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RESEARCH ARTICLE

Causes of Excessive Bleeding in Patients Who Underwent Open-Heart Surgery During the Early Postoperative Period

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ABSTRACT

Objectives: This study aimed to identify the incidence and causes of excessive bleeding during the early postoperative phase of open-heart surgery.

Methods: The files of patients who underwent elective open-heart surgery between January 2019 and January 2021 were reviewed. Excessive bleeding was defined according to the amount of hemorrhage during the first 24 h. The patients were divided into the bleeding group (with excessive bleeding, Group B) and control group (no excessive bleeding, Group C). Patients' demographic data, clamping and pumping times, intraoperative interventions, and clinical data, such as the need for blood and blood product replacement in the intensive care unit, were obtained. Measurements were performed using Student's t-test, Mann–Whitney U test, Pearson's chi-squared test, and correlation test.

Results: The incidence of bleeding was 9.7%, and the rate of re-exploration was 33%. The presence of chronic obstructive pulmonary disease was significantly higher in Group B (p=0.006). The preoperative use of antiaggregants was significantly higher in Group B than in Group C (p=0.001). No significant difference was observed between the groups in terms of bleeding and coagulation laboratory values as well as the need for intraoperative replacement of blood and blood products. However, the need for postoperative replacement of blood and blood products was significantly higher in Group B (p<0.001). Female sex was found to be negatively correlated with bleeding (p=0.032). Furthermore, a positive correlation was observed between chronic obstructive pulmonary disease, presence of CRF, use of anticoagulant, EuroSCORE, ECD duration, cross-clamping (CC) duration, and bleeding. The incidence of anemia among the patients was 41%.

Conclusion: The incidence of excessive bleeding in the early postoperative period was 9.7%. Of the patients, 33% required surgical reopening. The presence of chronic obstructive pulmonary disease, preoperative antiaggregant use, high EuroSCORE, and long CC and CPB durations may lead to excessive bleeding and may be helpful parameters in the prediction of bleeding. To reduce the risk of postoperative bleeding, We believe that it is crucial to maintain patients' optimal health conditions in terms of comorbidities before surgery. This also includes discontinuing any medications that increase the risk of bleeding for appropriate periods before surgery. Additionally, the use of tranexamic acid and reducing the duration of surgery are other preventive measures that can be taken to minimize risks.

Keywords: Excessive bleeding, open-heart surgery, postoperative period

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Introduction

The requirement of blood transfusion after open-heart surgery is approximately 30%, and excessive bleeding occurs in at least 10% of patients in the early postoperative period.[1] The rate of bleeding surgical caused and requires reoperation in the early postoperative period is between 4% and 6%. There are various factors that affect bleeding during open-heart surgery. Dilution and hypothermia during extracorporeal circulation may trigger coagulation disorder by causing an inflammatory response in open-heart surgery. Excessive bleeding increases the need for transfusion of allogeneic blood and blood products, increasing the risk of transfusion-induced serious intraoperative and postoperative complications. Perioperative hypofibrinogenemia (plasma fibrinogen levels below 1.5–2.0 g/L) has been reported to be the leading cause of postoperative coagulation disorders.

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Fibrinogen levels have been demonstrated to decrease by 40%–50% during cardiac surgery due to dilution and fibrinolysis.[2] The type of surgery, prolonged extracorporeal circulation time, prolonged cross-clamping (CC) duration, acute normovolemic hemodilution (ANH), on-pump ultrafiltration (UF), use of a cell saver, use of tranexamic acid (TXA) and/or methylprednisolone, preoperative anemia, thrombocytopenia, and use of preoperative medications have been reported to be the causes of postoperative bleeding.[1,3,4]

This retrospective study aimed to determine the incidence of excessive bleeding in the early postoperative period and to explore the factors that may cause bleeding in patients who underwent open-heart surgery in our clinic between January 2019 and January 2021.

Methods

This study was approved by the ethics committee of the Manisa Celal Bayar University Faculty of Medicine (approval date: 02/03/2021; approval no.: 33433. The anesthesia and intensive care follow-up cards of the patients were cross-sectionally analyzed. All the patients underwent open-heart surgery in Manisa Celal Bayar University Faculty of Medicine Hafsa Sultan Hospital Cardiovascular Surgery Center between January 2019 and January 2021. The study was conducted in accordance with the principles of the Declaration of Helsinki. Patients who were aged >18 years, underwent open-heart surgery, and were elective were included in the study. Pregnant women, patients in emergency cases, and patients with missing file information were excluded. Age, sex, presence of chronic diseases (diabetes mellitus, rheumatic diseases, chronic obstructive pulmonary disease [COPD]), type of surgery (coronary artery bypass graft surgery, valve replacement or repair), cardiopulmonary bypass duration (CPB), CC duration, ANH, UF, cell saver use, TXA and/or prednisolone use, preoperative anemia, presence of thrombocytopenia, medications that are ingested by patients (antiaggregants [aspirin, clopidogrel, plaquenil, and tegretol], anticoagulants [heparin, Coumadin, beta-blocker, and analgesic], etc.) were recorded.

The patients were divided into two groups according to the amount of drainage (chest and mediastinal tubes) in the early postoperative period: Group B (bleeding group with excessive) and Group C (control group no excessive bleeding). Increased drainage in the first 3 h (500 mL at 1 h, 400 mL at 2 h, and 300 mL at 3 h) or in the first 24 h (1,500 mL or more) in the intensive care unit after surgery was determined as excessive bleeding.

Anesthesia and cardiopulmonary bypass managements were performed in all patients according to the protocol of the clinic. Anticoagulant and/or antiaggregant drugs that had been taken in the preoperative period were discontinued according to the guidelines that suggested by european association of cardiology. Patients who had anemia (Hb<13 g/dL) underwent surgery after the condition was managed (blood transfusion and/or oral or IV administration of iron). In patients with Hb > 13 g/dL, ANH was performed after induction.

During cardiopulmonary bypass, moderate hypothermia (32°C–34°C), blood cardioplegia, and UF were applied at the perfusionist's discretion. Hematocrit was maintained between 21% and 24% during cardiopulmonary bypass and between 27% and 30% at the end of surgery, depending on the severity of the lesions. Prednisolone at the doses of 30 mg/kg (divided into two parts after induction and during CPB) and 30 mg.kg−1 (divided into three parts after induction and protamine administration) were given to all patients with ejection fraction <40% and patients subjected to valve surgery as clinical routine manner. In patients with suspected bleeding diathesis in the perioperative period, thromboelastography (TEG) or classical laboratory tests were conducted, and fresh frozen plasma, cryoprecipitate, and platelet suspension were given as required.

Statistical Analysis

SPSS 21.0 (version 22.0, SPSS, Inc., Chicago, IL, USA) was used for statistical analysis. Continuous variables were expressed as mean, standard deviation, median, minimum, and maximum values. In the comparison of two independent groups, "Student-t" was used for parametric variables, and "Mann-Whitney U" tests were used for non-parametric continuous variables. For correlation analysis between variables, "Pearson product moment"or "Spearman rank-order" method was used according to the distribution feature of the variable. The statistical significance limit of the "p" value was accepted as <0.05. P<0.05 was considered to indicate statistical significance.

Results

The files of 210 patients who underwent open-heart surgery in our clinic between January 2019 and January 2021 were retrospectively reviewed. Of the patients, 12 were excluded from the study because of missing data. Thus, only 198 patients were included in the final analysis, of whom 19 were allocated to Group B and 179 to Group C.

The descriptive characteristics of the patients are listed in Table 1. Of the patients, 144 (72.4%) were men and 54 (27.6%) were women. Their mean age was 59.6 (range, 28–85) years.

The comorbidities of the patients are listed in Table 2. In Group B, the percentage of patients who had COPD (25%) was significantly higher than those who did not have COPD (7%) (p=0.02).

Table 1. Descriptive characteristics of patients. Group B (bleeding group): patients who experienced excessive bleeding. Group C (control group): patients who did not experience bleeding

	Group B (n=19, % 9.7)	Group C (n=179, % 90.3)	p*
Age (year)	63.0±11.3	59.57±10.9	0.21
Sex , n			0.26
Female	2	52	
Male	17	127	
BSA (m^2)	1.88±2.4	2.07±2.4	0.74
EF (%)	0.52±0.4	0.6±0,3	0.10
EuroSCORE	6.33±1.0	5.2±1.0	0.19
Duration of surgery (min)	107±10.0	121±7.8	0.07
Duration of cross-clamping (min)	71.8±4.80	78.9±4.5	0.40
Type of surgery			
CABG	14	120	0.20
Isolated valve	3	34	0.30
Valve+CABG	1	3	0.58
Myxoma	0	4	0.40
ASD	0	2	0.30
Aortic dissection	6	1	0.35
Aneurysm	9	0	0.07
CABG+mediastinal mass	0	1	0.56

*: Student's t-test, Mann–Whitney U test, chi-squared test. Data were expressed as mean±standard deviation (SD).BSA: Body surface area; EF: Ejection fraction; CABG: Coronary artery bypass graft; ASD: atrial septal defect; min: Minute; m^2: meter squared.

The medications used by the patients are listed in Table 3. The use of antiaggregant was significantly higher in Group B ($p<0.01$).

No significant difference was observed in preoperative anemia and the coagulation parameters among the groups (Table 4). The need for intraoperative replacement of blood and blood products was not significantly different between the groups (Table 5) but was significantly higher in the postoperative period in Group B than in Group C.

The rate of excessive bleeding was 9.7% (n=19). Of the 19 patients, 5 experienced excessive bleeding within the first 3 h (Table 6). These 5 patients were reoperated within the first 24 h. Another patient who experienced excessive bleeding was reoperated at 3 h, and this patient died due to organ failure on postoperative day 4. The mortality rate due to bleeding was 5% (n=1), and the rate of reoperation was 31.6% (n=6). In 2 patients, the surgical cause of bleeding was found to saphenous vein and LIMA clip loosening. For the rest of the patients, the surgical cause was not determined.

The independent factors that caused excessive bleeding in the first 24 h after open-heart surgery are listed in Table 7. Excessive bleeding was correlated with female sex (r=0.153, p=0.045, at 1 h, and r=0.177, p=0.02, at 24 h), presence of COPD (r=0.143, p=0.03, at 1 h, and r=157, p=0.034, at 2), and presence of chronic renal failure (r=0.167, p=0.02, at 3 h). The presence of hypertension, atrial fibrillation, cerebrovascular events, and thyroid disease did not exhibit a statistically significant correlation with bleeding.

The preoperative use of angiotensin-converting enzyme inhibitors (ACEIs) and antiaggregants showed a significant positive correlation with excessive bleeding (r=0.158, p=0.028, at 3 h, and r=0.25, p=0.001, at 24 h). No correlation was observed between bleeding and preoperative blood values (Hb, Ht, plt) and between bleeding and bleeding parameters. The probability of bleeding occurrence was statistically significantly higher in patients with high EuroSCORE (European System for Cardiac Operative Risk Evaluation) (r=0.151, p=0.04, at 3 h). Furthermore, CPB duration and aortic CC duration were positively correlated with excessive bleeding (r=0.02, p=0.021, and r=0.011, p=0.024, at 24 h, respectively).

A cell saver was used during surgery in 4 patients (2%), which were all from Group C. The number of patients who underwent ANH after induction was 92 (46%), of whom 3 were from Group B. No significant difference was observed in terms of ANH application between the groups, and ANH application was not correlated with bleeding.

Table 2. Codiseases of patients

	Group B (n=19, %10)		Group C (n=179, %90)		p*
	n	%	n	%	
Anemia					
N	12	10	105	90	0.7
Y	7	9	74	91	
Hypertension					
N	8	9	84	91	0.7
Y	11	10	95	90	
Diabetes mellitus					
N	15	12	105	88	0.09
Y	4	5	74	95	
Chronic obstructive pulmonary disease					
N	13	7	161	93	0.02*
Y	6	25	18	75	
Atrial fibrillation					
N	17	9	170	91	0.3
Y	2	18	9	82	
Cerebrovascular disease					
N	19	10	168	90	0.3
Y	0	0.0	11	100	
Chronic renal disease					
N	18	9	173	91	0.5
Y	1	17	5	83	
Thyroid disease					
N	18	10	167	90	0.8
Y	1	8	12	92	

*: Pearson's chi-squared test. Date were given patient's number and percentage. Y: Yes; N: No.

Discussion

In this study, the files of patients who underwent elective open-heart surgery between January 2019 and January 2021 were retrospectively reviewed. The frequency and the causes of excessive bleeding in the early postoperative period were investigated. The incidence of bleeding was 9.7%. Furthermore, the presence of COPD and preoperative antiaggregant use were significantly higher in Group B than in Group C. No significant difference was observed between the groups in terms of preoperative laboratory values of bleeding and coagulation and the need for intraoperative replacement of blood and blood products. The need for postoperative replacement of blood and blood products was significantly higher in Group B ($p<0.001$). Female sex and intraoperative TXA use were negatively correlated with bleeding. In addition, the presence of COPD and chronic renal failure, preoperative antiaggregant use, high EuroSCORE, CPB duration, and CC duration were positively associated with bleeding.

The incidence of bleeding within 2 years was 9.7%. The literature presents varying ratios regarding the incidence of bleeding following open-heart surgery. The rate of excessive bleeding following CABG surgery was reported to be 3%–5%, 5%–7%, or 6%–9%.[5–7] Furthermore, the rate was reported to be 5% after aortic surgery[8] and 8% after valve surgery.[9] These incidence variabilities in the studies could be attributed to the differences in the criteria related to bleeding targeted in the studies, surgical pathologies, and clinical routine practices. The surgical procedures included in our study were not homogeneous: CABG surgery, large vessel and aortic surgery, valve surgery, myxoma, and atrial septal defect repair cases were included together. In this study, the surgery type was not isolated; CABG surgery, large vessel and aortic surgery, valve surgery, myxoma, and atrial septal defect repair cases were included together.

The rate of re-exploration due to postoperative bleeding in this study was 31.6% (n=6) (6 of 19 patients: 1 patient at 3 h and 5 patients at 12 h). The surgical cause of bleeding was determined in only 2 of the 6 patients. Due to the improvements in CPB techniques and equipment, the rate of surgically induced bleeding decreased from 14% to 2%.[1,10,11] In this study, the rate was 10.5%. In their meta-analysis,

Table 3. Drugs preoperatively used by patients

	Group B		Group C		p*
	n	%	n	%	
Fe					0.99
N	3	9.7	28	90.3	
Y	16	9.6	151	90.4	
B-12					0.72
N	16	9.3	156	90.7	
Y	3	11.5	23	88.5	
Analgesic					
N	17	8.8	177	91.2	0.66
Y	0	0.0	2	100.0	
ACEI					
N	11	9.2	109	90.8	0.77
Y	8	10.4	69	89.6	
Beta-blocker					
N	2	5.1	37	94.9	0.29
Y	17	10.7	142	89.3	
Calcium channel blocker					
N	16	10.1	142	89.9	0.61
Y	3	7.5	37	92.5	
Nitrate					
N	8	8.5	86	91.5	0.62
Y	11	10.6	93	89.4	
Antidiabetic					
N	17	11.7	128	88.3	0.093
Y	2	3.8	51	96.2	
Antiaggregant					<0.01*
N	16	8.5	172	91.5	
Y	2	66.7	1	33.3	
Antithrombocyte					
N	19	9.6	178	90.4	0.41
Y	0	0.0	0	0.0	
Bronchodilator					
N	9	8.6	96	91.4	0.57
Y	10	10.9	82	89.1	
Tranexamic acid					
N	12	17.1	34	82.9	0.07
Y	7	7.6	145	92.4	
Prednisolone					
N	12	9	122	91	0.70
Y	7	10.9	57	89.1	

*: Pearson's chi-squared test. Date were given patient's number and percentage. Fe: Ferrum medicament; B12: Vitamin B12; ACEI: Angiotensin-converting enzyme inhibitor.

Biancari et al.[1] reported that the rate of surgically induced excessive bleeding was 9%. Age, emergency interventions, presence of peripheral vascular disease, and history of aspirin use were also reported as causes of severe bleeding.

In this study, lower bleeding rate was observed in women. Similarly, previous studies have reported that men are at a higher risk of excessive bleeding after cardiac surgery;[1] however, some studies also demonstrated that sex is not an independent risk factor for excessive bleeding.[12] Ranucci et al.[13] reported that bleeding is better compensated for in women than in men due to differences in platelet number and function. Older age, high weight, and low BMI have also

Table 4. The preoperative hematocrit, thrombocyte and coagulation parameters in groups

	Group B (n=179, %90)	Group C (n=19, %10)	p*
Hematocrit	39.8±5.7	39.44±6.7	0.7
Thrombocyte	220.91±1.3	244.11±2.0	0.1
PT (sn)	128.53±1.5	123.63±1.7	0.2
aPTT (sn)	303.94±3.5	300.02±3.7	0.7
INR	11.22±1.0	12.33±1.0	0.8
Fibrinogen (mg/dL)	88.11±5.8	128.32±5.3	0.4
D-dimer (ng/mL)	24.16±5.8	58.11±4.9	0.7

*: Student's t-test. Data were given mean±standard deviation (SD). PT: Prothrombin time; aPTT: Activated partial thromboplastin time; INR: International normalized ratio.

Table 5. Requirement of blood and blood products intraoperatively and postoperatively in the intensive care unit

	Group B	Group C	p*
Intraoperative			
ERT (U)	1.5 (1.9)	1.35 (1.0)	0.61
FFP(U)	1.7 (1.6)	1.9 (1.0)	0.35
ANH (L)	0.5 (0.3)	0.7 (1.6)	0.42
Postoperative			
ERT(U)	3.8 (1.7)	1.12 (1.0)	<0.001*
FFP(U)	4.4 (1.6)	2.4 (1.0)	<0.001*
Thrombocyte (U)	1.0 (1.6)	0.1 (0.3)	<0.001*

*: Mann–Whitney U test. Data were expressed as medians. ERT: Erythrocyte suspension; FFP: Fresh frozen plasma; ANH: Acute normovolemic hemodilution; L: Liter; U: Unit.

Table 6. Bleeding timing of the patients

Criteria for excessive bleeding	Patients with excessive bleeding		Patients who underwent surgical re-exploring	
	n	%	n	%
1 h (500 mL or more)	0	0	0	0
2 h (400 mL or more)	2	1.0	0	0
3 h (300 mL or more)	5	2.5	1	5
24 h (1.500 mL or more)	17	8.6	5	26.3
Total	19	9.7	6	31.6

Table 7. Significant independent factors leading to excessive bleeding (correlation test)

Postoperative	Factors leading to excessive bleeding	r	p*
1 h	Female sex	–0.153	0.045
	COPD	0.143	0.03
2 h	COPD	0.157	0.034
3 h	CKF	0.167	0.02
	ACEI	0.158	0.03
	EuroSCORE	0.151	0.04
24 h	Female sex	–0.177	0.02
	Antiaggregant	0.131	0.02
	Tranexamic acid	0.25	0.001
	CC duration	0.151	0.037
	CPB duration	0.011	0.024

*: Pearson's correlation test or Spearman's correlation test (if not normally distributed). r: Correlation coefficient; COPD: Chronic obstructive pulmonary disease; CKF: Chronic kidney failure; ACEI: angiotensin-converting enzyme inhibitor; CC: Cross-clamping; CPB: Cardiopulmonary bypass.

been reported as other factors that cause bleeding.[1,14,15,12] Contrary to these studies, weight, age, and BMI did not cause bleeding in our study. Biancari et al.,[1] in their meta-analysis, reported that male sex, older age, presence of vascular disease, and preoperative aspirin use were factors that increased the risk of bleeding. They also reported that the factors causing severe bleeding requiring resternotomy were not individual, related to patients, factors but those related to the surgical procedure and postoperative procedures. As factors related to surgery, the use of an intraaortic balloon pump, long duration of mechanical ventilation, long duration of CPB, postoperative stroke, and acute kidney injury development were reported to cause excessive bleeding.[1] In our study, the type of surgery, autotransfusion (cell saver use), and UF parameters did not significantly differ between the groups or in correlation tests. However, similar to the literature, the duration of COPD and prolonged duration of CC were found to be independent risk factors of excessive bleeding.[1,16]

The proportions of patients with and without COPD were 25% and 7%, respectively, in Group B (Table 2). COPD alone may cause disorders in the coagulation system by increasing erythrocyte count due to bone marrow stimulation with chronic hypoxemia and endothelial damage in the vascular bed due to hypoxemia.[17] In our study, although not statistically significantly different, the EuroSCORE values, duration of CPB, and duration of CC were higher in patients with COPD and excessive bleeding compared with patients without COPD and bleeding. These factors were also found to be correlated with bleeding. The presence of these factors in addition to COPD may have increased the risk of bleeding in these patients. In addition to the fact that excessive bleeding can be expected in patients with COPD, it should be noted that excessive use of blood and blood products may trigger acute lung injury in patients with COPD.[18] Comorbidities, which are inherent to our patient group, have also been reported to cause excessive bleeding and re-exploration by inducing vascular and chronic endothelial damage.[1] Accordingly, in a review of more than 55,000 cases, peripheral vascular disease, diabetes, hypertension, renal failure, and stroke were reported to increase mortality and the need for re-exploration following open-heart surgery.[1] We found that there were correlations between

bleeding and several factors such as chronic kidney injury, hypertension, use of ACEIs, and EuroSCORE, although the correlation coefficients were low (Table 7).

While 66.7% of the patients who used antiplatelet medications (ASA and clopidogrel) experienced bleeding, only 8.5% of those who did not use them had bled ($p<0.001$). In our clinical practice, the use of antiplatelet medications is typically discontinued at least 5 days before. Based on the patients' characteristics, there are instances where the medications may not be discontinued, despite the risk of bleeding. Two patients in Group B did not discontinue antiaggregant use because of critical carotid lesions. Antiaggregant use is known to pose high bleeding risk in patients undergoing open-heart surgery.[3,19–21] Jacob et al.[22] compared patients who discontinued ASA use within 5 days (late) and those who discontinued use 6 or more days (early) before surgery among 4,143 patients who underwent CABG surgery and were using antiaggregants preoperatively. It was reported that late antiaggregant discontinuation did not change the rates of myocardial infarction, stroke, mortality, excessive bleeding, and reoperation but increased the need for intraoperative and postoperative transfusion. Thus, ASA discontinuation at least 5 days before surgery is recommended.[22] Although Kapetanakis et al.[23] also reported that clopidogrel use reduces thrombotic complications after percutaneous coronary revascularization, it increases the need for blood product transfusion and the risk for reoperation during and after off-pump coronary artery bypass graft surgery due to increased platelet inhibition.[23] In our study, excessive bleeding did not occur in 92.4% of patients who received intraoperative TXA (antifibrinolytic agent), whereas bleeding occurred in 7.6%. A negative correlation was observed between the use of TXA and bleeding. In our clinical routine practice, a total dose of 30 mg kg^{-1} was administered to all patients as a bolus divided into three equal doses, before, during, and after CPB. Shi et al.[24] reported that high-dose TXA (30 $mg.kg^{-1}$ bolus, 3 mg.kg.h. maintenance, and 2 $mg.kg^{-1}$ into prime) significantly reduced the need for blood transfusion compared with low-dose TXA regimen (10 $mg.kg^{-1}$ bolus, 2 $mg.kg^{-1}.h^{-1}$ maintenance, and 1 $mg.kg^{-1}$ into prime). It was reported to be safe in terms of 30-day mortality and for side effects such as seizure, renal dysfunction, and thrombotic events. In their meta-analysis, Guo et al.[25] also reported that the use of low-dose TXA was effective and safe.

In our study, 7 of the 19 patients who experienced bleeding had anemia. The presence of anemia was similar in the groups (Table 4). In our clinical practice, despite our efforts to manage anemia preoperatively, 41% (n=81) of the total study patients still had anemia (Hb<13 g/dL). The ERAS-C approach, developed in recent years, has highlighted the importance of reducing the need for blood transfusion by addressing preoperative anemia.[15,26]

The need to use erythrocyte suspension and fresh frozen plasma (FFP) was significantly higher in Group B in the postoperative intensive care unit. The use of fibrinogen, factor, or cryoprecipitate was limited in the postoperative period (n=10). In Group B, factor deficiencies were replaced with FFP and/or cryoprecipitate after the detection of pathology via TEG or classical laboratory tests.

Limitations of the study

This was a retrospective study using data obtained from the patients' medical records. First, the small number of cases caused low correlation coefficients and may have prevented reaching statistical significance. Second, although most of the data were obtained, it was realized that the interpretation of the data was incomplete. For example, parameters such as ferritin, B12, and folic acid, which may be valuable in evaluating anemia, could not be obtained from some patients.

Conclusion

The incidence of excessive bleeding in the early postoperative period was 9.7% in patients who underwent open-heart surgery under elective conditions in the 2-year period. Of these patients, 33% required surgical reopening. The presence of COPD, preoperative antiaggregant use, high EuroSCORE, and long CC and CPB duration may lead to excessive bleeding and are potentially helpful parameters in predicting bleeding. To minimize the risk of postoperative bleeding, it is crucial to optimize patients' comorbidities before surgery, discontinue medications that increase the risk of bleeding for appropriate periods prior to surgery, routinely administer TXA, and shorten the duration of the surgical procedure.

Disclosures

Ethics Committee Approval: The study was approved by The Manisa Celal Bayar University Faculty of Medicine Ethics Committee (no: 33433, date: 02/03/2021).

Authorship Contributions: Concept – T.Ö., İ.Ö., D.A.Ş., F.Y.; Design – T.Ö., İ.Ö., F.Y., D.A.Ş.; Supervision – T.Ö., İ.Ö., F.Y., D.A.Ş., A.A., O.Y.K.; Data collection &/or processing – T.Ö., İ.Ö., F.Y., D.A.Ş.; Analysis and/or interpretation – T.Ö., İ.Ö., F.Y., D.A.Ş.; Literature search – İ.Ö., O.Y.K., T.Ö.; Writing – İ.Ö., O.Y.K., T.Ö.; Critical review – T.Ö., F.T., D.A.Ş., A.A.

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