GOIANA JOURNAL OF MEDICINE

DOI 10.63162/V66N67E25535
ISSN 0034-9585
e25535
SCIENTIFIC ARTICLE - CASE REPORT

EVALUATION OF CARDIOLOGICAL PROFILE PARAMETERS IN PATIENTS UNDERGOING ORTHOPEDIC SURGERY AT A TERTIARY HOSPITAL IN GOIÁS AND ANALYSIS OF FACTORS ASSOCIATED WITH PERIOPERATIVE COMPLICATIONS

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ABSTRACT

Introduction: Perioperative cardiovascular assessment aims to identify increased risk of complications and adjust preventive measures. Physical limitations and the need for a rapid approach to the orthopedic patient restrict stratification. **Objective:** To evaluate the association between electrocardiographic (ECG) and laboratory changes, increased cardiovascular structures on chest radiography, length of hospital stay and high levels of morbidity and mortality. **Methods:** Patients underwent detailed history taking and physical examination. The risk profile was determined using the Multicenter Study for Perioperative Evaluation (EMAPO). Electrocardiographic alterations included blocks, presence of pathological Q waves, QRS > 150 ms, presence of atrial fibrillation and other arrhythmias. Analysis of chest radiographs determined the cardiothoracic ratio and the presence of mediastinal widening. Postoperative complications were considered as in-hospital death or length of hospital stay longer than 7 days and assessed using the Postoperative Morbidity Survey (POMS). **Results:** Eighty patients with a mean age of 79 years (54 to 100 years) were included, 46 of whom were women (57.5%). The overall mortality rate was 11.2% (14 deaths). The presence of isolated atrial and/or ventricular extrasystoles on the ECG ($p = 0.000$), advanced age ($p = 0.001$), reduced glomerular filtration rate ($p = 0.002$), length of hospital stay in the postoperative period ($p = 0.000$), EMAPO score with moderate to high risk ($p = 0.011$) and POMS score with involvement of sites other than cardiac decompensation ($p = 0.001$) were statistically significant, considering mortality. The mortality rate among those operated was 8.7%, and no patient died during the operation. Of all patients, 48.8% had decompensation in the perioperative period, the majority of which were nosocomial infections. **Conclusion:** The patient's clinical stability and the speed of surgical procedure are related to a better outcome. Conduction disturbances on the ECG, except for total atrioventricular block, as well as changes in the cardiac area and mediastinum were not associated with complications and do not suggest the need for progression in the investigation for surgical release.

Keywords: Perioperative care, Risk, Femoral fractures; Cardiology, Indicators of morbidity and mortality.

INTRODUCTION

The stratification of perioperative cardiovascular risk in non-cardiac surgeries allows for the identification of potential cardiovascular complications that increase morbidity and mortality, identifying more vulnerable patients and enabling the initiation of preventive measures to avoid complications in the immediate and late perioperative period[1]. However, excessive evaluation can lead to the misuse of resources and delays in the performance of surgical procedures.

Hip fracture is the most common type of fracture, especially among the elderly, associated with a high rate of morbidity and mortality, and with a significant impact on the quality of life of this population.[2]

At the Hospital de Urgência de Goiás (HUGO), surgery for hip fracture correction accounts for a large portion of hospital admissions. The timing of the surgery is considered critical for survival, with the recommendation that surgical treatment for acute hip fractures should occur within 24 hours of the trauma.[3]

Early intervention is associated with better outcomes during hospitalization, such as a reduction in the occurrence of pressure ulcers, infections, hospital length of stay, and mortality, as well as superior functional outcomes.[4] Preoperative exams help adjust clinical management and provide benefits for the patient, as well as predict postoperative complications. On the other hand, excessive testing can cause anxiety and delay in treatment, without leading to significant changes in clinical and surgical outcomes.[5]

Patients admitted to the Hospital de Urgência de Goiás for hip fracture correction were evaluated from November 2023 to November 2024, from the request for preoperative evaluation to the cardiology residency service, through to hospital discharge and any potential readmissions within a 30-day period.

The aim of this study was to evaluate the association between electrocardiographic changes, laboratory results, enlargement of cardiovascular structures on chest radiographs, length of stay for surgical procedure, and elevated levels of morbidity, mortality, or prolonged perioperative hospitalization.

METHODS

Patients with femur fractures admitted to the Hospital de Urgências de Goiás from November 2023 to November 2024 were included. Eligible for inclusion in the study were patients who underwent orthopedic interventions for primary femur fracture correction and for whom cardiovascular risk assessment was requested from the cardiology service of HUGO. After obtaining approval from the HUGO Research Ethics Committee, under number CAAE: 767243.6.0000.0033, patients were asked and informed about consenting to the inclusion in the research project. Patients who did not accept inclusion in the research protocol were evaluated according to the standard procedure of the cardiology service for cardiovascular surgical risk clearance. Patients showing signs of systemic inflammatory response syndrome (SIRS) or sepsis in the preoperative period requiring antibiotic therapy, as well as those showing signs of heart failure (class III/IV according to the New York Heart Association, NYHA) or elevated systolic blood pressure (SBP) above 160 mmHg or diastolic blood pressure (DBP) above 100 mmHg, or inadequate heart rate in atrial fibrillation above 100 bpm and requiring specific treatment, were also included in the study. Polytraumatized patients requiring surgical interventions at other orthopedic sites or organs were not included.

Cardiovascular Risk Assessment

Patients who accepted inclusion in the cohort underwent routine cardiovascular risk assessment, which consisted of detailed medical history and physical examination, a 12-lead electrocardiogram

(ECG), chest radiography, and laboratory tests including complete blood count, renal function, and electrolyte levels (sodium, potassium, magnesium). A transthoracic echocardiogram was performed in those who showed significant abnormalities on cardiac auscultation or ECG signs of atrial and/or ventricular overload, changes suggestive of ischemia in ventricular repolarization, or a QRS complex duration above 150 ms. Each individual's risk profile was determined using the Multicenter Study for Perioperative Evaluation of the São Paulo State Cardiology Society (EMAPO)[6], classifying them into low, moderate, high, and very high-risk categories. The electrocardiographic changes eligible for evaluation included atrioventricular and interventricular blocks, presence of pathological Q waves, QRS duration above 150 ms, presence of atrial fibrillation, and other arrhythmias. The analysis of chest radiography determined the cardiothoracic index (CTI)[7], which expresses the ratio between the size of the heart and the transverse dimension of the chest measured on a posteroanterior (PA) chest radiograph. A CTI value above 0.5 should be interpreted as indicating heart enlargement and mediastinal widening. The number of days between admission and the date of the surgical procedure was measured and correlated with the occurrence of complications.

The length of stay in the postoperative period was counted in days from the surgical procedure (D0) until hospital discharge or death. Postoperative complications were considered as in-hospital death or a length of stay exceeding 7 days. Early postoperative complications were assessed through the Postoperative Morbidity Survey (POMS)[8], which covers multiple organ and system involvement. The criteria considered in the POMS were obtained through medical history, physical examination, and review of medical records on the third and fifth day after the surgical procedure. The application of protocols and collection of all patient information involved in the research was carried out by cardiology residents or internal medicine residents who were involved with the cardiology service during the data collection period.

Statistical Analysis

The tabulation and statistical analysis were performed using Microsoft Excel®, version 2010. Quantitative variables were presented as means, standard deviations, minimums, and maximums. The distribution of these variables was analyzed using the Kolmogorov-Smirnov test, when necessary, for normality testing. Qualitative variables were presented as absolute numbers and proportions. The chi-square test was used when necessary. For continuous variables, comparisons were made using the Student's t-test. SAS® University Edition software was used for these calculations. A significance level of 5% ($p \leq 0.05$) was adopted.

RESULTS

Patients A total of 80 patients were included in the study, with a mean age of 79 years (ranging from 54 to 100 years), including 46 women (57.5%) and 34 men (42.5%). The overall mortality rate in this population was 11.2% (14 deaths) during the follow-up period. Among the variables analyzed, those that were statistically significant in relation to mortality included the presence of isolated atrial and/or ventricular extrasystoles on the 12-lead electrocardiogram (p: 0.000), age (p: 0.001), glomerular filtration rate (p: 0.002), length of stay in the postoperative period (p: 0.000), EMAPO score (p: 0.011), and POMS score (p: 0.001).

Considering the 80 patients assessed, ten were not operated on, with four of them dying before the procedure and six receiving conservative treatment.

The mortality rate among the operated patients was 8.75%, and no patient died during the intraoperative period. Among the total number of patients, 48.8% experienced decompensation during the perioperative period, with most cases being due to nosocomial infections. Only one patient experienced cardiac decompensation, and the surgical team opted for conservative treatment. Among those who experienced decompensation at any site during the hospitalization period, 32.5% progressed to death.

The time interval between the request and the release of the surgical risk by the Cardiology team was assessed, and 90% received a response within the first 24 hours after the request from the attending team, with 73.8% being cleared for the procedure. Patients who underwent the procedure without prior cardiological evaluation or before the formal definition of the risk had worse outcomes and increased mortality (p: 0.000).

In the postoperative period, after hospital discharge, about 10% of patients who underwent the surgical procedure required rehospitalization due to complications. Among them, the majority presented with surgical wound infection or infections at other sites (47.0%). Other complications included cardiac decompensation (1.6%) and venous thromboembolism (1.6%).

The data collected in this research are presented in Table 1.

Table 1. Sample Characterization and Association with Mortality.

Variables	All (n=80)	Mortality		p-value
		Yes (n=14)	No (n=66)	
Sociodemographic				
Age	79.0±11.7	88.2±7.2	76.9±11.6	0.001
Men	34 (42.5)	3 (21.4)	32 (48.5)	0.173
Women	46 (57.5)	11 (78.6)	34 (51.5)	
Clinical				
Comorbidities				0.917
None	27 (33.8)	3 (21.4)	24 (36.3)	
Hypertension	17 (21.3)	6 (42.8)	11 (16.7)	
NIDDM	3 (3.8)	0 (0)	3 (4.5)	
IDDM	3 (3.8)	0 (0)	3 (4.5)	
Dyslipidemia	0 (0)	0 (0)	0 (0)	
Previous stroke	1 (1.3)	1 (7.1)	0 (0)	
Previous myocardial infarction	2 (2.5)	0 (0)	2 (3.0)	
Severe valvulopathy	0 (0)	0 (0)	0 (0)	
≥ 2 comorbidities	22 (33.8)	4 (28.6)	23 (34.8)	
Electrocardiographic				
Chamber overload				0.161
RAO	0 (0.0)	0 (0.0)	0 (0.0)	
LAO	6 (7.5)	0 (0)	6 (9.1)	
Biatrial	1 (1.3)	0 (0)	1 (1.5)	
RVO	1 (1.3)	0 (0)	1 (1.5)	
LVO	6 (7.5)	1 (7.1)	5 (7.5)	
Biventricular	0 (0.0)	0 (0.0)	0 (0.0)	
None	66 (82.5)	13 (92.8)	53 (88.3)	
Interventricular blocks				0.861
None	61 (76.3)	10 (71.4)	51 (77.3)	
RBCD	1 (1.3)	0 (0)	1 (1.5)	
RBBB	4 (5.0)	1 (7.1)	3 (4.5)	
LBBB	2 (2.5)	0 (0)	2 (3.0)	
RBBB and ASDB	3 (3.8)	2 (14.2)	1 (1.5)	
ASDB	7 (8.8)	1 (7.1)	6 (9.1)	
LBCD	2 (2.5)	0 (0)	2 (3.0)	
Atrioventricular blocks				0.330
None	76 (95)	14 (100)	62 (93.9)	
1st degree AVB	4 (5)	0 (0)	4 (6.1)	
2nd degree AVB type 1	0 (0)	0 (0)	0 (0)	
2nd degree AVB type 2	0 (0)	0 (0)	0 (0)	
Complete AVB	0 (0)	0 (0)	0 (0)	
QRS duration				0.963
< 120ms	70 (87.5)	12 (85.8)	58 (87.9)	
120-150ms	9 (11.3)	2 (14.2)	7 (10.7)	
> 150ms	1 (1.3)	0 (0)	1 (1.5)	
				0.453

Pathological Q wave	72 (90)	13 (92.8)	59 (89.4)	
Absent	0 (0)	0 (0)	0 (0)	
Inferior	1 (1.3)	0 (0)	1 (1.5)	
Lateral	1 (1.3)	0 (0)	1 (1.5)	
Anterior	2 (2.5)	1 (7.2)	1 (1.5)	
Septal	4 (5)	0 (0)	4 (6.1)	
Two or more				0.153
Atrial fibrillation	3 (3.8)	1 (7.1)	2 (3.1)	
Paroxysmal	1 (1.3)	1 (7.1)	0 (0)	
Persistent	0 (0)	0 (0)	0 (0)	
First detected	0 (0)	0 (0)	0 (0)	
Long-standing persistent	1 (1.3)	0 (0)	1 (1.5)	
Permanent	75 (93.8)	12 (85.7)	63 (95.4)	
None				0.000
Other arrhythmias	67 (83.8)	6 (42.8)	61 (92.4)	
None	0 (0)	0 (0)	0 (0)	
Atrial flutter	5 (6.3)	1 (7.1)	4 (6.1)	
iVES, NSVT	7 (8.8)	6 (42.8)	1 (1.5)	
iAES, NSAT	1 (1.3)	1 (7.1)	0 (0)	
AE and VE				
Radiographic				0.062
Cardiothoracic index	54 (67.5)	6 (42.8)	48 (72.8)	
Normal	18 (22.5)	6 (42.8)	12 (18.2)	
Increased	5 (6.3)	1 (7.14)	4 (6.1)	
Poor quality of examination	3 (3.8)	1 (7.14)	2 (3.0)	
Not performed				0.959
Mediastinal enlargement	21 (26.3)	4 (28.6)	17 (25.7)	
Present	51 (63.8)	8 (57.1)	43 (65.1)	
Absent	5 (6.3)	1 (7.14)	4 (6.1)	
Poor quality of examination	3 (3.8)	1 (7.14)	2 (3.0)	
Not performed				
Laboratory				0.765
Hemoglobin	27 (34)	6 (42.8)	21 (31.8)	
> 12	38 (48)	4 (28.6)	34 (51.5)	
8-12	15 (19)	4 (28.6)	11 (16.7)	
< 8				0.310
Sodium	22 (27.5)	2 (14.3)	20 (30.3)	
< 135	56 (70)	11 (78.6)	45 (68.2)	
135-145	2 (2.5)	1 (7.1)	1 (1.5)	
> 145				0.784
Potassium	2 (2.5)	1 (7.1)	1 (1.5)	
< 3,5	77 (96.3)	12 (85.7)	65 (98.5)	
3,5-5,5	1 (1.3)	1 (7.1)	0 (0)	
> 5,5				**0.002**
Glomerular filtration rate	14 (17.5)	2 (14.2)	12 (18.2)	
> 90	28 (35)	3 (21.4)	25 (37.9)	
60-89	20 (25)	1 (7.1)	19 (28.8)	
45-59	13 (16.3)	3 (21.4)	10 (15.4)	
30-44	5 (6.3)	5 (35.7)	0 (0)	
15-29	0 (0)	0	0 (0)	
< 15				
Hospitalization time				0.055
Preoperative	2 (2.5)	0 (0)	2 (3.0)	
< 24h	2 (2.5)	0 (0)	2 (3.0)	
24-48h	11 (13.8)	3 (21.4)	8 (12.1)	
2-5 days	55 (68.8)	5 (35.7)	50 (75.7)	
> 5 days	10 (12.5)	6 (42.8)	4 (6.1)	
Not operated on				**0.000**
Postoperative	32 (40)	3 (21.4)	29 (43.9)	
< 48h	25 (31.2)	1 (7.1)	24 (36.4)	
2-7 days	12 (15)	3 (21.4)	9 (13.6)	
> 7 days	11 (13.8)	7 (50)	4 (6.1)	

Not operated on				
Scores				**0.011**
EMAPO - Risk	1 (1.3)	0 (0)	1 (1.5)	
Very low	15 (18.8)	1 (7.1)	14 (21.2)	
Low	57 (71.3)	9 (64.3)	48 (72.7)	
Moderate	5 (6.3)	3 (21.4)	2 (3.0)	
High	2 (2.5)	1 (7.1)	1 (1.5)	
Very high				**0.001**
POMS	40 (50)	1 (7.1)	39 (59.1)	
No impairment	1 (1.3)	0 (0)	1 (1.5)	
Heart failure	39 (48.8)	13 (92.9)	26 (39.4)	
Impairment – other sites				
Evaluations				
Cardiology evaluation				
< 24h				0.583
24-48h	72 (90)	13 (92.9)	59 (89.4)	
> 48h	7 (8.8)	1 (7.1)	6 (9.1)	
Surgical risk clearance	1 (1.3)	0 (0)	1 (1.5)	
< 24h				**0.000**
24-48h	59 (73.8)	7 (50)	52 (78.8)	
> 48h	9 (11.3)	1 (7.1)	8 (12.1)	
Not cleared	7 (8.8)	1 (7.1)	6 (9.1)	
Time between risk clearance and surgery	5 (6.3)	5 (35.7)	0 (0)	
< 24h				
24-48h				
> 48h				0.602
	11 (15.7)	1 (14.3)	10 (15.1)	
Readmission	10 (14.3)	1 (14.3)	9 (13.6)	
No	49 (70)	5 (71.4)	43 (65.1)	
Yes (Infection)				
Yes (Heart failure/Arrhythmias)	47 (73.4)	12 (85.7)	48 (72.72)	
Yes (PTE/VTE)	3 (4.7)	2 (14.3)	1 (1.5)	
Yes (Other)	1 (1.6)	0 (0)	1 (1.5)	
No / No return for outpatient care	1 (1.6)	0 (0)	1 (1.5)	
	2 (3.1)	0 (0)	2 (3.0)	
	10 (15.6)	0 (0)	11 (16.7)	

Legend: NIDDM (Non-Insulin Dependent Diabetes Mellitus), IDDM (Insulin Dependent Diabetes Mellitus), CVA (Cerebrovascular Accident), AMI (Acute Myocardial Infarction), RVO (Right Ventricular Overload), LVO (Left Ventricular Overload), RAO (Right Atrial Overload), LAO (Left Atrial Overload), RBCD (Right Bundle Branch Conduction Disorder), RBBB (Right Bundle Branch Block), LBBB (Left Bundle Branch Block), ASDB (Anterosuperior Divisional Block), LBCD (Left Bundle Branch Conduction Disorder), AVB (Atrioventricular Block), iVES Isolated Ventricular Extrasystole), NSVT (Non-Sustained Ventricular Tachycardia), iAES (Isolated Atrial Extrasystole), NSAT (Non-Sustained Atrial Tachycardia), AE (Atrial Ectopies),VE (Ventricular Ectopies).

DISCUSSION

The fractures in the femoral neck are common injuries observed in the general population, especially among the elderly, responsible for a large portion of surgeries and hospital bed occupancy in orthopedic wards.[9] About 90% are secondary to falls, with a multifactorial etiology, including a combination of clinical comorbidities and environmental factors. Age-related factors, such as visual and cognitive impairment, gait and balance changes, loss of functional capacity, and drug use, contribute to events in this population.[10]

Characteristics related to the hospitalization period can have a significant impact on the patients' quality of life. In this study, all patients who died had a hospitalization period of more than two days before the procedure, with 11 out of 14 patients (78.5%) staying in the hospital for more than five days until the intervention or the surgical team's decision for conservative treatment. Morrissey et al. observed that for each hour of delay in femoral neck fracture surgery, the risk of mortality increases by 1.8%, becoming significant after 24 hours of hospitalization.[11]

Regarding the time for the cardiology team's evaluation and the release of surgical risks, 90% of the patients in the study were assessed in less than 24 hours, and 73.8% of the total assessed had their surgical risks cleared within 24 hours as well. On the other hand, 70% of the patients underwent femoral fracture correction surgery within 48 hours after the surgical risk was cleared. Lee et al. showed that if surgery is performed within the first 48 hours after the fracture, there are lower rates of perioperative complications.[12]

It was observed in this group that patients with more than one comorbidity did not have worse outcomes, which may be attributed to the number of patients assessed. In contrast to the resolution of the American Academy of Orthopaedic Surgeons, patients with more pre-existing comorbidities have a higher mortality risk when surgery is delayed for more than 48 hours.[13]

Surgical risk is related to specific factors of the patient and the surgery. There are several tools for perioperative risk assessment, such as EMAPO (Operated Patient Morbidity and Mortality Scale), Lee, NSQIP, ACS-SRC, among others, which will produce similar results when used correctly.[14]

For the assessment of surgical risk in this study, the EMAPO score was used (a Brazilian classification that evaluates 27 variables for estimating perioperative risk, which includes a detailed medical history, a comprehensive physical examination, and specific complementary tests), as shown in Annex 1. According to this score, 57 patients (71.25% of the total) had a score of 9 or higher, being classified as moderate risk. Of these, 9 patients progressed to death, representing 64.3%. Another score used was the POMS (a simple method for detecting and quantifying postoperative complications that prevent hospital discharge), where patients are evaluated in 9 domains (pulmonary, infectious, renal, gastrointestinal, cardiovascular, neurological, hematological, wound, and pain), shown in Annex 2[15]. Of the total number of patients assessed, 92.9% of the deaths had decompensation from non-cardiac sites.

The request for laboratory and imaging tests, such as chest radiography, echocardiogram, and electrocardiogram, should be made selectively, based on the patient's age, medical condition, planned procedure, and the likelihood that the results will alter treatment or aid in risk assessment. In most cases, there is no need to request routine or screening preoperative tests for patients who are clinically stable, especially if the patient is asymptomatic. There is data suggesting that preoperative tests increase costs and delay surgeries without improving outcomes16.[16]

Considering the laboratory tests requested in the preoperative period, as described in Table 1, both the hemoglobin and electrolyte (sodium and potassium) levels did not show significant alterations compared to baseline values that would impact the mortality rate. On the other hand, the glomerular filtration rate (GFR) evaluated, which includes creatinine values and the individuals' age, showed that 35.7% of the deaths had a GFR lower than 30 ml/min/1.73 m², with a significant p-value. Barbosa et al. evaluated 182 individuals with femur fractures and concluded that 57% had some preoperative complication, of which 14.3% had acute kidney injury and 18.7% had electrolyte disturbances, showing relevant alterations to the study.[17]

Electrocardiographic alterations such as chamber overload, intraventricular block, atrioventricular block, presence of pathological "Q" wave, duration of the QRS complex, and the presence of atrial fibrillation did not have relevance in the final outcome of patients undergoing surgical procedures, as can be seen in Table 1. On the other hand, 40% of the patients who died presented atrial arrhythmias (atrial ectopy or non-sustained atrial tachycardia) during hospitalization. Polanczyk CA et al. evaluated the incidence of supraventricular arrhythmias in 4,181 patients during the

perioperative period of non-cardiac surgeries and reported that it was a more common arrhythmia after surgery, with a 33% increase in both time and hospital stay.[18]

In this study, 45% of the patients underwent transthoracic echocardiography, and of these, 73.3% of the deaths had preserved ejection fraction. Studies show that performing a complete exam may cause an average delay of 1.6 days in the surgery, and the exam is not always available at the ideal time. Furthermore, most patients do not require any type of preoperative cardiological intervention, whether surgical or clinical.[19]

Karen et al. describe that performing transthoracic echocardiography significantly increases the time until surgery and does not improve patient survival, even if cardiac medical interventions were performed. It should be individually titrated for each patient according to perioperative risk.[20]

We observed that both early surgeries and early hospital discharge reduce the postoperative hospital stay time, in addition to preventing complications such as deep vein thrombosis, pulmonary embolism, and the risk of hospital-acquired infections. Other studies have also evaluated that the incidence of pulmonary infection, urinary tract infection, and deep vein thrombosis in the lower limbs was lower within 30 days in patients undergoing early surgery.[21]

The hospital readmission rate due to complications after the surgical procedure was 10%, of which only 1.6% had cardiac decompensation and 4.7% had infections (surgical site or other locations).

The main limitations of the study are described as follows. During the course of the project, including the period of data collection and patient follow-up, the hospital underwent an administrative reform, which altered the flow of admissions and surgeries, significantly impacting the sample size initially proposed. Additionally, some patients did not attend their post-discharge outpatient follow-up appointments, making it difficult to assess their postoperative condition.

CONCLUSION

The patient's clinical stability and the speed at which the surgical procedure is performed are related to better outcomes. Conduction disturbances on the electrocardiogram, except for total atrioventricular block, as well as changes in the cardiac and mediastinal areas, were not associated with complications and do not suggest the need for further investigation for surgical clearance. Among all the variables analyzed—age, glomerular filtration rate, presence of arrhythmias on the ECG (iAES, iVES, NSAT, NSVT), and postoperative hospitalization time—were linked to an unfavorable outcome. Patients classified as having moderate to very high cardiovascular risk by the EMAPO score had worse outcomes. Those with decompensation in other sites, according to the POMS score, were also associated with increased mortality.

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Library Review - Izabella Goulart

Spell Check: Dario Alvares
Received: 12/03/25. Accepted: 12/03/25. Published in: 25/03/25.