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ORIGINAL ARTICLE
ORİJİNAL ARAŞTIRMA

Predictors of Mortality in Stanford Type A Aortic Dissection Patients with Pericardial Hematoma: A Single Center Experience

Perikardiyal Hematomlu Stanford Tip A Aortik Diseksiyon Hastalarında Mortalite Belirteçleri: Tek Merkez Deneyimi

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ABSTRACT

Aim: This retrospective study aimed to explore mortality predictors in patients undergoing surgical repair for Acute Stanford Type A Aortic Dissection (ATAAD) with concomitant pericardial hematoma between 2010 and 2022.

Material and Method: Data from 270 patients were reviewed, focusing on 42 cases with preoperative pericardial hematoma while excluding Type B dissections, chronic cases, and redos. Pericardial hematoma confirmation employed preoperative imaging and surgical evidence. Hemodynamic instability, defined by systolic blood pressure <80 mmHg, was assessed.

Results: Hemodynamic instability was observed in 25 (59.5%) patients, and in-hospital mortality stood at 35.7%. Multivariate analysis indicated hemodynamic instability's significant predictive role for mortality (p=0.004). While age, preoperative renal status, and previous coronary intervention lacked direct associations with early mortality, hemodynamic instability emerged as a strong determinant.

Conclusion: This study underscores the paramount significance of hemodynamic instability in determining mortality outcomes in patients with pericardial hematoma and ATAAD undergoing surgical repair.

Keywords: Aortic dissection, mortality, cardiac tamponade

ÖZ

Amaç: Bu retrospektif çalışma, 2010 ile 2022 yılları arasında akut Stanford Tip A Aortik Diseksiyon (ATAAD) nedeniyle cerrahi tamir geçiren ve eşzamanlı perikardiyal hematomu olan hastalardaki mortalite belirteçlerini araştırmayı amaçlamıştır.

Gereç ve Yöntem: 270 hastanın verileri incelendi. Tip B disseksiyonlar, kronik vakalar ve redo işlemler çalışma dışı bırakıldı.Preoperatif perikardiyal hematomu olan 42 vaka çalışmaya dahil edildi. Perikardiyal hematomun teyidi, preoperatif görüntüleme yoluyla ve cerrahi sırasında yapıldı. Hemodinamik instabilite, kardiyak tamponad gibi nedenlere bağlı olarak sistolik kan basıncının 80 mmHg'nin altında olması olarak tanımlandı.

Bulgular: Hemodinamik instabilite, hastaların 25'inde (%59.5) gözlendi ve hastane içi mortalite %35.7 olarak bulundu. Çok değişkenli analiz, hemodinamik instabilitenin mortalite için önemli bir belirteç rolü olduğunu gösterdi (p=0.004). Yaş, preoperatif böbrek hasarı ve daha önceki koroner girişimler, erken mortaliteyle istatiki olarak ilişkili bulunamazken, hemodinamik istikrarsızlık güçlü bir belirteç olarak ortaya kondu.

Sonuç: Bu çalışma, perikardiyal hematom ve ATAAD'lı hastalarda cerrahi tamir geçiren hastalarda mortalite sonuçlarını belirlemede hemodinamik instabilitenin önemini vurgulamaktadır.

Anahtar Kelimeler: Aort diseksiyonu, mortalite, tamponad

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INTRODUCTION

Acute Stanford Type A aortic dissection (ATAAD) is a lethal condition that requires prompt action after diagnosis. This critical medical emergency demands immediate and decisive surgical intervention to avoid potentially devastating complications. The condition arises when a tear in the aortic intima causes blood to flow between the layers of the aorta. As blood continues to dissect along the vessel wall it can lead to various complications such as malperfusion syndromes, myocardial infarction, aortic valve dysfunction and aortic rupture.

Pericardial hematoma is an infrequent yet crucial complication that profoundly impacts the progression of aortic dissection. The occurrence of aortic rupture resulting in a pericardial hematoma significantly diminishes the chances of survival and escalates mortality rates (1,2). Swift and effective management of the pericardial hematoma, with the aim of alleviating cardiac tamponade, becomes the primary treatment objective. However, the available literature concerning patients with pericardial hematoma in the context of acute Stanford Type A aortic dissection remains limited. Therefore, our study aimed to comprehensively analyze the outcomes of these patients and identify predictors of mortality to better understand and address this critical medical challenge.

MATERIAL AND METHOD

This retrospective study focused on patients who underwent surgical repair for acute Stanford Type A Aortic dissection within the timeframe of January 2011 to December 2022 in our hospital. The study was carried out with the permission of Istanbul Mehmet Akif Ersoy Research and Training Hospital Ethics Commitee (No: 2023.06.69) to ensure compliance with ethical guidelines and standards, in accordance with the principles outlined in the Declaration of Helsinki. A total of 270 patients data were reviewed, and 42 patients with preoperative pericardial hematoma were included in the analysis. The study specifically excluded patients with Type B dissections and chronic dissections, as well as redo patients. The primary objective of the study was to assess in-hospital mortality. Additionally, the research examined preoperative demographic characteristics of the patients, surgical technique details, intraoperative data, and occurrences of in-hospital and early complications.

The confirmation of pericardial hematoma was based on preoperative imaging modalities such as computed tomography, magnetic resonance imaging, or echocardiography. However, the presence of blood in the pericardium during surgery was necessary to definitively confirm this finding. Hemodynamic instability was characterized by hypotension, specifically with systolic blood pressure below 80 mmHg, resulting from conditions like cardiac tamponade, shock, heart failure, myocardial ischemia, or infarction. Diabetes mellitus was defined as a medical history of the condition, irrespective of medication use. Chronic obstructive pulmonary disease was identified by a documented history of obstructive pulmonary disease before the surgery. Renal dysfunction was defined as having a preoperative serum creatinine level exceeding 2.0 mg/dl. Operative mortality encompassed deaths occurring within 30 days after the operation or during the hospitalization period immediately following the surgery.

Surgical Procedure

Patients diagnosed with ATAAD and preoperative pericardial hematoma underwent emergent surgical operation. The procedure conducted under general anesthesia. The patient was positioned in a supine manner on the operating table, with standard monitoring equipment in place. A median sternotomy incision was then carefully performed to gain access to the mediastinum. Following sternotomy, the pericardium was meticulously opened, revealing the dissected aorta. The pericardial hematoma was cautiously evacuated to relieve cardiac tamponade, with meticulous hemostasis applied to the bleeding source, typically originating from the dissected aorta. Subsequently, systemic heparinization was initiated to achieve an activated clotting time (ACT) exceeding 400 seconds. The specific details of the surgical procedure may have been adjusted based on individual patient characteristics and the extent of aortic involvement. Surgical decisions were primarily guided by the attending cardiac surgeons' clinical judgment and the unique condition of each patient. Cannulation for cardiopulmonary bypass (CPB) involved the use of axillary, femoral, brachiocephalic arteries, and aorta. In cases necessitating aortic arch repair, hypothermic circulatory arrest (HCA) was implemented. Core temperature was gradually lowered to below 25°C, enabling HCA initiation. Antegrade cerebral perfusion was simultaneously established to ensure adequate brain perfusion during the arrest period. Depending on the extent of aortic involvement, repair techniques varied, including ascending aorta replacement, aortic root replacement, arch replacement, and elephant trunk procedure. Following satisfactory hemodynamic stabilization and rewarming, patients were weaned from CPB. Hemostasis and closure of the sternum performed. Patients were subsequently transferred to the intensive care unit for postoperative monitoring.

Statistical analysis

The statistical analysis was conducted using IBM SPSS version 26.0 software. (IBM Corp, Armonk, NY, USA) Continuous data were expressed as either mean ± standard deviation (SD) or median with interquartile range (IQR), while categorical data were presented as counts and frequencies. To assess the normality of the data distribution, the Kolmogorov-Smirnov test was employed. For predicting mortality, a logistic regression model was utilized in the multivariate analysis. Statistical significance was defined as a p-value less than 0.05.

RESULTS

The study population had a mean age of 56.07 ± 13.56 years, consisting of 28 men and 14 women. Among the patients, 34 (81%) had arterial hypertension, and 13 (31%) had diabetes mellitus preoperatively. Prior to the operation, 7 (16.7%) patients had renal dysfunction. The mean ejection fraction was 55.36 ± 4.86. Eleven (26.2%) patients had undergone a previous percutaneous coronary intervention, and 5 (11.9%) patients were identified with a bicuspid aortic valve. As for aortic insufficiency, 11 (26.2%) patients had severe, and 7 (16.7%) patients had moderate aortic insufficiency. Hemodynamic instability was observed in 25 (59.5%) patients when they were going for the operation. (**Table 1**)

Table 1: Demographics and clinical characteristics of patients

Patients Characteristics	N=42 n (%) / mean ±SD
Age (years)	56.07 ± 13.56
Male	28 (66.7)
Body surface area	1.91 ± 0.17
Arterial hypertension	34 (81.0)
Preoperative renal dysfunction	7 (16.7)
Diabetes mellitus	13 (31.0)
Chronic obstructive pulmonary disease	12 (28.6)
Previous percutaneous coronary intervention	11 (26.2)
Ejection fraction (%)	55.36 ± 4.86
Bicuspid aortic valve	5 (11.9)
Aortic insufficiency	
None	14 (33.3)
Mild	10 (23.8)
Moderate	7 (16.7)
Severe	11 (26.2)
Atrial fibrillation	4 (9.5)
Hemodynamic instability	25 (59.5)

The median operation time was 305.5 minutes (IQR: 248.5-374.5). The median cardiopulmonary bypass time was 163.5 minutes (IQR: 141.5-260.5), and the median aortic cross clamp time was 87 minutes (IQR: 59.0-133.0). For antegrade cerebral perfusion, 28 patients (66.7%) required it, with a median perfusion time of 35.0 minutes (IQR: 25.0-59.0). Among the patients, 24 underwent an aortic arch repair procedure: hemiarch repair in 12 patients (28.5%), total arch repair in 8 patients (19.0%), and total arch repair accompanying an elephant trunk procedure in 4 patients (9.5%). Additionally, 17 patients (40.0%) underwent a root replacement procedure. The most preferred arterial cannulation site was the axillary artery in 20 patients (47.6%), and the choice of venous cannulation site was the right atrium in 33 patients (78.6%). (**Table 2**)

Table 2: Operational data of patients

Operational data	N=42 n (%) / median (IQR)
Operation time (min)	305.5 (248.5-374.5)
Cardiopulmonary bypass time (min)	163.5 (141.5-260.5)
Aortic cross clamp time (min)	87.0 (59.0 -133.0)
Antegrade selective perfusion time (min)	35.0 (25.0-59.0)
Temperature (minimal) (min)	25.0 (18.0 -29.0)
Arch replacement	
Hemiarch replacement	12 (28.5)
Total arch replacement	8 (19.0)
Total arch replacement + ET	4 (9.5)
Root replacement procedure	17 (40.0)
Arterial cannuliation site	
Axillary artery	20 (47.6)
Femoral artery	15 (35.7)
Femoral + Axillary artery	2 (4.8)
Brachiocephalic artery	4 (9.5)
Arcus aorta	1 (2.4)
Venous cannulation site	
Right atrium	33 (78.6)
Femoral vein	4 (9.5)
Femoral vein + Superior vena cava	4 (9.5)
Bicaval cannulation	1 (2.4)

In-hospital mortality was observed in 15 (35.7%) patients across the cohort. 3 (7.1%) patients necessitated extracorporeal membrane oxygenator support, while 32 (76.2%) patients required inotropes after the operation. The median length of stay in the intensive care unit was 3 days (IQR: 1-5 days), and the median hospital stay duration was 8 days (IQR: 1-12 days). Postoperative renal dysfunction was experienced by 7 (16.6%) patients, and one patient required dialysis after the surgery. Additionally, 7 (16.6%) patients suffered from cerebrovascular events after the surgery, all of whom had undergone the operation while in a state of coma and hemodynamic instability. (**Table 3**)

Table 3: Postoperative data of patients

Postoperative data	N=42 n (%) / median (IQR)
In-hospital mortality	15 (35.7)
Postoperative inotrope requirement	32 (76.2)
ECMO requirement	3 (7.1)
ICU stay time (days)	3.0 (1.0-5.0)
Hospital stay time (days)	8.0 (1.0-12.0)
Ventilation time (hours)	36.0 (20.0-75.0)
Postoperative renal dysfunction	7 (16.6)
Postoperative cerebrovascular events	7 (16.6)

The results of the multivariate analysis demonstrated that among acute Stanford Type A aortic dissection patients with pericardial hematoma, hemodynamic instability emerged as the sole predictive factor for mortality (p=0.004). However, age, preoperative renal status, and previous coronary intervention were not found to be significantly associated with early mortality in this patient cohort (**Table 4**).

Table 4. Multivariate analysis of predictors of mortality

	Odds ratio	p value
Age	2.76	1.03
Preoperative renal impairment	2.00	0.50
Hemodynamic instability	6.54	0.04*
Previous percutaneous coronary intervention	4.14	0.10

DISCUSSION

ATAAD is a medical catastrophe that if left untreated carries an alarming mortality rate of 1% to 2% per hour starting immediately after symptom onset (3). In 2000, The International Registry of Acute Aortic Dissection data revealed that in-hospital mortality rate for surgically treated type A dissection stood at 26%, reflecting the gravity of this life-threatening condition (2). However, advancements in medical knowledge, improved diagnostic techniques, and enhanced surgical interventions have contributed to a significant reduction in mortality rates. Recent data indicates that the mortality rate for surgically treated aortic dissection has decreased to 18%, underscoring the positive impact of advancements in medical care and early strategy interventions (4). Despite this progress, acute type A aortic dissection remains a medical emergency that necessitates prompt recognition and timely treatment.

Pericardial hematoma emerges as a noteworthy complication of aortic dissection, frequently arising due to aortic rupture. The prevalence of pericardial hematoma in Acute Type A Aortic Dissection (ATAAD) varies across existing literature, primarily due to differences in how it is defined. Kaufeld et al. reported a pericardial hematoma rate of 37% in their study (5). In an article by Bayegan et al., comprising 87 patients, 37 (38%) cases were identified as impending cardiac tamponade and 7 (8%) as severe cardiac tamponade (6). Gilon et al. detected cardiac tamponade in 18% of ATAAD patients, a rate also found by Ji et al. in their study (7,8). In our own series, we observed a pericardial hematoma occurrence in 15% of ATAAD cases.

Pericardiocentesis stands as a debated and contentious method for relieving pericardial tamponade in patients with ATAAD. In 1994, Isselbacher et al. presented findings suggesting potential harm from pericardiocentesis in aortic dissection patients (9). Their speculation revolved around concerns of inducing bleeding and exacerbating dissection extension due to the procedure. On the contrary, Hayashi et al. demonstrated more favorable outcomes associated with pericardiocentesis in aortic dissection patients (10). They attributed these results to a meticulous approach in managing pleural effusion drainage, which differed from Isselbacher's method of drainage. The stance on pericardiocentesis in the context of Acute Type A Aortic Dissection (ATAAD) varies in the literature. While some sources consider it a contraindication, select case reports underscore pericardiocentesis as a potentially effective intervention in deteriorating patients (11,12).

The anticipated association between pericardial hematoma and Acute Type A Aortic Dissection (ATAAD) is reflected in higher in-hospital mortality rates compared to cases without hematoma. Kaufeld et al. observed a mortality rate of 29.6% among patients with pericardial hematoma, contrasting with 17.2% in those without hematoma (13). Gilon et al. reported a 44% mortality rate in surgically managed patients with cardiac tamponade, while the rate was 20% without tamponade; furthermore, medically managed patients had a 92% mortality rate (7). Ji et al. found a mortality rate of 29.5% in patients with cardiac tamponade (8). In the current study, our findings indicate an in-hospital mortality rate of 35.7% among ATAAD patients with pericardial hematoma.

Our study highlights a robust association between preoperative hemodynamic instability and mortality. In the context of ATAAD, hemodynamic instability exerts a significantly adverse influence on patient survival. For instance, Trimachi et al. reported a mortality rate of 31.4% among unstable patients (14). Similarly, Conway et al. demonstrated a stark contrast, with a 47% mortality rate observed in hemodynamically unstable patients compared to 14% in stable cases (15). Long et al. also established a noteworthy association between hemodynamic instability and mortality, revealing a substantial rate of 61.5% (16). Moreover, Bayegan's findings underscore the critical role of hemodynamic stability, as impending cardiac tamponade with palpable pulses exhibited a distinct risk profile compared to severe cardiac tamponade lacking pulses (6). Notably, the latter group faced a 16-fold elevated risk for unfavorable outcomes, encompassing mortality and multi-organ failure.

Despite its contributions, this study has several limitations. The retrospective design may be subject to biases. The study also draws data from a single hospital which might limit the generalizability of the findings. The relatively small sample size, especially in the subset with pericardial hematoma might restrict the statistical power to detect significant associations. Future prospective, multicenter researches are needed to address the issue and refine our knowledge in this field.

CONCLUSION

In conclusion, our study has provided valuable insights to the ATAAD patients with pericardial hematoma, shedding light on critical factors influencing patient outcomes. The presence of pericardial hematoma, often stemming from aortic rupture, emerged as a significant marker of increased mortality risk, underscoring the urgent need for vigilant monitoring and prompt interventions in such cases. Hemodynamic instability emerged as a strong predictor of mortality, echoing findings across various studies and reinforcing its role in determining patient survival rates.

ETHICAL DECLARATIONS

Ethics Committee Approval: The study was carried out with the permission of Istanbul Mehmet Akif Ersoy Research and Training Hospital Ethics Commitee No: 2023.06.69

Informed Consent: Because the study was designed retrospectively, no written informed consent form was obtained from patients.

Referee Evaluation Process: Externally peer-reviewed.

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