABG: Coronary artery bypass grafting; MVR: Mitral valve replacement; TAP: Tricuspid annuloplasty.

No. 3), who underwent colectomy, followed by CABG. The gastrointestinal resections were conducted after the cardiac procedure was completed and heparin treatment was reversed to prevent excessive surgical bleeding. All gastrointestinal resections were carried out using standard techniques to accomplish complete resection of cancer and lymph node dissection, except for one case that was complicated with liver metastasis. All cardiac operation were performed through median sternotomy, and then the skin incision of median laparotomy for gastrointestinal resection was selected to avoid contact with a chest skin incision to prevent the mediastinitis.

Short-term results

The total operative time was 512.8 ± 85.4 min (range, 420 to 635 min). Ten patients were placed on cardiopulmonary bypass (CPB) for 72 to 144 min, with an average of

116.3 ± 16.0 min. The average amount of intraoperative bleeding was 1256.2 ± 1127 mL (range 330 to 4200 mL). All operations were performed without intraoperative incidents. The average ICU stay was 3.15 ± 1.98 d (range 1 to 8 d). The duration of postoperative ventilatory assistance was 35.1 ± 28.96 h (range 8 to 116 h). The mean postoperative hospital stay was 19.1 ± 2.7 d (range 8 to 51 d).

Five patients (33.3%) experienced postoperative complications. One patient had aspiration pneumonia and required re-intubation on postoperative day 4 for an additional 6 d. Cerebral infarction occurred in 1 patient, and this resolved with medical treatment. A transient increase in total bilirubin occurred in 1 patient (max value: 8 mg/dL), and the bilirubin values were returned to normal by conservative therapy. Surgical bleeding complications occurred in two patients who required reoperation

for bleeding from the chest or abdomen. One was an 83-year-old man who had COPD, underwent AVR and distal gastrectomy simultaneously, and suffered massive bleeding from chest drainage tube postoperatively. He temporarily recovered after the reoperation to treat the bleeding. However, Methicillin-resistant *Staphylococcus aureus* pneumonia developed shortly after the surgery and he died of respiratory failure 10 wk after undergoing the initial surgery. No clinical anastomotic leaks related to the gastrointestinal surgery and cardiovascular events were observed in the early postoperative period. In addition no mediastinitis, both wound infection and mechanical valve infection occurred. The remaining 10 patients were uneventful during postoperative course.

The surgical stage of the gastric cancers was stage I A (defined by tumor-node-metastasis classifications) in 7 patients, stage I B in 1 patient, and stage II in 2 patients. All patients with colon cancer were in advanced stages, and thus one patient was in Stage II, two patients were in stage III B, and one patient was in stage IV. Three received postoperative chemotherapy for the treatment of colon cancer.

Long-term results

Fourteen of 15 patients were discharged, and 6 of them died during the follow-up period, which averaged 56.9 ± 47.1 mo (range, 2 to 149 mo). The patient with multiple bilobar liver metastases before the surgery died of liver failure at 17.2 mo. Two patients died of cancer recurrence at 80.8 and 53.4 mo after operation.

The causes of death of the other 2 patients were suffocation and renal failure. Six of 14 patients are currently alive without evidence of recurrence after surgery, and have experienced no cardiovascular events during the long-term follow-up. The cumulative survival rates for all patients undergoing simultaneous procedures were 69.2% at 5 years.

DISCUSSION

The treatment of patients who require surgery for both cardiac disease and gastrointestinal malignancy is still controversial. A staged procedure depending on the clinical priority is usually preferred because most surgeons assume that the prolonged operative time and extensive surgical invasiveness associated with simultaneous procedures must increase the surgical morbidity and mortality. However, there are also several unfavorable issues associated with a staged procedure. For instance, when an isolated cardiac operation is performed before gastrointestinal resection, the malignant lesion may develop massive gastrointestinal bleeding due to the heparinization required for CPB, and moreover untreated cancer may progress during the interval prior to the second operation. On the contrary, postoperative cardiovascular complication may occur during gastrointestinal resection and that could be fatal^[10]. The concomitant approach, could resolve those problem. Although a simultaneous procedure is apparently attractive, it is necessary to ensure the

safety so that this approach can be generally accepted. This study focused on the safety and indications of simultaneous procedures.

Most of the simultaneous procedures in the present series were performed successfully in short-term period. The hospital mortality and morbidity rate was 6.6% and 33.3%, respectively, and the outcome was quite acceptable.

One of surgeon's prime concerns about the safety of simultaneous operations is that CPB has several disadvantageous systemic effects including bleeding disorders, thrombotic complications, massive fluid shifts and immunosuppression, all associated with homeostatic disruption. Furthermore, CPB is also associated with mesenteric ischemia, which may contribute to varying degrees of organ damage^[11,12].

Cerebral infarction and hyperbilirubinemia, which are the most common complications associated with CPB, occurred in one patient each, but those resolved with medical treatment. There were no postoperative gastrointestinal complications related to resection and reconstruction, such as anastomosis leakage, ileus and bleeding. Only one patient unfortunately died of respiratory failure after an early reoperation for postoperative bleeding from the chest, and he was a person of advanced age with COPD and was a high risk case. The postoperative occurrence of bleeding associated with abnormal blood coagulation following CPB and systemic heparinization, which is one of the most dreaded complications, may frequently be life-threatening for high risk patients in disrupted homeostasis. Therefore, the management of bleeding should be ensured with caution at the end of cardiac surgery. OPCAB is preferable to avoid the adverse effects of CPB, and improve the outcome of a combined operation by allowing gastrointestinal resection to be performed safely^[13,14]. OPCAB was performed in all of the 4 patients in the current series, and their postoperative courses were favorable. OPCAB should be selected whenever possible in patients with severe coronary disease undergoing combined procedure.

Most cardiovascular surgeons have concern that the addition of clean-contaminated operation to cardiac operation would increase the incidence of postoperative infection; wound infection, mediastinitis and mechanical valve infection. However, there was no incidence of surgical site infection in this series, thus routine management of infection, using prophylactic antibiotics, sterilization of the surgical field, and separation of an each skin incision, was able to adequately prevent postoperative infectious complications in simultaneous operation.

This study cannot conclude that the hospital morbidity and mortality of patients undergoing simultaneous procedure are better than that of staged procedures, and cannot clarify whether simultaneous operations contribute benefits to patients over a long term period. However the current experience demonstrated that the combination of standard cardiac operations, such as CABG or single valve replacement, and uncomplicated gastrointestinal resections such as gastrectomy or colectomy was

safe and favorable excluding patients with serious comorbidities or poor cardiac function.

The result of this study suggest that, the simultaneous procedures are an acceptable alternative for selected patients, but further studies are necessary to determine the role of the two strategies for patients with cardiovascular disease and concurrent gastrointestinal malignancy.

COMMENTS

Background

Patients requiring surgical intervention for gastroenterological pathology and cardiac events mostly entail careful attention. A surgeon has to weigh the pros and cons, and decisions are sometimes cumbersome especially when simultaneous surgery has to be performed. However concomitant cardiac and gastrointestinal surgery holds some advantages at times, like limiting the patients to single exposure of anesthesia, same recovery time along with economic benefits. The aim of the study was to assess the safety and outcome of simultaneous procedure. On reviewing the outcome in 15 patients who underwent simultaneous surgical procedure, the overall outcome was found to be satisfactory.

Research frontiers

The authors retrospectively studied the outcome in the patients who underwent concomitant cardiac and gastrointestinal surgery. Same time, the authors analyzed the publish literature on concomitant surgery.

Innovations and breakthroughs

Despite advances in surgery, anesthesia, surgical skills and the high tech settings; the surgeons may find themselves reluctant to perform concomitant cardiac and gastrointestinal surgery. This study evaluated the outcome in 15 cases of simultaneous surgery. Immediate and delayed postoperative outcomes were found to be satisfactory.

Applications

The result suggests that concomitant cardiac and gastrointestinal surgery can be safely performed when required.

Terminology

Simultaneous operation, cardiac disease, gastrointestinal malignancy, gastric cancer, colon cancer.

Peer review

This is a retrospective study to assess the outcomes of concomitant surgery for gastrointestinal pathology with cardiac events. Simultaneous gastrointestinal and cardiac surgery may have an appropriate outcome and can be safely performed.

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