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# Junctional Ectopic Tachycardia After Congenital Heart Surgery: Incidence, Risk Factors, and Outcomes

## Konjenital Kalp Cerrahisi Sonrası Ektopik Kavşak Taşikardisi: Görülme Sıklığı, Risk Faktörleri ve Sonuçları

**ABSTRACT**

**Objective:** Postoperative junctional ectopic tachycardia (JET) is usually a self-limiting condition; however, when combined with atrioventricular dissociation and postoperative ventricular dysfunction, it may increase morbidity and mortality. This study aimed to determine the overall incidence of JET following congenital heart surgery, to identify patient and procedure-related risk factors, and to evaluate the clinical impact of JET on outcomes.

**Methods:** The records of 2,814 patients who underwent cardiac surgery over a five-year period were reviewed retrospectively to identify those with JET. For each patient diagnosed with JET, two controls who underwent surgery during the same period were selected to compare possible risk factors and outcomes.

**Results:** The incidence of JET following congenital heart surgery was 2.66% in this large cohort. Univariate analyses revealed statistically significant associations between JET and factors such as young age, small body weight, high vasoactive inotropic score, operations involving the ventricular septum, surgical complexity score, increased cardiopulmonary bypass time, delayed sternal closure, extracorporeal membrane oxygenation (ECMO) requirement, and increased risk of postoperative JET. In multivariate analysis only the association between surgeries involving the ventricular septum, ECMO requirement, and increased risk of JET persisted. Compared to controls, patients with JET experienced prolonged intubation times, longer stays in the intensive care unit and hospital, more frequent unplanned re-interventions, and higher mortality rates.

**Conclusion:** Junctional ectopic tachycardia can lead to serious hemodynamic consequences in patients following congenital heart surgery and is associated with poorer clinical outcomes. Both patient and procedure-related factors contribute to the overall risk of developing JET. Identifying associations and predictors of JET can help improve patient outcomes.

**Keywords:** Congenital heart disease, congenital heart surgery, junctional ectopic tachycardia, postoperative arrhythmia

**ÖZET**

**Amaç:** Postoperatif ektopik kavşak taşikardisi (JET) genellikle kendi kendini sınırlayan bir durumdur, ancak atriyoventriküler dissosiasyon ve postoperatif ventriküler disfonksiyonla birleştiğinde postoperatif dönemde morbidite ve mortaliteyi artırabilir. Bu çalışmanın amacı, konjenital kalp cerrahisini takiben gelişen JET insidansını, JET riski ile ilişkili olabilecek hasta ve prosedürle ilgili faktörleri ve JET'in klinik sonuçlar üzerindeki etkisini değerlendirmektir.

**Yöntemler:** Beş yıl içerisinde konjenital kalp ameliyatı geçiren 2814 hastanın kayıtları retrospektif olarak incelendi ve JET gelişen hastalar belirlendi. Her JET hastası için, aynı dönemde ameliyat edilen iki kontrol hastası, potansiyel risk faktörleri ve sonuçları açısından JET hastalarıyla karşılaştırmak üzere seçildi.

**Bulgular:** Açık kalp cerrahisi geçiren bu büyük hasta grubunda JET insidansı %2,66 saptandı. Univariant analizler genç yaş, düşük vücut ağırlığı, yüksek vazoaktif inotrop skoru, ventriküler septuma müdahele edilen ameliyatlar, cerrahi kompleksite skoru, artmış kardiyopulmoner bypass süresi, ameliyat sonrası sternumun açık bırakılması ve ECMO gereksinimi ile postoperatif JET riski artışı arasında istatistiksel olarak anlamlı ilişkiler olduğunu gösterdi. Çok değişkenli analiz sonrasında, yalnızca ventriküler septuma müdahele edilen ameliyatlar ve ECMO gereksinimi ile JET riski artışı arasındaki anlamlı ilişki devam etti. Kontrollerle karşılaştırıldığında, JET hastalarında daha uzun entübasyon süreleri, daha uzun yoğun bakım ve hastanede kalış süreleri, daha sık önceden planlanmayan girişimler ve daha yüksek mortalite vardı.

**Sonuç:** JET, konjenital kalp cerrahisini takiben sık görülen hemodinamik açıdan anlamlı taşiaritmilerden biridir ve ameliyat sonrası kötü klinik sonuçlarla ilişkilidir. Hem anatomik

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substrat hem de cerrahi prosedür, JET gelişim riskine katkıda bulunur. JET'in ilişkili olduğu faktörleri ve öngörücü faktörleri tanımlamak sonuçların iyileştirilmesine yardımcı olabilir.

**Anahtar Kelimeler:** Konjenital kalp hastalıkları, konjenital kalp cerrahisi, ektopik kavşak taşikardisi, postoperatif aritmi

Junctional ectopic tachycardia (JET) is a narrow QRS complex tachyarrhythmia with ventricular rates exceeding 170 beats per minute (bpm), and usually presents with ventricular-atrial (VA) dissociation where the ventricular rate is faster than the atrial rate.[1,2] It is the most common tachyarrhythmia following congenital heart surgery, with an incidence ranging from 1.0% to 11.4%.[3-6] Junctional ectopic tachycardia usually arises within 72 hours after cardiac surgery. Although the exact mechanism of JET remains unknown, it is influenced by both surgical and non-surgical factors. Surgical risk factors include stretching or mechanical trauma to the atrioventricular (AV) node, widespread muscle bundle resection, right ventricular outflow tract reconstruction, and manipulations of the ventricular septum.[7,8] Non-surgical risk factors include younger age, extended cardiopulmonary bypass (CPB) and aortic cross clamp (ACC) time, low plasma magnesium levels, catecholamine use, and hyperthermia.[9-11] Although JET is usually a self-limiting condition, rapid heart rate, loss of AV synchrony, and consequent low cardiac output (LCO) can seriously deteriorate hemodynamic status in the early postoperative period, potentially increasing morbidity and mortality.[1,9,12] Thus, the objectives of this study were to determine the incidence of postoperative JET, to describe patient and procedure-related risk factors for JET, and to evaluate its clinical consequences in the early postoperative period following congenital heart surgery at a single center.

## ABBREVIATIONS

| | |
|---|---|
| ACC | Aortic cross clamp |
| AV | Atrioventricular |
| bpm | Beats per minute |
| CPB | Cardiopulmonary bypass |
| DEX | Dexmedetomidine |
| ECG | Electrocardiogram |
| ECMO | Extracorporeal membrane oxygenation |
| ICU | Intensive care unit |
| IQR | Interquartile ranges |
| JET | Junctional ectopic tachycardia |
| LCO | Low cardiac output |
| LCOS | Low cardiac output syndrome |
| STAT | Society of Thoracic Surgeons - European Association for Cardio-Thoracic Surgery |
| VIS | Vasoactive inotropic scores |
| VSD | Ventricular septal defect |

## Materials and Methods

After approval by the Dr. Siyami Ersek Thoracic and Cardiovascular Surgery Training and Research Hospital Ethics Committee (Approval Number: 29.11.2022/E-28001928-604.01.01, Date: 29.11.2022), data from all patients who underwent congenital heart surgery between January 2018 and January 2023 were reviewed. Patients who experienced JET were identified and included in the study. The diagnosis of JET was made by a pediatric cardiologist in the cardiac intensive care unit (CICU) using a 12-lead electrocardiogram (ECG) (Figure 1), and, when needed, an atrial electrocardiogram provided via epicardial temporary pacing wires. From the same surgical database, we matched each JET patient with two control subjects who underwent surgery during the same period. Matching was based solely on the timing of surgery to compare possible independent predictors and consequences of JET. Exclusion criteria included the presence of preoperative arrhythmia or pacemaker implantation, any other type of postoperative arrhythmia, and postoperative temporary pacemaker use. The medical records of

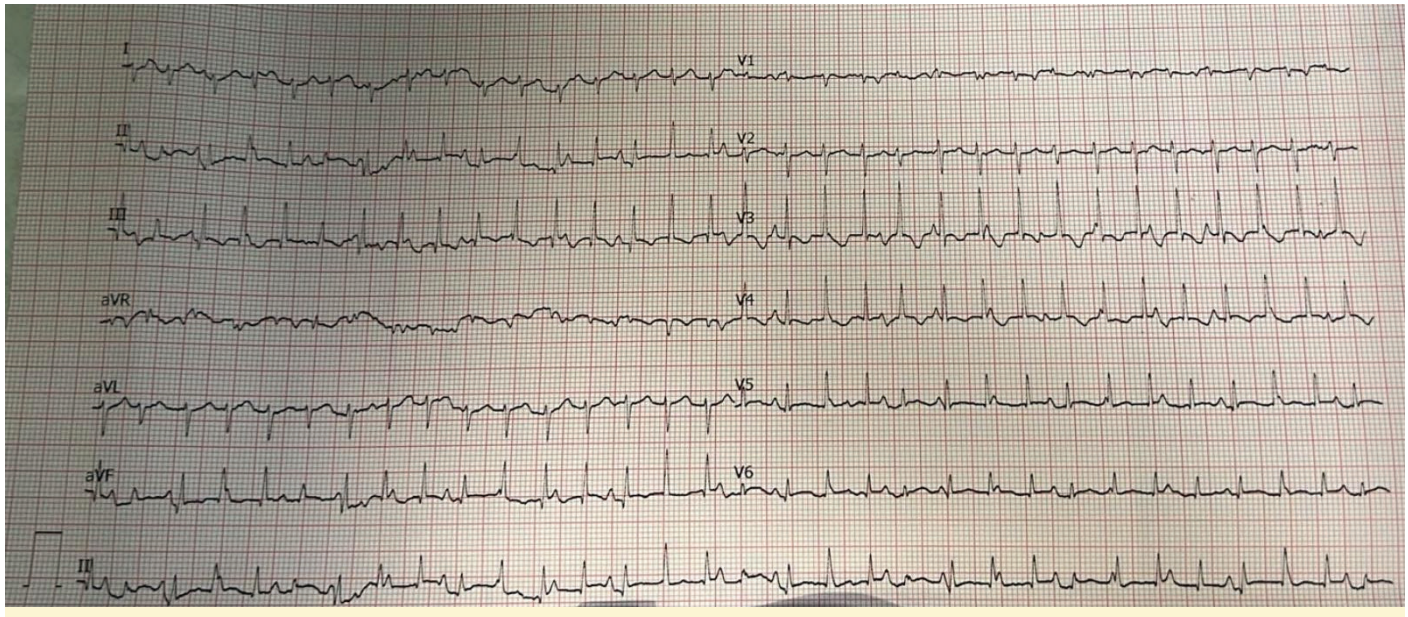


**Figure 1. 12-lead electrocardiogram showing junctional ectopic tachycardia in a patient.**

JET and control patients were reviewed, and information on patient demographics, primary cardiac pathologies, surgical procedures, duration of CPB as well as ACC times, vasoactive inotropic scores (VIS), extracorporeal membrane oxygenation (ECMO) requirements, mechanical ventilation (MV) time, length of CICU and hospital stay, and survival were extracted.[13] The complexity of surgical procedures was categorized according to the Society of Thoracic Surgeons - European Association for Cardio-Thoracic Surgery (STAT) scoring system.[14] Timing of onset of JET following surgery and its duration, the course of the arrhythmia-whether it was trivial or required treatment-and the method of treatment were noted. We handle JET episodes according to the hemodynamic status of the patient. The management strategy starts with effective analgesia and sedation. A core temperature around 35-36°C is targeted, if necessary, with surface cooling. We replace magnesium universally, and if present, other electrolyte abnormalities are fixed. When possible, exogenous catecholamine support is reduced or discontinued. Dexmedetomidine (DEX), an alpha-2 receptor agonist widely used for sedation and analgesia in CICU, and known for its dose-dependent effect on heart rate and sympathetic system activity, is started in the next step.[15] If JET persists and hemodynamic measurements do not improve sufficiently, amiodarone is preferred as the first-line antiarrhythmic drug. Overdrive pacing, which aims to provide AV synchronization and increase cardiac output, has been used in a few patients with heart rates below 160 bpm. Although beta-blockers, specifically esmolol, have been used in a few cases, they are not preferred as a first-line agent.

The primary outcome measure of the study was to delineate the incidence of JET. Secondary outcomes were to define (1) the potential patient and procedure-related risk factors for developing JET and (2) the impact of JET on patient postoperative outcomes. These results were compared between the patients and control subjects.

Informed consent was obtained from patients or their guardians during hospitalization. Our study was conducted in accordance with the Declaration of Helsinki. Artificial intelligence (AI) and assisted technologies (such as Large Language Models [LLMs], chatbots, or image creators) were not used at any stage.

### Statistical Analysis

Statistical analyses were performed using IBM SPSS Statistics Software version 21 (IBM Corp., Armonk, New York, United States). Continuous variables were described using medians and interquartile ranges (IQR). Categorical variables were described by the number of patients and relative frequencies. The Mann-Whitney U test was used to compare continuous variables between two groups. Categorical variables were analyzed using the chi-squared test or Fisher's exact test, as appropriate. Associations between individual variables and the outcome of interest were initially assessed using univariate binary logistic regression. Variables showing a significant association in the univariate analysis were considered for inclusion in the multivariate model. Multivariable analysis was performed using binary logistic regression to identify independent predictors of outcome. A p value of less than 0.05 was considered statistically significant.

### Results

A total of 2,814 congenital heart surgeries were performed during the study period, with 75 cases diagnosed with JET, yielding an overall incidence of 2.66%. The clinical characteristics of the patients are outlined in Table 1.

**Table 1. Patient and Procedure Related Characteristics of Patients with Junctional Ectopic Tachycardia and Controls**

| | Subjects with JET (n = 75) | Control Subjects (n = 50) |
|---|---|---|
| Age at surgery, median (IQR), months | 8.5 (3-20) | 30 (6-72) |
| Age group, n (%) | | |
| Newborn, 0-30 days | 13 (17.3) | 18 (12) |
| Infant, 31 days-1 year | 34 (45.3) | 35 (23.3) |
| Young child, 1-6 years | 26 (34.7) | 60 (40) |
| Older child, 6-12 years | 1 (1.3) | 22 (14.7) |
| Teenager, 12-18 years | 1 (1.3) | 11 (7.3) |
| Adult, > 18 years | 0 | 4 (2.7) |
| Body weight, median (IQR), kg | 8 (4-10.1) | 11.25 (6-18) |
| Sex, male, n (%) | 41 (54.7) | 73 (48.7) |
| STAT score, n (%) | | |
| 1 | 1 (1.3) | 28 (18.7) |
| 2 | 6 (8) | 40 (26.7) |
| 3 | 54 (72) | 65 (43.3) |
| 4 | 13 (17.3) | 16 (10.7) |
| 5 | 1 (1.3) | 1 (0.7) |
| Surgery involving ventricular septum, n (%) | 60 (80) | 81 (54) |
| Delayed sternal closure, n (%) | 30 (40) | 16 (10.7) |
| Vasoactive inotropic score, median (IQR) | 17 (13.75-25) | 12 (7-17) |
| CPB time, median (IQR), min | 179 (137-218.5) | 133 (93.5-186.5) |
| ECMO, n (%) | 15 (20) | 3 (2) |

CPB, Cardiopulmonary Bypass; ECMO, Extracorporeal Membrane Oxygenation; IQR, Interquartile Range; JET, Junctional Ectopic Tachycardia; STAT score, The Society of Thoracic Surgeons - European Association for Cardio-Thoracic Surgery Score.

**Table 2. Surgical Procedures in Patients with Junctional Ectopic Tachycardia**

| Type of Surgery | n (%) |
|---|---|
| Repair of TOF and TOF variants | 34 (45.3) |
| CAVSD repair | 9 (12) |
| Arterial switch + VSD closure | 8 (10.7) |
| VSD closure + aortic arch repair | 8 (10.7) |
| Fontan operation | 4 (5.3) |
| Glenn operation | 3 (4) |
| PAB | 3 (4) |
| Nikaidoh operation | 3 (4) |
| Aortic arch reconstruction + coarctation repair | 1 (1.3) |
| MBT shunt | 1 (1.3) |
| Benthall procedure | 1 (1.3) |

CAVSD, Complete Atrioventricular Septal Defect; IQR, Interquartile Range; JET, Junctional Ectopic Tachycardia; MBT, Modified Blalock-Taussig shunt; PA, Pulmonary Artery; PAB, Pulmonary Artery Banding; RV, Right Ventricle; TGA, Transposition of the Great Arteries; TOF, Tetralogy of Fallot; VSD, Ventricular Septal Defect.

Although JET occurred after a variety of operations, ventricular septal defect (VSD) closure was part of the surgical procedure in 60 (80%) patients (Table 1). Analyses of surgeries frequently performed in patients who developed JET revealed higher incidences in repair of Tetralogy of Fallot (TOF) and TOF variants (45.3%), complete atrioventricular septal defect (CAVSD) repair (12%), arterial switch operation with ventricular septal defect closure (10.7%), and VSD closure with aortic arch reconstruction (10.7%) (Table 2).

Most commonly, the first JET episode occurred within 24 hours of the surgery (in 74.7% of the patients), and most commonly, the tachyarrhythmia lasted 24 to 48 hours (in 44% of the patients). In 18 patients (24%), conservative measures were sufficient, and JET resolved without pharmacotherapy. The remaining patients required pharmacotherapy, either DEX alone or an antiarrhythmic agent in addition to DEX. Amiodarone was the most commonly used first-line antiarrhythmic agent (Table 3). All patients eventually returned to sinus rhythm, except for three cases who required permanent pacemaker implantation.

**Table 3. Characteristic Behavior and Treatment of Junctional Ectopic Tachycardia Episodes**

| | | |
|---|---|---|
| Timing of First JET Episode Post-Surgery | Within 24 hours after surgery | 56 (74.7%) |
| | Within 24-48 hours after surgery | 19 (25.3%) |
| Duration of JET | Less than 24 hours | 22 (29.3%) |
| | 24-48 hours | 33 (44%) |
| | 48-72 hours | 20 (26.7%) |
| Treatment of JET | Conservative measures | 18 (24%) |
| | Conservative measures + DEX | 12 (16%) |
| | Conservative measures + DEX + amiodarone | 39 (52%) |
| | Conservative measures + DEX + beta blocker | 3 (4%) |
| | Conservative measures + DEX + beta blocker + overdrive pacing | 3 (4%) |

DEX, Dexmedetomidine; IQR, Interquartile Range; JET, Junctional Ectopic Tachycardia.

**Table 4. Univariate and Multivariate Logistic Regression Analysis of Risk Factors for Junctional Ectopic Tachycardia**

| | *P* | OR | 95% CI for the OR | *P* | OR | 95% CI for the OR |
|---|---|---|---|---|---|---|
| Age at surgery, median (IQR), months | 0.000 | 0.980 | 0.970-0.990 | 0.444 | 0.980 | 0.932-1.031 |
| Age group | | | | | | |
| Newborn, 0-30 days | **Reference Category** | | | | | |
| Infant, 31 days-1 year | 0.849 | 1072 | 0.525 -2.187 | | | |
| Young child, 1-6 years | 0.001 | 0.284 | 0.134 -0.600 | | | |
| Older child, 6-12 years | 1.000 | 0.000 | NA | | | |
| Teenager, 12-18 years | - | - | | | | |
| Adult, > 18 years | - | - | | | | |
| Body weight, median (IQR) | 0.000 | 0.925 | 0.885- 0.966 | 0.675 | 0.948 | 0.738-1.217 |
| Sex, male | 0.396 | 0.786 | 0.451-1.371 | | | |
| STAT score | | | | | | |
| 1 | **Reference Category** | | | **Reference Category** | | |
| 2 | 0.195 | 4.200 | 0.479-36.836 | 0.998 | 0.000 | 0.00 |
| 3 | 0.002 | 23.262 | 3.064-176.592 | 0.998 | 0.000 | 0.00 |
| 4 | 0.004 | 22.750 | 2.718 -190.421 | 0.753 | 0.605 | 0.026-13.829 |
| 5 | 0.056 | 28.000 | 0.921- 851.593 | 0.763 | 0.610 | 0.025-15.125 |
| Surgery involving ventricular septum | 0.000 | 3.407 | 1.778-6.531 | 0.044 | 0.197 | 0.040-0.959 |
| Delayed sternal closure | 0.000 | 0.179 | 0.089-0.359 | 0.848 | 1.135 | 0.310-41.52 |
| Vasoactive inotropic score, median (IQR) | 0.000 | 1.131 | 1.081-1.183 | 0.325 | 0.964 | 0.896-1.037 |
| CPB time, median (IQR) | 0.019 | 1.006 | 1.001-1.012 | 0.896 | 0.999 | 0.991-1.008 |
| ECMO | 0.000 | 12.250 | 3.422-43.858 | 0.026 | 14.365 | 1.368-150.821 |

CI, Confidence Interval; CPB, Cardiopulmonary Bypass; ECMO, Extracorporeal Membrane Oxygenation; IQR, Interquartile Range; JET, Junctional Ectopic Tachycardia; NA, Not Applicable; OR, Odds Ratio; STAT Score, The Society of Thoracic Surgeons – European Association for Cardio-Thoracic Surgery Score.

**Table 5. Outcomes Based on Occurrence of Postoperative Junctional Ectopic Tachycardia**

| Outcome | Subjects with JET | Control Subjects | *P* |
|---|---|---|---|
| Length of MV, median (IQR), days | 7 (3-11) | 1 (0-2) | <0.001 |
| Length of ICU stay, median (IQR), days | 12 (7-18) | 2.5 (1-5.25) | <0.001 |
| Unplanned re-intervention, n (%) | 13 (17.3) | 5 (3.3) | 0.001 |
| Length of hospital stay, median (IQR), days | 18 (13-26) | 7 (6-12.25) | <0.001 |
| Permanent pacemaker implantation, n (%) | 3 (4) | 0 | |
| Mortality, n (%) | 7 (9.3) | 3 (2) | 0.017 |

ICU, Intensive Care Unit; IQR, Interquartile Range; JET, Junctional Ectopic Tachycardia; MV, Mechanical Ventilation.

Of the 75 patients with JET, seven died, resulting in an in-hospital mortality rate of 9.3%, while the mortality rate for the entire cohort was 4.4%.

The case-control study included 75 patients diagnosed with JET and 150 matched controls. Univariate analyses showed statistically significant associations between young age, low body weight, high VIS, operations involving the ventricular septum, surgical complexity score (STAT 3 and 4), prolonged CPB time, delayed sternal closure, ECMO requirement, and increased risk of postoperative JET (all $P < 0.05$) (Table 4). However, following multivariate analysis, surgeries that involve the ventricular septum and ECMO requirement remained independently associated with an increased risk of JET (Table 4).

Compared with controls, patients with JET had longer durations of mechanical ventilation (median 7 vs. 1 day), longer intensive care unit (ICU) stays (median 12 vs. 2.5 days), longer hospital stays (median 18 vs. 7 days), and more frequent unplanned re-interventions (all $P < 0.05$). Regarding mortality, which was 9.3% in JET patients and 2% in the control group, there was a statistically significant difference between the two groups ($P < 0.05$) (Table 5).

## Discussion

Junctional ectopic tachycardia is one of the most common tachyarrhythmias in the postoperative setting, with an incidence between 1.0% and 11.4%.[3-5,7] Our study presents a relatively low incidence of JET (2.66%). This can be attributed to an era effect, refinements in surgical techniques and myocardial protection strategies, or improvements in perioperative care.

In our study, univariate analysis showed significant associations between age, body weight, STAT score, surgeries involving the ventricular septum, delayed sternal closure, VIS, CPB time, unplanned reinterventions, ECMO requirement, and post-operative JET. However, the majority of identified predictors were interrelated and reflected the fact that JET patients have complex cardiac pathologies, were younger, and sicker than their controls. Additionally, interpreting the univariate analysis alone can be confounding rather than causal. Therefore, multivariate logistic regression analysis was performed and revealed that surgeries involving the ventricular septum and ECMO requirement significantly affected the risk of developing JET.

Junctional ectopic tachycardia patients were younger and had lower body weights than controls, consistent with previous studies.[2,3,10,11] Physical manipulation in relatively small hearts, immaturity of the myocardium, and the complexity of surgical procedures likely increase the propensity for arrhythmias in small infants.

The emergence of arrhythmias may also be related to specific cardiac pathologies.[3,5,9,16] In the present study, 60% of the procedures included VSD closure as part of the operation, and JET occurred more frequently following surgeries for TOF and TOF variants. Procedures involving VSD closure put the patient at risk for JET; however, isolated VSD closure did not pose a greater risk for JET, suggesting that factors other than direct manipulation of the AV node make patients vulnerable to JET.

In agreement with previous reports, our study showed that the greater the inotropic support used after surgery, the higher the likelihood of JET.[17,18] Postoperative inotrope administration, whether alone or in combination, may be arrhythmogenic, and the immature myocardium of young infants makes them vulnerable to arrhythmogenic side effects. However, it is not clear whether primary postoperative JET compromised the hemodynamic status and led to the initiation of inotropic support, or whether the almost universal use of inotropic agents following CPB secondarily resulted in postoperative JET.

Patients who were not able to wean from the CPB machine in the operating room or who experienced low cardiac output syndrome (LCOS) in the ICU required ECMO support. Junctional ectopic tachycardia was more frequent in patients who needed ECMO support, and conversely, there was a tendency for JET patients to require ECMO support more often. This can be explained by the fact that JET worsens already existing LCOS, and patients requiring ECMO generally have undergone a complex procedure and are in a hemodynamically labile condition with high-dose inotropic support, making them vulnerable to JET.

Patients who underwent unplanned reinterventions during their ICU stay experienced JET more frequently. Unplanned reinterventions, either transcatheter or surgical, indicate the presence of hemodynamically significant residual or additional cardiac lesions that impede postoperative recovery. In such patients, the cardiac pathology is almost always more complex, the duration of the operation is longer, and high-dose inotropic agents are required for an extended period. Sternal closure is generally delayed in patients who underwent complex cardiac surgeries at early ages. In our cohort, this group has a propensity for JET, highlighting the importance of surgical complexity and young age.

With rapid ventricular rates and accompanying AV dissociation, JET may result in LCOS, compromise recovery from surgery, and contribute to postoperative mortality.[7,11] In our study, the duration of MV support, ICU stay, and hospital stay were longer, and mortality was higher in patients with JET compared to controls (9.3% vs. 2%). Longer ICU stays have been associated with increased risks of morbidity and mortality following congenital heart surgery.[19] However, proving a cause-effect relationship between JET and postoperative mortality is difficult because JET patients were generally sicker and younger, had more extensive cardiac surgery, and required more inotropic support.

When each fatal case was reviewed, deceased patients were also suffering from other comorbidities such as residual/additional cardiac lesions associated with significant hemodynamic consequences, multi-organ failure, or infections. This suggests that JET was not the sole cause of increased morbidity and mortality but may have accelerated the downward spiral.

### Limitations

Our study was retrospective in nature and had the limitations of its design. Self-limiting JET episodes that were not recorded might have been missed because only patients who were registered as having JET in the database were included. This may lead to a low incidence rate. Using a VIS may have some disadvantages because the impact of each inotrope is not clear, and the formula does not include the duration of treatment. Also, the study was not designed to evaluate the efficacy of different therapeutic options, which hindered us from discussing different therapeutic options for postoperative JET.

### Conclusion

Junctional ectopic tachycardia is one of the most frequent hemodynamically significant tachyarrhythmia following congenital heart surgery, though it is not as common as previously reported. Although most of the predictors we investigated were interrelated, the highest risk factors for postoperative JET include complex cardiac pathologies requiring early repair, delayed sternal closure, unplanned reinterventions, high VIS, procedures involving the ventricular septum, and ECMO requirement. Junctional ectopic tachycardia is associated with poorer outcomes and a worse clinical course in terms of prolonged length of stay (LOS) in the ICU and higher mortality. These findings emphasize the importance of JET following surgery for congenital heart disease. Early attention to associations and predictors of JET can help create preventive strategies and early treatment attempts.

**Ethics Committee Approval:** Ethics committee approval was obtained from Ethics Committee of Dr. Siyami Ersek Thoracic and Cardiovascular Surgery Training and Research Hospital Ethics Committee (Approval Number: 29.11.2022/E-28001928-604.01.01, Date: 29.11.2022).

**Informed Consent:** Informed consent was obtained from patients or their guardians during hospitalization.

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