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Hepatic and gastrointestinal complications after adult cardiac surgery

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Abstract

Background: Gastrointestinal tract (GIT) complications are associated with increased morbidity and mortality after cardiac surgery. Therefore, the goal of this research was to estimate the frequency of GIT and hepatic complications after cardiac surgery and to determine the risk factors for these complications. Additionally, we studied the effect of these complications on the outcomes of surgery.

Methods: This longitudinal study included 139 consecutive patients who underwent elective cardiac surgery. Patients were grouped according to the GIT and hepatic complications into two groups. Postoperative outcomes were compared between the two groups.

Results: The mean age was 59.43 years, and 106 patients were males (76%). The GIT and hepatic complications rate were 15.8% (n= 22). Hepatic dysfunction occurred in 8.6% of cases, GIT bleeding in 2.9%, paralytic ileus in 2.2%, fulminant hepatic failure in 2.2%, and GIT bleeding combined with paralytic ileus in 0.7%. The overall mortality was 7.2 % (n= 10). The mortality rate in patients who developed GIT and hepatic complications was 45.5% (n= 10 out of 22 patients). There was statistically significantly higher mortality (10 (45.5%) vs. 0; P= 0.001), cardiac arrest (10 (45.5%) vs. 3 (2.6%); P= 0.001), and reoperation rate (5 (22.7%) vs. 6 (5.1%); P= 0.005) among patients with GIT or hepatic complications.

Conclusion: Patients with hepatic and GIT complications could have higher mortality, morbidity, and longer hospital stay than the non-complicated group.

KEYWORDS
Hepatic complications; Gastrointestinal complications; Cardiac surgery

Introduction

Hepatic dysfunction following cardiac surgery is underreported in the literature; however, it is worthy of mention because of its difficult management and fatal consequences. Hepatic dysfunction may present as mild hyperbilirubinemia, or much less commonly, as a hepatic failure as part of multi-system organ failure [1]. Clinical necessity and urgency to diagnose and manage as early as possible in the course of a patient's illness are supported by the fact that gastrointestinal tract (GIT) issues have changed little [2, 3]. Intestinal bleeding, ischemia, pancreatitis, cholecystitis, diverticulitis, and hepatic dysfunction are the most prevalent clinical consequences. The most common complications

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are an ileus or constipation, although it is clinically not relevant and is thus not documented as morbidity. Mortality rates of patients with GIT complications ranged from 10 to 60% [3].

Several risk factors contributed to gastrointestinal complications. Preexisting renal and hepatic dysfunction, renal failure, inotropic support, arrhythmia, an intra-aortic balloon pump, and prolonged mechanical ventilation contributed to gastrointestinal complications [1]. Previous studies indicated that perioperative hypo-perfusion of the splanchnic bed is the cause of developing these complications [1]. Patients' outcomes have improved in recent years because of the increased clinical focus on GIT problems that might arise following heart surgery [4]. However, morbidity and mortality associated with these complications are still high [3]. Therefore, the goal of this research was to estimate the frequency of GIT and hepatic complications after cardiac surgery and to determine the risk factors for these complications. Additionally, we studied the effect of these complications on the outcomes of surgery.

Patients and Methods

Design and patients

This research is a longitudinal prospective cohort study conducted on 139 cardiac surgery patients. Patients were included consecutively from October 2021 until April 2022. We included patients 18 years old or older who underwent elective cardiac surgery for coronary artery bypass graft (CABG) and valvular or aortic surgery. We excluded patients with a pregnancy, urgent or emergent cardiac surgery, terminal malignancies, congenital cardiac surgery, and patients who did not stop antiplatelet five days before surgery. Follow-up was done until patients were discharged from the hospital.

We obtained approval from the Research Ethics Committee in Benha Faculty of Medicine, and informed consent was obtained from all patients before the beginning of the study.

Data and definitions

The outcomes were measured during follow-up for GIT and hepatic complications. GIT complications included GIT bleeding, defined as the presence of hematemesis or melena with hemoglobin drop, hepatic dysfunction, defined as three folds increase above the upper reference level of liver enzymes, paralytic ileus included temporary paralysis of intestinal movements evident with sluggish or absence of intestinal sounds that improved spontaneously or medically without surgical intervention and hepatic encephalopathy include neuropsychiatric abnormalities associated with acute liver failure excluding central causes with CT brain.

Table 1: Patient characteristics of the studied patients

	(n= 139)
Age (years), mean± SD	59.3 ± 10.6
Male, n (%)	106 (76.26%)
Smoker, n (%)	6 (4.3%)
Total comorbidities, n (%)	125 (90%)
Hypertension, n (%)	83 (59.7%)
Diabetes mellitus, n (%)	66 (47.5%)
Cardiovascular disease unrelated to the surgery, n (%)	44 (31.7%)
Chronic kidney disease, n (%)	15 (10.8%)
Chronic respiratory disease, n (%)	10 (7.2%)
Cancer, n (%)	6 (4.3%)
Familial hypercholesteremia, n (%)	5 (3.6%)
Peptic ulcer, n (%)	2 (1.4%)
Epilepsy, n (%)	2 (1.4%)
Hypothyroidism, n (%)	2 (1.4%)
Hyperthyroidism, n (%)	2 (1.4%)
Rheumatoid arthritis, n (%)	1 (0.7%)
Marfan syndrome, n (%)	1 (0.7%)

Following admission, all patients were subjected to full clinical history, physical examination, bedside chest x-ray, and baseline 12-leads ECG. Laboratory investigations included complete blood picture, ALT (Alanine transaminase), total and direct bilirubin, coagulation profile (PC%, INR, PTT), arterial blood gases, central venous blood gases, serum lactate, and random blood glucose level. Imaging investigations, including abdominal ultrasonography, bedside echocardiography, and CT, were done if indicated.

Intraoperative data were collected. These data included type of surgery, number of grafts, valves repaired or replaced, cardiopulmonary bypass,

Table 2: Comparison of the baseline data between patients with GIT and hepatic complications (Group A) and non-GIT and hepatic complications (Group B). Data are presented as numbers and percentages or mean and standard deviation.

	Total (n= 139)	Group A (n= 22)	Group B (n= 117)	P-value
Hypertension	83 (59.7%)	14 (63.6%)	69 (59%)	0.68
Diabetes mellitus	66 (47.5%)	9 (40.9%)	57 (48.7%)	0.5
Stroke	2 (1.4%)	1 (4.5%)	1 (0.9%)	0.18
Chronic lung disease	10 (7.2%)	1 (4.5%)	9 (7.7%)	0.6
Chronic kidney disease	15 (10.8%)	4 (18.2%)	11 (9.4%)	0.22
Hypercholesteremia	5 (3.6%)	0 (0%)	5 (4.3%)	0.32
Peptic ulcer	2 (1.4%)	1 (4.5%)	1 (0.9%)	0.18
Liver cirrhosis	6 (4.3%)	2 (9.1%)	4 (3.4%)	0.23
Noncirrhotic liver disease	66 (47.5%)	8 (36.4%)	58 (49.6%)	0.25
abnormal liver function*	28 (20.1%)	9 (40.9%)	19 (16.2%)	0.008
Serum Creatinine	1.16 ± 0.71	1.32 ± 0.9	1.13 ± 0.67	.26
ALT (U/L)	29.20± 36.42	48.5± 81.54	25.57±17.03	.006
Serum bilirubin (mg/dl)	0.46 ± 0.66	1.08 ± 1.51	0.34 ± 0.13	.001
LVEF (%)	61.48± 12.33	58 ± 11.88	62.14±12.35	.15

* Defined as >35 in pre-ALT (alanine transaminase)
ALT: Alanine transaminase; LVEF: Left ventricular ejection fraction

cross-clamp, total operative times, colloid and crystalloid given, arrhythmia, inotropes, arrhythmia, urine output, and re-exploration.

Postoperative data included days of hospital stay, postoperative events, and laboratory results.

Statistical analysis:

The sample size was calculated using EPI-Info (Epidemiological information package) software version 6.1. Based on an estimated incidence of GIT and hepatic complications of (10%), a minimum sample size of 139 patients is required to have a margin of error of 5% and 95% confidence, with a study power of 80%.

The data were coded, entered, and processed using the Statistical package for social science (SPSS) (version 18) (IBM Corp, Armonk, NY, USA). The results were represented in tabular and diagrammatic forms and then interpreted. Mean, standard deviation, range, frequency, and percentage were used as descriptive statistics. The incidence rate of complications was presented as a percent with a 95% confidence interval. A comparison between groups with and without GIT and liver complications was made. Logistic regression analysis was performed to identify predictors of mortality. The Chi-Squared test was used to compare categorical data, and the student's t-test was used to compare continuous data. A P-value of <0.05 was considered statistically significant.

Results

Baseline data

There were 106 male patients, and the mean age was 59.4 years (range, 24–80). Smokers presented 4.3% of the study population. There were 83 hypertensives (59.7%), 66 diabetics (47.5%), 15 with chronic kidney disease (10.8%), and ten patients with chronic respiratory disease (7.2%). (Table 1)

The incidence of GIT and hepatic complications was 15.8% (95% CI 9.74-24.86) (22 out of 139 patients). The most common manifestations involved were hepatic dysfunction (8.6%) (95% CI 3.94-13.26), GIT bleeding (2.9%) (95% CI 0.11-5.69), paralytic ileus (2.2%) (95% CI 0-4.64), fulminant hepatic failure (2.2%) (95% CI 0-4.64) and GIT bleeding combined with paralytic ileus (0.7%).

GIT complication and hepatic dysfunction patients had a higher prevalence of hypertension (63.6% versus 59%), chronic kidney disease (18.2% versus 9.4%), and liver cirrhosis (9.1% versus

Table 3: Comparison of intraoperative data between patients with GIT and hepatic complications (Group A) and non-GIT cand hepatic complications (Group B). Data are presented as numbers and percentages or mean and standard deviation.

	Total (n= 139)	Group A (n= 22)	Group B (n= 117)	P-value
Number of grafts				
0	34 (24.5%)	8 (36.4%)	26 (22.2%)	0.13
1-2	6 (4.3%)	1 (4.5%)	5 (4.3%)	
3-4	91 (65.5%)	12 (54.5%)	79 (67.5%)	
5-6	8 (5.8%)	1 (4.5%)	7 (6%)	
Valve surgery				
0	88 (63.3%)	11 (50%)	77 (66.4%)	0.42
1-2	49 (35.3%)	11 (50%)	38 (32.5%)	
3-4	2 (1.4%)	0 (0%)	2 (1.7%)	
RCBS transfusion				
0	50 (36%)	11 (50%)	50 (36%)	0.001
1	25 (18%)	0 (0%)	25 (18%)	
2	25 (18%)	0 (0%)	25 (18%)	
3	14 (10%)	0 (0%)	14 (10%)	
4	7 (5%)	1 (4.5%)	7 (5%)	
>4	18 (13%)	10 (45.5%)	18 (13%)	
CPB time (h)	0.42±0.66	0.59±0.8	0.39±0.62	0.3

CPB: cardiopulmonary bypass, RBCs: red blood cells

3.4%). GIT complication and liver dysfunction patients had a statistically significant higher preoperative abnormal liver function (40.9% compared with 16.2%) (P=0.008). There were statistically significant differences between groups regarding preoperative alanine transaminase and serum bilirubin. (Table 2)

Operative data

There was no statistically significant difference between groups regarding the number of grafts and valves repaired or replaced. The number of PRBC blood transfusion were significantly higher in the GIT complications group (P= 0.001). (Table 3)

Postoperative data

The overall mortality after cardiac surgery was 7.2 % (n= 10) (95% CI 2.9-11.5). The mortality rate in patients who developed GIT and hepatic complications was 45.5% (n= 10 out of 22 patients) (95% CI 24.7-66.3). There were statistically significantly higher mortality, cardiac arrest, and reoperation rates among GIT and hepatic complications group. There were significantly higher serum creatinine, ALT, and bilirubin levels in patients with complications. IABP (number of days used postoperatively), total inotropic support, hospital and ICU stay days, and mechanical ventilation duration were significantly higher among patients with complications. (Table 4)

Mortality

There were statistically significant differences between survivors and nonsurvivors regarding myocardial infarction, stroke, chronic kidney disease, peptic ulcer, right ventricular failure, hepatic cirrhosis, and GIT complications. (Table 5)

Binary logistic regression analysis was conducted to detect predictors of mortality in all patients, revealing that right ventricular failure and GIT complications were significant predictors for patients' mortality. (Table 6)

Discussion

In the current study, the incidence of GIT and hepatic complications was 15.8% (22 out of 139 patients). The most common manifestations were hepatic dysfunction (8.6%), GIT bleeding (2.9%),

Table 4: Comparison of outcomes between patients with GIT and hepatic complications (Group A) and non-complications patients (Group B). Data are presented as numbers and percentages or mean and standard deviation

	Total (n= 139)	Group A (n= 22)	Group B (n= 117)	P-value
Mortality	10 (7.2%)	10 (45.5%)	0 (0%)	.001
Cardiac arrest	13 (9.4%)	10 (45.5%)	3 (2.6%)	.001
Reoperation	11 (7.9%)	5 (22.7%)	6 (5.1%)	.005
Arrhythmia	53 (38.1%)	11(50%)	42 (35.9%)	.21
serum creatinine (mg/dl)	1.64 ± 1.12	2.47 ± 1.84	1.49 ± 0.84	0.03`
ALT (U/dl)	139.25±565	689.27±1311.3	35.83± 18.77	0.001
Bilirubin (mg/dl)	0.67±1.29	2.31±2.73	0.38 ± 0.17	0.001
Days on IABP	0.24±1.39	1.09 ± 2.96	0.09 ± 0.75	0.002
Duration inotropic support	4.25 ±9.12	16.41±18.37	1.97±2.15	0.001
Hospital stay (days)	7.76±4.82	12.27±9.78	6.91±2.46	.001
ICU stay (days)	4.15 ±3.5	7.5 ± 6.47	3.52±2.11	.001
MV duration (days)	0.94±2.90	4.41±6.141	0.28±0.810	0.001
Sepsis	59 (42.4%)	9 (40.9%)	50 (42.7%)	.87

ALT: Alanine transaminase; IABP: Intra-aortic balloon pump; ICU: Intensive Care Unit; MV: Mechanical ventilation

paralytic ileus (2.2%), fulminant hepatic failure (2.2%), and GIT bleeding combined with paralytic ileus (0.7%). The overall mortality was 7.2 % (10 out of 139 patients). The mortality rate after GIT complications was 45.5% (10 out of 22 patients).

The pathophysiology of GIT complications following cardiac surgery has not been well elucidated. The low cardiac output resulting in visceral hypoperfusion and mucosal ischemia has been suggested as a causative agent [5]. Various stressors, including anesthesia, surgical trauma, anticoagulation, cardiopulmonary bypass, and decreased temperature, may cause visceral organ damage. Micro-embolism increased intestinal permeability, and free radicals via ischemia-reperfusion damage have all been linked to cardiopulmonary bypass [6].

Table 5: Comparisons of different characteristics among dead and survivors in total patients (n=139). Data are presented as numbers and percentages or mean and standard deviation

	Dead (n= 10)	Survived (n= 129)	P-value
Age (Years)	61.6±18.8	59.2±9.8	0.7
Sex (male)	8 (80%)	98 (76%)	0.77
Smokers	0 (0%)	6 (4.7%)	0.99
Body mass index (Kg/m2)	31.1±8.2	31.3±5.1	0.9
Hypertension	6 (60%)	77 (59.7%)	0.9
Diabetes mellitus	4 (40%)	62 (48.1%)	0.62
Arrhythmia	0 (0%)	10 (7.8%)	0.36
Myocardial infarction	4 (40%)	17 (13.2%)	0.02
Stroke	1 (10%)	1 (0.8%)	0.018
Chronic lung disease	1 (10%)	9 (7%)	0.7
Chronic-kidney disease	3 (30%)	12 (9.3%)	0.042
Hypercholesteremia	0 (0%)	5 (3.9%)	0.99
Peptic ulcer	1 (10%)	1 (0.8%)	0.018
Right ventricular failure	3 (30%)	6 (4.7%)	0.002
Hepatic cirrhosis	2 (20%)	4 (3.1%)	0.01
Non-cirrhotic hepatic pathology	4 (40%)	62 (48.1%)	0.62
GIT and hepatic dysfunction	10 (100%)	12 (9.3%)	0.001

The incidence of GIT complications after cardiac surgery ranges between 0.29 and 5.5% [7], with an overall mortality rate between 11 and 72% [5]. Most series suggest the incidence is between 1 and 2%, with a mortality of 30% [4]. In Australia, Saxena and coworkers [8] reported a 3% incidence of GIT complications in octogenarians compared to 1.3% in patients <80 years old after aortic valve replacement. Viana and associates [4] reported 27% GIT complication rate and the 68% liver dysfunction rate. The incidence of GIT hemorrhage following cardiac surgery was 0.39%, and mortality was 38%.

Table 6: Binary logistic regression for the predictors of mortality in total patients (n=139)

Variables	P-value	Odds ratio
Myocardial infarction	0.087	0.137
Stroke	0.076	0.023
Chronic kidney disease	0.23	0.267
Peptic ulcer	0.24	0.085
Right ventricular failure	0.02	0.053
GIT & hepatic complications	0.001	7.48

Marsoner and coworkers [9] found a 2.9% overall incidence of GIT complications and a 23% 30-day mortality for patients with GIT complications in their study of 4883 consecutive adult patients who had on-pump cardiac surgery. Gulkarov and collaborators [10] reported a GIT complication rate of 2.3% and a 30-day death rate of 39 after mitral valve surgery.

GIT hemorrhage was the most common abdominal complication following cardiac surgery reported by lazar and associates [11]. Only 36% of patients in our research had taken therapeutic anticoagulation to protect the integrity of the prosthetic valve. This could be a contributing factor to GIT bleeding in our cohort.

GIT problems ranged from 0.3 to 5.5%, with an average frequency of 1.2%. The reported related mortality ranged from 0.3% to 87.7%; however, the average mortality in modern investigations was 32% [12]. The most common complication reported was GIT bleeding, accounting for approximately 35% of GIT complications [13].

Other commonly reported complications included mesenteric ischemia (14% of GIT complications), pancreatitis, cholecystitis, and ileus [14]. Rare complications (<2.5% of GIT complications) included fulminant hepatic failure [15].

Approximately one-third of all GIT problems were caused by postoperative ileus, followed by GIT hemorrhage. However, fulminant hepatic failure, with a mortality rate of around 50%, is the most problematic [16]. Marsoner and coworkers [9] reported that all cases of paralytic ileus could be managed with endoscopic or medical therapy. Nevertheless, this subgroup's postoperative mortality was excessive at 26% due to multi-organ failure [1].

In this study, there were statistically significantly higher mortality, cardiac arrest, and reoperation rate among the GIT complication group. Moreover, there were significantly more elevated serum creatinine, ALT, and bilirubin levels in GIT complications. A number of univariable analyses have examined the association between chronic renal failure (CRF), acute renal failure (ARF), and gastrointestinal problems after heart surgery [17]. Gulkarov and coworkers [10] reported that chronic renal failure (CRF) was an independent determinant for GIT complications in 18% of patients who had GIT complications. Hess and associates [18] revealed a considerable increase in mortality and morbidity when GIT issues arise. Those with gastrointestinal issues had a mortality rate of 24.8% in the first 30 days.

Several studies have shown a relationship between short-term survival after heart surgery and GIT problems. Hospital mortality rates have been estimated to be as high as 34% to 87% [13]. A study conducted by Sabzi and colleagues [19] concluded that liver function tests showed a brief worsening following coronary artery bypass surgery. Hypoxia, pump-induced inflammation, or a reduction in hepatic blood flow may have contributed to the rise in levels. Chacon and associates [20] reported that hepatic failure might occur due to several risk factors after cardiac surgery. High preload chronic heart failure, New York Heart Association class II to IV, and poor

ejection fraction are all preoperative risk factors for right-sided heart failure.

Limitations of the study:

This study is limited by the number of patients included and the follow-up period. Additionally, the study is a single-center experience.

Conclusion

Patients who suffered from hepatic and GIT complications could have higher mortality, morbidity, and longer hospital stay than the non-complicated group.

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Conflict of interest: Authors declare no conflict of interest.

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