

Effect of Prophylactic Amiodarone Versus Dexmedetomidine on Reducing the Frequency of Postoperative Junctional Ectopic Tachycardia after Pediatric Open Heart Surgery

Prophylactic Amiodarone VS Dexmedetomidine on Reducing of Postoperative Tachycardia

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ABSTRACT

Objective: To compare the effect of prophylactic amiodarone versus dexmedetomidine on reducing the frequency of post-surgical junctional ectopic tachycardia (JET) following pediatric open heart surgery.

Study Design: Randomized controlled trial study.

Place and Duration of Study: This study was conducted at the Pediatric Cardiology Intensive Care Unit (PCICU), National Institute of Cardiovascular Diseases, Karachi, Pakistan from May 2021 to April 2023.

Materials and Methods: Children of both genders aged between 1 to 12 years and planned to undergo cardiopulmonary bypass surgery were included. Children in amiodarone group (n=50) were given amiodarone at the time of induction of anaesthesia as 5-10 mcg per kg per minute (depending upon the hemodynamic) and continued for the next 48 hours. In the dexmedetomidine group (n=50), children were administered dexmedetomidine at the time of induction of anaesthesia as 0.2-0.5 mcg per kg per hour (depending upon the hemodynamics) and continued for the next 48 hours. The frequency of JET was noted.

Results: In a total of 100 children undergoing cardiopulmonary bypass surgery, 61 (61.0%) were boys while the mean age was 6.4±4.8 years. The mean cardiopulmonary bypass and aortic cross clamp time were 86.7±34.5 minutes and 45.9±24.1 minutes respectively. The most frequent types of CHDs were ventricular septal defect (VSD) and tetralogy of fallot (TOF) noted in 38 (38.0%) and 26 (26.0%) children respectively. Overall, frequency of JET was noted in 18 (18.0%) children. The frequency of JET was 5 (10.0%) children in amiodarone group versus 13 (26.0%) in the dexmedetomidine group (p=0.0373).

Conclusion: Post-surgical JET was found to be a common observation among children undergoing cardiopulmonary bypass surgery. Prophylactic amiodarone resulted in significantly less frequency of JET when compared to dexmedetomidine.

Key Words: Amiodaron, aortic clamp time, ventricular septal defect, dexmedetomidine, junctional ectopic tachycardia.

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INTRODUCTION

Congenital heart defects (CHDs) are considered to an important public health issue globally.

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The estimated incidence of CHDs hover around 8 to 12 per 1,000 live-births.^{1,2} Surgical interventions are generally required adopting general anesthesia for the correction of underlying congenital defects and may accompany few short-term and long-term complications inflicting stress upon the affected Individuals and their families.^{3,4}

One of the common complications of pediatric cardiac surgery is junctional ectopic tachycardia (JET) which could be due to exaggerated automaticity of the atrioventricular (AV) nodal tissues which is explained by AV dissociation but not often have a 1 to 1 retrograde ventriculo-atrial conduction.⁵ The literature reports the frequency of JET following pediatric cardiac surgery for the correction of congenital cardiac defects ranging between 2-22%.⁶ JET is linked with relatively higher rates of post-surgical hemodynamic variations and morbidity which warrants approach towards

prevention of post-surgery JET among these cases.⁷ Some of the important risk associated with post-surgical JET among pediatric population undergoing correction of underlying congenital cardiac defects are younger age, prolonged duration of cardiopulmonary bypass (CPB) and aortic cross clamp (ACC) time, higher inotropic scores, types of surgery and electrolyte imbalances.^{8,9}

Multiple treatment options exist for the treatment of post-surgical JET but researchers have shown that amiodarone may help in prevention of post-surgical JET among children undergoing cardiac surgery.¹⁰ Dexmedetomidine is commonly used as sedative and analgesia in pediatric intensive care units (PICUs) and is known to be a selective agonist on alpha-2 adrenoceptor helps in limiting its action on the central nervous system reducing unwanted cardiovascular adverse effects.¹¹ Sympatholytic actions of dexmedetomidine make it a drug beneficial in preventing post-surgical tachyarrhythmias but not much research is available. El Amrousy et al revealed that the frequency of JET was significantly less in dexmedetomidine cases (3.3%) when compared to placebo (16.7%).¹² A recent study showed that the frequency of JET was 8.5% in amiodarone group versus 14.2% in dexmedetomidine group ($p=0.022$).¹³

No data exists regarding the frequency of JET following open heart surgery among children undergoing open heart surgery. This study was planned to compare the effect of prophylactic amiodarone versus dexmedetomidine on reducing the frequency of post-surgical JET following pediatric open heart surgery.

MATERIALS AND METHODS

This randomized controlled trial was carried out at pediatric cardiology intensive care unit (PCICU), "National Institute of Cardiovascular Diseases, Karachi", Pakistan from May 2021 to April 2023. Approval from "Institutional Ethical Committee" was obtained. Written and informed consents were acquired from parents/caregivers of all children included in this study after explaining them the aims, procedures and drugs involved in this study. Taking frequency of JET as 3.3% following open heart surgery and prophylactic dexmedetomidine, with 95% confidence level and 5% margin of error, the sample size was calculated to be 50. Another 50 patients were enrolled in amiodarone, so the total sample considered for this study was 100 (50 in each group). Inclusion criteria were children of both genders aged between 1 to 12 years and planned to undergo cardiopulmonary bypass surgery. Children with atrial septal defect closure or Glenn shunt or those having pre-existing left ventricular dysfunction and arrhythmias were not included.

Socio-demographic and clinical characteristics of all children were noted. A 12-lead electrocardiogram was performed in all children prior to surgery to record as a baseline. Employing lottery method, children were randomized into either amiodarone group ($n=50$) or dexmedetomidine group ($n=50$). Children in amiodarone group were given amiodarone at the time of induction of anaesthesia as 5-10 mcg per kg per minute (depending upon the hemodynamic) and continued for the next 48 hours. In the dexmedetomidine group, children were administered dexmedetomidine at the time of induction of anaesthesia as 0.2-0.5 mcg per kg per hour (depending upon the hemodynamics) and continued for the next 48 hours. After the surgery, close monitoring and surveillance was done and electrocardiogram done whenever required. As a routine, a daily electrocardiogram was done in all children. In case a tachycardia was observed without an identifiable preceding P wave, atrial wire electrograms were frequency done to decipher the atrial depolarization. JET was labeled as a supraventricular tachycardia at a ventricular rate that exceeded the maximum normal sinus rate for the child's age, no preceding P wave or a retrograde P wave and ventricular rate that exceeded or equaled to atrial rate. In case, JET was detected, children were managed as per standard and institutional protocols.

Data analysis was performed using "Statistical Package for Social Sciences (SPSS)", version 26.0. Mean and standard deviation were used to represent quantitative data. Numbers and proportions were used to describe qualitative data. Chi-square test was used to compare the baseline characteristics and the frequency of JET in both study groups. Quantitative data were compared using independent sample t-test. P value below 0.05 was taken as significant.

RESULTS

In a total of 100 children undergoing cardiopulmonary bypass surgery, 61 (61.0%) were boys and 39 (39.0%) girls. The mean age was 6.4 ± 4.8 years (ranging between 1 to 12 years). Residential status of 57 (57.0%) children was rural. Malnutrition was identified in 54 (54.0%) children. Electrolytes imbalances were noted in 80 (80.0%) children. The mean cardiopulmonary bypass and aortic cross clamp time were 86.7 ± 34.5 minutes and 45.9 ± 24.1 minutes respectively. The most frequent types of CHDs were ventricular septal defect (VSD) and tetralogy of fallot (TOF) noted in 38 (38.0%) and 26 (26.0%) children respectively. Table No. 1 is showing comparison of demographic, clinical and intra-operative characteristics between both study groups.

Table No. 1: Comparison of Demographic, Clinical and Intra-operative Characteristics (N=100)

Characteristics		Amiodarone (n=50)	Dexmedetomidine (n=50)	P-value
Gender	Male	32 (64.0%)	29 (58.0%)	0.5385
	Female	18 (26.0%)	21 (42.0%)	
Age (years)	1-5	23 (46.0%)	21 (42.0%)	0.6870
	6-12	27 (54.0%)	29 (58.0%)	
Residence	Urban	23 (46.0%)	20 (40.0%)	0.5445
	Rural	27 (54.0%)	30 (60.0%)	
Malnutrition		26 (52.0%)	28 (56.0%)	0.6882
Electrolyte imbalance		39 (78.0%)	41 (82.0%)	0.6171
Down Syndrome		8 (16.0%)	6 (12.0%)	0.5644
Cardiopulmonary bypass time (minutes), Mean±SD		83.4±31.2	86.3±36.5	0.6703
Aortic Cross Clamp time (minutes), Mean±SD		46.5±22.8	44.7±25.6	0.7112

Overall, frequency of JET was noted in 18 (18.0%) children. The frequency of JET was 5 (10.0%) children in amiodarone group versus 13 (26.0%) in the dexmedetomidine group (p=0.0373) as shown in figure No. 1.

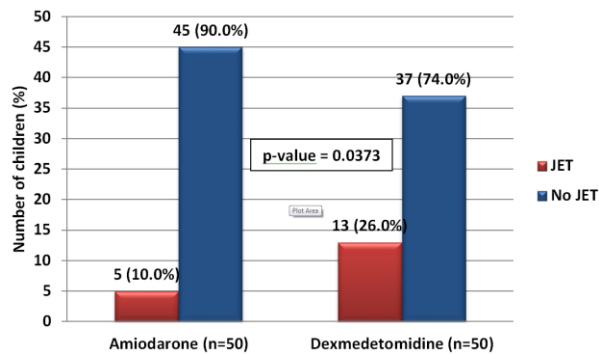


Figure-1: Frequency of junctional ectopic tachycardia among both study groups (N=100)

DISCUSSION

In the present study, 61.0% children undergoing cardiopulmonary bypass were boys. A study from Iran found that 53% children undergoing cardiac surgeries were male.¹⁴ A study from the same center analyzing children who underwent open heart surgery revealed that 55.8% children were male.¹⁵ The same study also found that the mean age at the time of surgery was 7.9±5.1 years.¹⁵ In the present study, the mean age of the children was 6.4±4.8 years. The mean age of children in a study conducted in Iran was 4.5±4.9 years.¹⁴ A study from Indonesia revealed median age of children undergoing cardiac surgery was 36 months. Data from developed countries show that age of the children at the time of undergoing cardiac surgery involving cardiopulmonary bypass is much lesser when compared to data from our parts of the world.¹⁴⁻¹⁶

In this study, the most types of CHDs for which cardiopulmonary bypass surgeries were performed were VSD (38.0%) and TOF 26 (26.0%). Local data has established that VSD is the most frequency acyanotic heart lesion while TOF is known to be the more

common cyanotic type heart lesion.¹³ A study from India by Wadile S et al found that VSD and TOF were commonest types of heart lesions for which open heart surgeries were performed so our data is quite consistent with the regional and local findings.^{13,17}

JET is considered to an important post-surgery arrhythmias and can cause major hemodynamic alterations that can affect outcomes. Talwar and colleagues revealed the frequency of post-surgical arrhythmias after cardiac surgery was 8% while JET was the most common type.¹⁸ Another study from Turkey showed that overall incidence of arrhythmias was 9% while JET was the most common types of arrhythmias.¹⁹ This study noted that the overall frequency of JET among children undergoing cardiopulmonary bypass surgery was 18%. A recent analysis of 5-year from lower to middle income countries calculated the frequency of arrhythmias among children undergoing cardiac surgery was 22.5% while JET was the commonest type noted among 64.9% of those cases. In this study, 10.0% children who were administered amiodarone developed JET versus 26.0% in the dexmedetomidine group. The frequency of JET was significantly more among children in dexmedetomidine group (p=0.0373). El Amrousy et al revealed that the frequency of JET was significantly less in dexmedetomidine cases (3.3%) when compared to placebo (16.7%).¹² Recent study shared the frequency of JET as 8.5% in amiodarone versus 14.2% in dexmedetomidine groups (p=0.022).¹³ Not much data analyzing frequency of JET following prophylactic amiodarone and dexmedetomidine exist so further randomized trials can further shed light on whatever little comparative data is available.

Relatively small sample and a single center study site were some of the limitations of this research. We were unable to note the impact of JET on the outcomes of studied cases so further prospective trials are needed to further verify the findings of this study.

CONCLUSION

Post-surgical JET was found to be a common observation among children undergoing

cardiopulmonary bypass surgery. Prophylactic amiodarone resulted in significantly less frequency of JET when compared to dexmedetomidine.

Author's Contribution:

Concept & Design of Study: Talal Arshad
 Drafting: Ram Chand, Muhammad Asif Khan
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Conflict of Interest: The study has no conflict of interest to declare by any author.

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