

## Original Article

### *Gastrointestinal Complications After Cardiac Surgery*

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#### ABSTRACT

**Background:** Gastrointestinal (GI) complications occur after 0.4–2.9% of cardiac surgery procedures. Although infrequent, GI complications constitute some of the most serious complications of cardiac surgery with a high associated morbidity and mortality rate of 14–63%. In this study, we aimed to determine the incidence of and the risk factors for GI complications following open-heart surgery.

**Methods:** In this retrospective study, 800 adult patients who underwent valvular surgery, coronary artery bypass grafting (CABG), combined procedures, aortic surgery, and the surgical correction of adult congenital heart defects in Rajaie Cardiovascular, Medical, and Research Center between April 2014 and May 2016 were studied. The clinical data on any GI complication—including its incidence, characteristics, diagnostic measures, mortality, and medical or surgical management—were retrospectively analyzed. Statistical analysis was performed using a non-paired Student *t*-test and the  $\chi^2$  test.

**Results:** A total of 800 patients underwent open cardiac surgery: 340 (42.5%) had CABG, 290 (36.3%) had valve surgery, 120 (15%) had combined procedures (valve surgery + CABG), 15 (1.9%) had aortic surgery, and 35 (4.3%) had congenital defect correction. Among these patients, GI complications were seen in 36 patients, with an incidence rate of 4.5%. The total mortality rate was 11.1%. Our results revealed that advanced age, a prolonged cardiopulmonary bypass time, prolonged mechanical ventilation, a history of peptic ulcer, and the use of inotropic support or intra-aortic balloon pumps were the risk factors for GI complications after cardiac surgery.

**Conclusions:** GI complications following cardiac surgery have a low incidence rate but high morbidity and mortality rates. Primary detection and prompt appropriate intervention are essential for the outcome of the patients. (*Iranian Heart Journal 2019; 20(2): 56-61*)

**KEYWORDS:** Gastrointestinal complications, Cardiac surgery, Complications, Cardiac surgery, Acute mesenteric ischemia, Cardiopulmonary bypass

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Received: August 28, 2018

Accepted: December 3, 2018

**G**astrointestinal (GI) complications occur after 0.4–2.9% of cardiac surgery procedures.<sup>1</sup> Although infrequent, GI complications are deemed serious complications of cardiac surgery with a high associated morbidity and mortality rate of 14–63%.<sup>2,3</sup> The most common reported GI complications include bleeding, pancreatitis, perforated ulcer, mesenteric ischemia, ileus obstruction, cholecystitis, and diverticulitis.<sup>4</sup> Despite the advances made in the areas of anesthesia, extracorporeal circulation, surgical techniques, perfusion technologies, and postoperative care, the rate of GI complications is still high following cardiac surgery.<sup>5</sup> It can be a challenge to reach an early diagnosis of such complications. Unfortunately, patients with GI complications frequently present with atypical symptoms, often have severe underlying diseases, and may be unable to describe symptoms or react to examination due to mechanically ventilated sedation and analgesia. In addition, the symptoms may be overshadowed by severe cardiac and pulmonary conditions.<sup>5,6,7</sup> There is a growing belief that splanchnic perfusion during cardiopulmonary bypass (CPB) may not be adequate for metabolic needs and, thus, contributes to the development of GI complications.<sup>8</sup> What usually ensues is prolonged mechanical ventilation and intensive care unit (ICU) and hospital lengths of stay as well as additional invasive procedures such as surgery and endoscopy, all of which increase the cost of hospitalization.<sup>9,10,11</sup> In this study, we aimed to determine the incidence of and the risk factors for GI complications following open-heart surgery.

## METHODS

In this retrospective study, 800 adult patients who underwent valvular surgery, coronary artery bypass grafting (CABG), combined procedures, aortic surgery, and the surgical correction of adult congenital heart defects in

Rajaie Cardiovascular, Medical, and Research Center between April 2014 and May 2016 were studied. The exclusion criteria consisted of off-pump CABG and thoracic or thoracoabdominal aortic surgery. Every operation involved the use of moderately hypothermic (28–32°C) CPB perfusion. Myocardial preservation was achieved with cold (4°C) crystalloid cardioplegia solutions and warm blood via both antegrade and retrograde techniques, supplemented with topical hypothermia in the pericardial cavity. During CPB, the hematocrit level was kept minimally at 22–25%. All the patients had a nasogastric tube placed in the operating room, and the tube remained in place for a minimum of 12 hours after the operation and longer if the patient remained intubated. They also received prophylactic intravenous antibiotics and conventional blood or liquid infusion, if necessary. In patients with a postoperative low cardiac output, inotropic drug support was required, with or without the insertion of the intra-aortic balloon pump (IABP). The routine inotropic drug support consisted of dopamine/duobafendin or amrinon/milrinone, combined with additional vasoconstrictors such as adrenalin and phenylephrine, if necessary. Postoperatively, all the patients underwent a routine prophylactic antacid treatment against ulcers with ranitidine in the ICU. A proton-channel blocker (pantoprazole) was only used in patients with a history of ulcers. Anticoagulant therapy was applied in all cases that had undergone valve(s) replacement and/or vascular prosthesis implantation. GI complications were classified as follows: GI hemorrhage, gastroduodenal perforation, paralytic ileus, acute calculus cholecystitis, acute calculus cholecystitis, and ischemic bowel disease. The clinical data on any GI complication—including its incidence, characteristics, diagnostic measures, mortality, medical or surgical management, and relative risks—were retrospectively analyzed.<sup>7</sup> Statistical analysis was performed using a non-paired Student *t*-test and the  $\chi^2$  test. The

statistical analyses were performed using the SPSS software, version 21, for Windows (SPSS Inc, Chicago, IL, USA). A  $P$  value  $< 0.05$  was considered statistically significant.

## RESULTS

Out of the 800 patients, 464 (58%) were men and 336 (42%) were women at a mean age of  $68 \pm 13.5$  years. The mean weight was 68.6 kg, and the body mass index was 21.8. The operative procedures were comprised of CABG, isolated valve surgery, combined CABG and valve surgery, and the surgical correction of adult congenital heart defects. Totally, 411 (62.7%) patients were placed on the pump for a maximum of 100 minutes and 228 (37.3%) patients experienced it for longer than 100 minutes. The demographic and operative characteristics of all the patients are illustrated in Table 1. In addition, 495 (61.8%) patients had hypothermia over  $30^\circ\text{C}$  and 305

(38.2%) experienced hypothermia  $\leq 28^\circ\text{C}$ . For all the study participants, the mean arterial pressure was 65 mm Hg during cardiac surgery. A total of 800 patients underwent open cardiac surgery: 340 (42.5%) had CABG, 290 (36.3%) had valve surgery, 120 (15%) had combined procedures (valve surgery + CABG), 15 (1.9%) had aortic surgery, and 35 (4.3%) had congenital defect correction. Among these patients, GI complications were seen in 36 patients, with an incidence rate of 4.5%. The total mortality rate was 11.1%, as opposed to 1.3% in the patients without GI complications ( $P < 0.0001$ ). The mortality and morbidity in the patients with and without postoperative GI complications are presented in Table 2. Nine patients needed surgical treatment, and medical handling was applied in the remaining patients. The results of the logistic regression analysis of the risk factors for GI complications after cardiac surgery are depicted in Table 3.

**Table 1.** Incidence of complications and mortality with respect to different GI complications

Complication	Patients	Incidence	Laparotomies	Deaths	Mortality(%)
GI bleeding	8	22.2	0	0	0
Paralytic ileus	12	33.3	0	0	0
Acute cholecystitis	5	13.8	5	0	0
Pancreatitis	4	11.1	1	0	0
Gastroduodenal perforation	2	2.7	1	1	50
Ischemic bowel disease	2	5.5	2	2	100
Hepatic dysfunction	4	11.1	0	1	25
Total	36	4.5	9	4	11.1

GI, Gastrointestinal

**Table 2.** Mortality and morbidity in the patients with and without postoperative GI complications

	Without GI Complications	With GI Complications	P value
Mortality	1.3%	11.1%	$< 0.0005$
Mean intensive care stay (d)	$3.8 \pm 2.97$	$11.25 \pm 8.63$	$< 0.003$
Mean hospital stay (d)	$11.23 \pm 3.15$	$27.35 \pm 9.65$	$< 0.005$

GI, Gastrointestinal

The patients with GI complications had a longer ICU stay and a higher mortality rate, while the late appearance of GI complications was associated with a prolonged hospital stay (Table 2).

According to our logistic regression analysis, advanced age, a prolonged CPB time, prolonged mechanical ventilation, a history of peptic ulcer, and the use of inotropic support or the IABP were the risk factors for GI complications after cardiac surgery (Table 3).

**Table 3.** Logistic regression analysis of the risk factors for gastrointestinal complications after cardiac surgery

	Regression coefficient	Partial correlation coefficient	Standard error of the mean	P value
Advanced age	0.481	0.113	0.321	< 0.05
Prolonged CPB time	0.234	0.125	0.285	< 0.05
Prolonged mechanical ventilation	0.142	0.217	0.034	< 0.05
History of peptic ulcer	0.371	0.129	0.311	< 0.05
Use of inotropic support or IABP	0.135	0.211	0.174	< 0.05

CPB, Cardiopulmonary bypass; IABP, Intra-aortic balloon pump

## DISCUSSION

The pathophysiology of GI complications after cardiac surgery has yet to be fully elucidated. A low cardiac output resulting in visceral hypoperfusion and mucosal ischemia and necrosis has been implied. Surgical trauma, anticoagulation, anesthesia, CPB, and hypothermia are responsible for triggering stress responses that may ultimately lead to visceral organ injury. CPB has also been implicated in the development of micro emboli, increase in intestinal permeability, free radical production through ischemia reperfusion injury, splanchnic hypoperfusion, and gastric mucosal acidosis.<sup>12</sup> Previous studies have reported that complications after cardiac surgery are relatively rare, with an incidence ranging from 0.3–2% and a high mortality rate of 11–59%.<sup>13,14</sup> For example, the inpatient mortality rate of patients who developed ischemic bowel disease or gastroduodenal perforation was as high as 100% and 50%, respectively. In our study, the incidence of GI complications in patients undergoing cardiac surgery was 4.5% with a mortality rate of 11.1%, both of which are consistent with the existing reports. Despite improvements in perioperative care, monitoring, anesthesia, and operative techniques, the incidence and mortality of GI complications have not changed through the years.<sup>15,16</sup> In the current study, 5 possible predictors of GI complications after cardiac surgery were identified: older age, increased durations of CPB time, prolonged mechanical ventilation, a history of peptic ulcer, and the use of inotropic support or the IABP, which chimes

in with the studies by Gomez et al,<sup>17</sup> Karangelis et al,<sup>18</sup> Vassiliou et al,<sup>19</sup> Zhang et al,<sup>20</sup> Mangi et al,<sup>21</sup> Rodriguez et al,<sup>22</sup> Filsoufi et al,<sup>2</sup> Ashfaq et al,<sup>9</sup> and Gulkarov et al.<sup>13</sup> Vasoconstrictor drug therapy after cardiac surgery, exclusively norepinephrine and epinephrine, has been associated with a rise in mean arterial pressure and systemic blood flow; however, it is correlated with a decline in the splanchnic flow repartition of blood flow from the splanchnic to the systemic circulation.<sup>23</sup> In our study, we found a significant relationship between GI complications and a prolonged length of stay in the ICU and the hospital, which is consistent with the studies by Chaudhry et al,<sup>24</sup> Yapici et al,<sup>25</sup> and Rodriguez et al.<sup>22</sup>

## CONCLUSIONS

In conclusion, GI complications following cardiac surgery have a low incidence rate but high morbidity and mortality rates. The diagnosis of GI complications remains difficult because signs and symptoms are often subtle, or nonspecific, and this commonly leads to a delay in definitive diagnosis and treatment. Primary detection and prompt appropriate intervention are essential for the outcome of the patients.

### Acknowledgements

We hereby thank all the personnel of Rajaie Cardiovascular, Medical, and Research Center.

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