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Predictors of Survival in Resternotomy Following Primary Cardiac Surgery: A Retrospective Cohort Study

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ABSTRACT

Background: Cardiac surgery significantly improves survival and quality of life for patients with cardiovascular diseases. However, some patients require chest re-exploration to manage complications such as bleeding, hemodynamic instability, or cardiac tamponade. Despite advancements in cardiac surgery, chest re-opening surgeries present high-risk challenges associated with increased mortality rates and prolonged recovery.

Objectives: This study aimed to identify the demographic, clinical, and perioperative factors influencing outcomes in patients undergoing chest re-exploration.

Patients and Methods: This retrospective cohort study analyzed 497 patients who underwent primary cardiac surgery between March 2021 and March 2025 at multicenters of the authors. Of these, 25 required chest re-exploration within 30 days. Demographic, clinical, and surgical variables were extracted from medical records, and factors such as re-exploration timing, blood loss, hematocrit, lactate levels, and extracorporeal circulation (ECC) time were analyzed.

Results: Among the 25 patients who underwent chest re-exploration, 23 (92%) survived, while 2 (8%) died. Moreover, non-survivors had significantly higher pre-re-exploration blood loss, lower hematocrit levels, elevated lactate concentrations, prolonged ECC times, and longer time to re-exploration. In addition, no significant demographic differences were observed between survivors and non-survivors. The study revealed that key factors such as timely re-exploration, blood loss, and biochemical markers (hematocrit and lactate levels) significantly influenced outcomes following chest re-exploration.

Conclusions: Understanding the predictors of survival in patients undergoing chest re-exploration is crucial for improving clinical outcomes. Early identification of high-risk patients improves survival rates, suggesting the need for enhanced perioperative monitoring. Further prospective studies are needed to validate these findings and develop strategies that enhance patient safety during chest re-exploration in cardiac surgery.

Keywords: Chest re-opening, Cardiac surgery, Perioperative factors.

INTRODUCTION

Cardiac surgery plays a vital role in managing a wide range of cardiovascular conditions, significantly improving both survival and quality of life [(1)]. In recent years, enhanced recovery after surgery (ERAS) principles have become integral to surgical care, aiming to reduce surgical stress and accelerate recovery through evidence-based, standardized protocols [(2, 3)]. While these principles are increasingly applied in cardiac surgery, patient outcomes remain heavily influenced by pre-existing comorbidities such as diabetes, chronic kidney disease, and anemia [(4)]. Despite advancements in surgical techniques and perioperative care, a subset of patients requires chest re-opening surgery due to life-threatening complications such as excessive bleeding, hemodynamic instability, or cardiac tamponade [(5, 6)].

Primary cardiac procedures include coronary artery bypass grafting (CABG), used to treat coronary artery disease, and valve surgery, performed to address valvular dysfunction such as stenosis or regurgitation [(7-9)]. Although outcomes for these procedures have improved over time, complications can still arise, particularly in high-risk patients. Postoperative bleeding remains one of the most urgent complications requiring reoperation. Management typically involves blood product transfusions, guided by standard coagulation tests or point-of-care viscoelastic testing. However, when bleeding leads to hemodynamic compromise or fails to respond to medical therapy, surgical re-exploration becomes necessary. Delays in intervention can result in increased transfusion requirements, worsening cardiac function, and higher mortality [(10, 11)].

Chest re-opening is a complex and high-risk procedure associated with increased morbidity, mortality, and healthcare costs [(12, 13)]. Compared to primary cardiac surgery, the literature on chest re-opening procedures is limited and often heterogeneous. While numerous studies have explored risk factors for adverse outcomes following initial surgeries [(14, 15)], fewer have focused on predictors of survival in patients undergoing chest re-opening. Emerging evidence suggests that variables such as the timing of re-exploration, volume of blood loss, and biochemical markers like hematocrit and lactate levels may influence outcomes [(16-19)].

Hematocrit reflects the proportion of red blood cells in circulation and serves as a surrogate for oxygen-carrying capacity. Low hematocrit may indicate significant blood loss or hemodilution, while elevated levels may signal dehydration or compensatory erythrocytosis [(20)]. In the context of chest re-opening, maintaining adequate hematocrit is crucial for tissue oxygenation and often guides transfusion decisions [(21)]. Lactate, a byproduct of anaerobic metabolism, serves as a marker of tissue hypoxia and metabolic stress. Elevated lactate levels

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are associated with poor perfusion, shock, and organ dysfunction, and have been linked to increased mortality in critically ill patients [22]. In chest re-opening cardiac surgery, persistent hyperlactatemia may reflect ongoing circulatory compromise or surgical bleeding, both of which can negatively impact survival. While these biomarkers are increasingly used in clinical decision-making, their predictive value in the context of chest re-opening remains underexplored [23].

Given the high-risk nature of chest re-opening and the limited evidence base, there is a clear need for targeted research to identify factors that influence survival. Understanding the interplay between demographic characteristics, clinical presentation, intraoperative variables, and biochemical markers can improve risk stratification and guide clinical decision-making.

This study aimed not only to report the incidence of early chest re-opening but also to identify modifiable perioperative factors that may reduce its occurrence and improve patient outcomes. By analyzing real-world data from a retrospective cohort, we sought to contribute to the existing literature and provide actionable insights that might support the development of more effective perioperative management strategies for this high-risk population.

PATIENTS AND METHODS

This retrospective cohort study analyzed 497 patients who underwent primary cardiac surgery between March 2021 to March 2025 at multicenters of the authors.

The objective was to examine the demographic, clinical, and surgical characteristics of patients who required chest re-exploration surgery and to identify factors associated with survival and mortality in this group.

Patient Selection:

Of the total 523 cardiac surgery patients, 26 were excluded (5 were lost to follow-up [patients transferred to outside institutions without accessible records before 30 days], 21 underwent redo surgery for unrelated indications). A total of 497 patients who underwent primary cardiac surgery during the study period were included. Patients were eligible if they were aged 18 years or older and had either elective, urgent (not elective but not immediate), or emergency (required within hours to prevent death) cardiac procedures. Those who required chest re-exploration within 30 days of the initial operation formed the chest re-exploration cohort (n = 25). This cohort was further divided into survivors (n = 23) and non-survivors (n = 2). Exclusion criteria were patients who underwent redo surgery for unrelated cardiac conditions, individuals with incomplete medical records, and those who were lost to follow-up within the study timeframe.

Data Collection and Variables:

Data were extracted from electronic medical records and included demographic characteristics (age, gender, body mass index [BMI]), medical history (presence of comorbidities such as diabetes mellitus, hypertension, and renal failure[defined per KDIGO stage 2 or higher]), and surgical details. Patients were stratified by procedure type: CABG, valve repair/replacement, combined, and others. For the chest re-opening group, additional variables were collected, including time to re-exploration, blood loss before re-exploration, total intraoperative blood loss, hematocrit levels, lactate concentrations, and extracorporeal circulation (ECC) times. Preoperative, intraoperative, and postoperative parameters were thoroughly documented to identify predictors of survival and mortality.

Surgical Procedures:

Primary cardiac operations were performed following standard institutional protocols by skilled surgical teams. Coronary artery bypass grafting (CABG) was carried out using cardiopulmonary bypass (on-pump), with both arterial and venous grafts harvested as appropriate. Valve surgeries involved repair and replacement procedures, employing advanced materials and techniques to ensure optimal outcomes. Combined CABG and valve surgeries were performed for patients requiring concurrent interventions. Additionally, other types of cardiac surgeries, such as atrial septal defect closure, were also conducted based on the individual patient's needs.

Chest re-opening surgeries were performed for indications such as hemodynamic instability, excessive bleeding (defined as ≥1000 mL of chest tube output within 12 h postoperatively), or suspected cardiac tamponade. All procedures adhered to institutional guidelines to minimize risks and optimize outcomes.

Ethical Consideration

This study was ethically approved by the Ethics Committee of Shebin El-Kom Teaching Hospital (IRB HSH00103, 30-7-2025). Written informed consent was obtained from all participants. The study adhered to strict ethical guidelines, ensuring the confidentiality and privacy of patient data. The study protocol conformed to the Helsinki Declaration, the ethical norm of the World Medical Association for human subjects.

Statistical Analysis

Data were analyzed using SPSS for Windows, version 25.0 (IBM Corp., Armonk, NY, USA). Continuous variables were assessed for normality and summarized as medians with interquartile ranges or means with standard deviations, as appropriate. Categorical variables were presented as frequencies and percentages. Differences between groups were evaluated using the Mann-Whitney U test for non-parametric continuous variables, independent samples t-tests for parametric data, and Fisher's exact test or chi-square tests for categorical variables.

Statistical significance was defined as $P < 0.05$. To assess potential associations between pre-re-exploration parameters and outcomes, a univariate analysis was performed, followed by multivariate logistic regression for significant predictors. The results are presented with corresponding CIs and P-values.

RESULTS

Patient Demographics and Characteristics of Primary Heart Operations

A total of 497 patients underwent primary heart operations, of whom 25 (5%) required chest re-opening surgery. The indications for chest re-exploration were bleeding (n=14), ischemia (n=7), tamponade (n=3), graft malfunction (n=1). The urgency of operations differed between the total cohort and the chest re-exploration group. Among all patients, elective surgeries were predominant (74.1%), followed by urgent (19.1%) and emergency procedures (6%) **(Table 1)**. In the chest re-opening group, elective surgeries accounted for 56%, with an increased proportion of urgent (28%) and emergency procedures (16%). The distribution of surgical types varied. The CABG was the most common procedure, performed in 62.8% of the total cohort and 40% of the chest re-opening group. Valve repair/replacement operations constituted 13.3% of the total surgeries but were more frequent among chest re-opening cases (36%). Combined CABG and valve procedures represented 10.4% of the total cohort and 16% in chest re-openings, while other operations accounted for 13.5% and 8%, respectively **(Table 1)**.

Table (1): Characteristics of Primary Heart Operation in All Patients.

Characteristics	Total (n = 497)	Chest re-opening (n = 25)
Urgency of operation		
Elective	371 (74.1%)	14 (56%)
Urgent	96 (19.1%)	7 (28%)
Emergency	30 (6%)	4 (16%)
Type of operation		
CABG	314 (62.8%)	10 (40%)
Valve repair/replacement	67 (13.3%)	9 (36%)
Combined	52 (10.4%)	4 (16%)
Other	67 (13.5%)	2 (8%)

CABG: Coronary artery bypass grafting
Other = congenital repairs, atrial myxoma excision, etc.

Characteristics of Chest Re-exploration Procedures

Among the chest re-exploration survivors, CABG was the most frequently performed primary operation (52.2%), followed by valve repair/replacement operations (34.8%). Combined CABG and valve procedures were observed in 8.7% of survivors, whereas other procedures accounted for 4.3%. In contrast, both non-survivors underwent either CABG (50%) or valve repair/replacement operations (50%), with no cases of combined procedures or other types of surgeries reported. Reoperations were recorded in 8.7% of survivors and 50% of non-survivors **(Table 2)**.

Table (2): Characteristics of Primary Heart Operation in Chest re-opening Patients.

Characteristics	Survived (n = 23)	Died (n = 2)
Type of operation		
CABG	**12 (52.2%)**	**1 (50%)**
Valve repair/replacement	**8 (34.8%)**	**1 (50%)**
Combined	**2 (8.7%)**	**0 (0%)**
Other	**1 (4.3%)**	**0 (0%)**
Reoperation	**2 (8.7%)**	**1 (50%)**

CABG: Coronary artery bypass grafting
Other = congenital repairs, atrial myxoma excision, etc.
Reoperation = separate surgical procedure unrelated to initial surgery during same admission

Demographic Data of Chest Re-exploration Patients

The 25 patients who underwent chest re-exploration had a median age of 70 years, and the majority were male (68%). Survivors comprised 23 patients (92%), while 2 patients (8%) died. Although demographic factors, including gender distribution, median age, BMI, and prevalence of comorbidities (diabetes mellitus, hypertension, and renal failure), showed numerical differences between survivors and non-survivors, these differences were not statistically significant ($P > 0.05$, **Table 3)**.

Table (3): Demographic Data of Chest re-opening Patients.

Characteristics	Total (n = 25)	Survived (n = 23)	Died (n = 2)
Number of patients	25	23 (92%)	2 (8%)
Number of male patients	17 (68%)	15 (65.2%)	2 (100%)
Age (mean ± SD)	70 ± 10.5	64.9 ± 9.8	70.3 ± 6.1
Body mass index [median (IQR)]	27.3	27.8	26.6
Diabetes mellitus	6 (24%)	5 (21.7%)	1 (50%)
Hypertension	19 (76%)	17 (73.9%)	2 (100%)
Renal failure	6 (24%)	5 (21.7%)	1 (50%)

Pre-Re-exploration Characteristics

Significant differences were observed between survivors and non-survivors in parameters assessed before re-exploration. Time to re-exploration was significantly longer in non-survivors (780 min) compared to survivors (300 min, $P < 0.001$). Blood loss before re-exploration was significantly higher in non-survivors (1800 vs. 900 mL, $P < 0.001$), as was total blood loss **(3700 vs. 2500 mL, P < 0.001, Table 4)**. Hematological and biochemical parameters also differed significantly. Non-survivors had lower hematocrit levels (20% vs. 30%, $P = 0.001$) and higher lactate concentrations (7.0 vs. 2.5 mmol/L, $P < 0.001$). The ECC time was prolonged in non-survivors (130 min) compared to survivors **(90 min, P < 0.001, Table 4)**.

Table (4): Characteristics Before Re-exploration

Characteristics	Survived (n = 23)	Died (n = 2)
Time to re-exploration (min)	300	780
Blood loss before re-exploration (mL)	900	1800
Total blood loss (mL)	2500	3700
Haematocrit (%)	30	20
Lactate (mmol/L)	2.5	7.0
Extracorporeal circulation (min)	90	130

DISCUSSION

Understanding patient demographics and characteristics in primary heart operations is crucial for improving surgical outcomes and tailoring postoperative care. This study investigated patient demographics, characteristics of primary heart operations, and outcomes following chest re-opening procedures. The findings provide valuable insights into the factors influencing chest re-opening surgeries and their associated outcomes, offering implications for clinical practice and future research.

Our results demonstrated that 5% of patients undergoing primary heart operations required chest re-exploration surgery, highlighting the significance of identifying high-risk populations. This relatively low percentage, while encouraging, reflects the inherent risks in cardiac surgery and the ongoing need for close monitoring of patients after initial procedures. This finding underscores the importance of tailored preoperative assessment and planning, particularly for individuals who may be predisposed to requiring subsequent procedures. In heart surgery, the distinction between elective and urgent procedures plays a key role in outcomes, and this cohort's characteristics provide insight into how surgical urgency influences the likelihood of needing chest re-opening surgeries. Elective surgeries predominated in the total cohort (74.1%), yet when analyzing the chest re-opening group, a different pattern emerged. The chest re-opening group exhibited a higher proportion of urgent and emergency procedures, with 28% and 16% of cases, respectively, falling into these categories. This shift suggests that the urgency of the initial procedure plays a significant role in the likelihood of requiring chest re-opening surgery. Urgent and emergency surgeries, by their very nature, are often associated with more complex cases and greater perioperative risk, which may contribute to a higher rate of complications or failure requiring further surgical intervention. This finding is consistent with the understanding that operations performed in emergent situations, particularly in patients with unstable or deteriorating conditions, may not achieve the same level of optimal outcomes as elective procedures. This raises the question of whether early identification and management of high-risk patients could mitigate the need for chest re-opening surgeries in these urgent cases [(24)].

When we examined the specific types of procedures involved, CABG emerged as the most common primary procedure in our cohort, representing 62.8% of cases. This finding was consistent with prior studies, which have identified CABG as the predominant cardiac procedure worldwide [(25)]. However, the proportion of CABG procedures in the chest re-exploration group was significantly reduced to 40%, and valve operations accounted for 36% of the chest re-opening cases. This shift highlights the increasing complexity of cases requiring chest re-exploration surgery, particularly those involving valve procedures, which were generally considered to carry a higher risk of complications and require more specialized surgical techniques compared to CABG. The increased prevalence of valve surgeries in the chest re-exploration group aligned with findings from other studies that emphasized the challenges and risks associated with these operations. Valve procedures, particularly those involving valve repair or replacement, often required careful management due to the intricate nature of the heart's valve structures, as well as the patient's overall health and comorbidities [(26)].

These operations are associated with a higher likelihood of complications such as endocarditis, valve failure, or prosthetic valve dysfunction, all of which could contribute to the need for chest re-opening surgery [(27)]. Moreover, patients requiring valve surgery may often present with more advanced forms of heart disease, which complicates their postoperative recovery and increases the risk of adverse outcomes [(28)]. Combined CABG and valve procedures represented 10.4% of the total cohort, but this proportion increased to 16% in the chest re-opening group. This finding further emphasizes the complexity of cases that necessitate chest re-opening surgeries. Patients undergoing combined CABG and valve procedures typically have both coronary and valvular heart disease, which often presents as a more advanced

form of cardiovascular pathology. These surgeries tend to be more challenging due to the dual nature of the disease process, requiring a surgeon to address both coronary atherosclerosis and valvular dysfunction in a single operation [29].

The higher frequency of combined procedures in the chest re-opening group may be a reflection of the difficulty in managing such complex cases. These patients are more likely to experience complications such as graft failure, valve dysfunction, or other postoperative sequelae that would necessitate chest re-opening surgeries. In particular, combined procedures tend to have longer operative times and higher rates of complications, both of which contribute to the elevated risk of chest re-opening [30].

This highlights the need for a careful, multidisciplinary approach to the management of these patients, with close postoperative monitoring and early intervention when complications arise. Other operations, a category that includes a variety of less common heart surgeries, such as congenital heart disease procedures, accounted for 13.5% of the total surgeries in the cohort. However, only 8% of the chest re-opening cases were from this category. This suggests that while these operations are less frequent, they tend to have a relatively lower risk of requiring chest re-opening surgery compared to CABG and valve operations. This finding may indicate that, in general, patients undergoing less complex or more targeted procedures, such as those for arrhythmias or specific congenital heart defects, may experience better outcomes with fewer complications that necessitate further surgical intervention. However, the small proportion of other operations in both the total and chest re-opening groups should be interpreted with caution, as these surgeries may be subject to different clinical variables and not directly comparable to the more common CABG or valve procedures.

The study revealed the complexity of cardiac surgery outcomes, with survivors and non-survivors having different outcomes based on the type of surgery performed and intraoperative factors. In the survivor group, CABG was the most frequently performed procedure (52.2%), followed by valve operations (34.8%). This suggested that despite the complexity of these surgeries, outcomes were generally favorable when performed in a carefully selected patient population. In contrast, the non-survivor group showed an equal distribution between CABG and valve operations (50% each), suggesting that mortality outcomes in this cohort were not solely dependent on the type of surgery performed. This highlighted the importance of considering other variables, such as patient comorbidities, the severity of underlying heart disease, and perioperative factors, which might play a more substantial role in determining postoperative survival. Several intraoperative factors were significantly associated with mortality, providing key insights into the variables that may influence patient outcomes [31].

Prolonged time to re-exploration, greater blood loss, lower hematocrit levels, elevated lactate concentrations, and ECC time were all significantly correlated with non-survivors. These findings are consistent with established literature, which highlights the critical importance of intraoperative management in minimizing complications and improving survival [32]. Prolonged time to re-exploration may reflect delayed recognition of complications such as bleeding, graft failure, or other intraoperative events, which could lead to worse outcomes if not addressed promptly. Greater blood loss during surgery is a well-documented risk factor for adverse outcomes, as it can lead to hypovolemic shock, coagulopathy, and multi-organ failure [33].

Lower hematocrit levels, often indicative of tissue hypoxia or inadequate perfusion, were also associated with worse outcomes [34].

Elevated lactate concentrations, often indicative of tissue hypoxia or inadequate perfusion, were also linked to poor outcomes [35]. Extended ECC time was associated with higher mortality in the non-survivor group. Cardiopulmonary bypass, while essential for providing circulatory support during cardiac surgery, is not without risks. Therefore, minimizing ECC time and ensuring efficient management of the extracorporeal circuit is crucial to optimizing patient outcomes. These findings collectively reinforce the critical role of timely intervention and optimal intraoperative management in improving surgical outcomes. They emphasize that while the type of surgery is important, factors such as blood management, perfusion, and timely recognition of complications play a crucial role in determining postoperative survival. Given these associations, surgical teams need to focus not only on the procedural aspects of cardiac surgery but also on the broader context of intraoperative care. Early identification of complications, rapid re-exploration when necessary, and effective management of blood loss and perfusion are key strategies for improving survival rates, especially in patients undergoing complex procedures such as chest re-opening. Future research should focus on refining perioperative protocols, including blood conservation strategies, the use of hemodynamic monitoring tools, and minimizing ECC time to further reduce mortality rates in this high-risk patient population.

In the cohort of 25 patients who underwent chest re-opening, the median age was 70 years, with a predominance of male patients comprising 68% of the group. The majority of these patients (92%) survived the procedure, while 8% (2 patients) unfortunately died. While there were notable differences in demographic characteristics such as gender, median age, BMI, and the prevalence of comorbidities like diabetes mellitus, hypertension, and renal failure between survivors and non-survivors, these differences

were not statistically significant ($P > 0.05$). The median age of 70 years reflects the aging population typically observed in patients undergoing complex cardiac procedures like chest re-opening, which is often required for cases involving complications or redo surgeries following initial cardiac interventions. Older age has been widely recognized as a risk factor in cardiovascular surgery, with advanced age correlating with increased perioperative risks, including longer recovery times and a higher likelihood of postoperative complications. However, in our study, age did not emerge as a statistically significant factor in differentiating survivors from non-survivors, which may suggest that other factors, such as the nature of the surgery itself or intraoperative variables, may play a more substantial role in determining patient outcomes. The male predominance in this cohort (68%) aligns with existing literature, which suggests that men are more likely to experience cardiovascular disease at younger ages compared to women. This could partially explain the higher representation of men in studies of chest re-opening patients, as coronary artery disease and other cardiac pathologies that necessitate re-interventions tend to affect males more frequently. However, the gender distribution did not reach statistical significance in relation to survival outcomes, suggesting that gender alone may not be a critical factor influencing mortality in this population. Similarly, while there were differences in BMI, with some trends indicating that higher BMI might be associated with worse outcomes, these did not reach statistical significance in our cohort. Obesity is widely recognized as a risk factor for poorer postoperative outcomes, especially in cardiac surgery, as it is often associated with other comorbid conditions such as hypertension, diabetes, and sleep apnea. However, our findings suggest that BMI, within the range observed in this cohort, did not have a substantial independent effect on survival outcomes in chest re-opening patients. The prevalence of comorbidities such as diabetes mellitus, hypertension, and renal failure was also analyzed in relation to survival. These conditions are common in patients undergoing cardiac surgery and can significantly influence surgical outcomes. Diabetes mellitus, for example, is known to impair wound healing, increase the risk of infections, and lead to microvascular damage, which can complicate cardiac surgery recovery. Hypertension increases the risk of myocardial injury and may contribute to complications like bleeding or stroke. Renal failure is a critical comorbidity in cardiac surgery, as it is associated with increased mortality and morbidity due to compromised renal perfusion during surgery, as well as the need for preoperative dialysis. Although these comorbidities were numerically more prevalent in non-survivors, the differences did not reach statistical significance, which might suggest that other more dynamic factors, such as intraoperative management, surgical technique, and postoperative care, are more influential in determining outcomes than the baseline presence of these comorbidities. Although there were some numerical differences in demographic characteristics and comorbidities between survivors and non-survivors in this cohort, none of these factors reached statistical significance. This indicates that while these variables may influence patient health and outcomes in a general sense, they may not be decisive on their own in predicting survival after chest re-opening. Instead, intraoperative factors such as surgical complexity, blood loss, and postoperative management likely play a more significant role in determining survival outcomes. These findings suggest that future research could focus on identifying more specific predictive markers of mortality and survival, possibly integrating both demographic data and intraoperative variables, to better inform risk stratification and surgical decision-making in patients undergoing chest re-opening.

The strengths of this study include the comprehensive analysis of demographic, clinical, and intraoperative variables, as well as the detailed comparison of survivors and non-survivors. These data offer a nuanced understanding of factors influencing chest re-opening outcomes. However, the study is limited by its retrospective design and relatively small sample size for the chest re-opening cohort, which may limit the generalizability of findings. Additionally, the absence of long-term follow-up data precludes conclusions regarding the durability of outcomes. However, the retrospective design and limited number of mortality events (n=2) significantly constrain statistical analysis and generalizability of the findings.

The findings underscore the importance of meticulous perioperative planning and monitoring for patients undergoing high-risk procedures, particularly valve surgeries. The significant differences in pre-re-exploration parameters between survivors and non-survivors highlight the potential utility of early identification of high-risk patients using hematological and biochemical markers. Implementing rapid response protocols for patients exhibiting elevated lactate levels or prolonged ECC times could improve survival rates. Recognizing early signs and indications of re-opening could support risk stratification and guide immediate management strategies, particularly for bleeding and tamponade.

Future research should focus on prospective studies to validate the prognostic utility of pre-re-exploration parameters, such as lactate concentrations and hematocrit levels. Additionally, exploring the long-term outcomes of chest re-opening patients and investigating the underlying mechanisms linking surgical urgency and outcomes could provide deeper insights. Developing predictive models incorporating demographic, clinical, and intraoperative variables may enhance risk stratification and guide clinical decision-making.

CONCLUSION

In conclusion, this study highlights critical factors influencing outcomes following chest re-exploration procedures. By identifying key predictors of survival and emphasizing the importance of timely intervention, our findings contribute to improving the management and prognosis of patients requiring chest re-exploration cardiac surgery.

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