

Postoperative Arrhythmia Repair of Tetralogy of Fallot in Pediatrics

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ABSTRACT

Tetralogy of Fallot (ToF) is the most common cyanotic congenital heart disease. ToF affects 3% to 10% of all babies born with congenital heart disease. Arrhythmia is a common complication following congenital heart surgery. As a medical guide, it is important to know Arrhythmia as a complication after ToF surgery. Method : The author searched, selected, and chose journals related to Arrhythmia after ToF repair surgery through several research databases including ScienceDirect, Google Scholar, PubMed, and Wiley. by using the keywords "Arrhythmia", "Surgery", "Pediatrics" and "Tetralogy of Fallot". The results of the literature search were 2,006 journals with 21 journals meeting the selection criteria, and 6 studies that would be analyzed further. Results and Discussion : Arrhythmia after heart surgery is a common complication that occurs. The most common type of arrhythmia that occurs after ToF repair surgery is JET. This arrhythmia is associated with injury to the heart's conduction system during surgery. JET is a life-threatening tachyarrhythmia that occurs especially after procedures near the AV node (AVN), such as ToF repair operation. The main risk factor for postoperative arrhythmias is a longer cardiopulmonary bypass time. Conclusion : Arrhythmia is a common complication that occurs after ToF repair surgery and is an important cause of morbidity and mortality if not treated immediately.

Keywords:

Arrhythmia, Surgery, Pediatrics, Tetralogy of Fallot

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1. INTRODUCTION

Tetralogy of Fallot (ToF) is disease heart congenital the most common cyanotic happen . ToF attack 3% to 10% of all over baby born with disease heart default. 3 ToF is disease heart default cyanotic first to be described formally and constitute prototype For operation heart palliative and definitive next. 4 Operation repair ToF has experience progress outside normal since first done 50 years then and now done more beginning compared to decade previously [1]. 5 Successful operation has increase adult population with ToF post repair . Evaluation number hope life after operation repair ToF estimated increases with improvement ToF, figure 30 - 40 year survival rate reported 85 to 90% post repair. However, with increasing number hope live , group patient I also experienced this complications further , esp frequent arrhythmias result morbidity and mortality many years after repair [2].

Arrhythmia is a common complication following congenital heart surgery. Although in most cases it is temporary and treatable, this disease is a cause of considerable morbidity and mortality. 1 These arrhythmias mostly occur in the early postoperative period when hemodynamic fluctuations are common,

making the patient unstable and can cause cardiac output syndrome low levels and heart attacks if not treated and treated in a timely manner. 7 Previous studies have stated that the incidence of arrhythmias ranges from 7.3% to 48% in the early postoperative period after congenital heart surgery [3]. Arrhythmias often require intervention, such as medication changes, use of a temporary or permanent pacemaker, or electrical cardioversion/defibrillation [4].

The etiology of postoperative arrhythmias in children recovering from the effects of surgery is thought to be myocardial injury [5], cannulation, sutures close to the conduction system, cardiac dysfunction, electrolyte disturbances, catecholamine stimulation, acute changes in intracardiac pressure and volume [6], inflammation related to cardiopulmonary bypass (CPB), hemodynamic disorders, and pain. There are only a few studies that describe the relationship between the incidence of arrhythmias after congenital heart surgery, especially ToF. As a medical guide, it is important to know arrhythmia as a complication after ToF surgery. It is important to prepare appropriate management to reduce the morbidity and mortality of arrhythmias after ToF repair surgery [7].

2. METHODS

The author searched, selected, and selected journals related to Arrhythmia after ToF repair surgery through several research databases including ScienceDirect, Google Scholar, PubMed, and Wiley. Research searches were carried out using the keywords "Arrhythmia", Surgery, "Pediatrics" and "Tetralogy of Fallot". The results of the literature search were 2,006 journals with 22 journals meeting the selection criteria through title and abstract, and 6 studies that would be analyzed further [8]. We prioritized research published within the last ten years. Writing begins with literature selection through title and abstract, followed by reviewing the contents of each piece of literature that meets the criteria and is followed by discussion between authors [1]. Studies that were not fully accessible were excluded [5]. The final results will be obtained from the studies that will be used in this literature review [9].

3. RESULTS AND DISCUSSION

Table 1. Literacy Sources

Author, year	Population	Objective	Research result
Jain et al, 2019	65 patients pediatrics in post ICU undergo operation cardiac	Know incident arrhythmia post operation heart in children	Period beginning post operation after operation the heart is closely related to arrhythmia heart
Alp et al, 2014	239 patients post operation heart congenital , 17 patients ToF	Evaluate arrhythmia post operation heart congenital	Operation repair ToF , ASD, and VSD are factor risk happen arrhythmia . The most common arrhythmia are supraventricular extrasystole and VES
Abdelaziz et al, 2014	193 patients post operation heart open	Know JET incidence and factors risk post operation heart	Associated JET events with operation heart open . JET associate with mortality and morbidity post operation .
Ishaque et al, 2022	812 patients post operation heart congenital , 272 patients ToF	Identify prevalence and diagnosis of arrhythmias in patients pediatrics post operation cardiac	More from One of five patients child suffer arrhythmia post operation early in the research This

Sahu et al, 2018	369 patients under 18 years of age who undergo operations , including 94 patients ToF	Know incidence , diagnosis, and associations arrhythmia in children post operation	Arrhythmia is frequent problem _ happen after operation open heart
Talwar et al, 2015	224 patients pediatrics post operation heart	Know incident , factor risks , and protocols arrhythmia post operation heart	Arrhythmia early post operation is reason important forever take care stay in ICU. Incident arrhythmia Enough low post operation heart open

Tetralogy of Fallot

Tetralogy of Fallot (ToF) is one of the most common cyanotic congenital heart defects. The prevalence of this disease covers 7–10% of all congenital heart defects with an incidence of one in 3,500 live births. 3 TOF is characterized by four main characteristics, namely ventricular septal defect (VSD), right ventricular outflow tract obstruction (RVOTO), overriding aorta, and right ventricular hypertrophy (RVH). A VSD is usually a large non-restrictive defect often located in the perimembranous and muscular areas of the ventricular septum, this condition allows blood flow between the ventricles. RVOTO is the main characteristic of ToF which can also cause RVH which is another main characteristic of ToF [10]. In the presence of a nonrestrictive VSD, worsening RVOTO will increase right ventricular pressure, promote a right-to-left shunt through the VSD, reduce pulmonary blood flow, and cause hypoxemia. RVOTO will cause an increase in pressure in the right ventricle to maintain blood flow to the lungs, this can cause right ventricular hypertrophy [11]. 8 Another condition that underlies ToF is overriding aorta, this condition describes a ventriculoarterial connection where the aorta can shift to follow the shape of the VSD To varying degrees, this occurs due to misalignment of the outflow tract components of the septum. In ToF, the aorta still arises from the left ventricle, and only partially originates from the right ventricle.9 This anatomical abnormality in ToF allows blood to mix between the pulmonary and systemic circulation [12]. This mixing usually occurs in a VSD, with a right to left shunt adding deoxygenated blood to the systemic circulation, which then causes cyanosis. The right to left shunt through the VSD is determined by the relative pressure gradient between the right ventricle and the left ventricle

The diagnosis of ToF can be made after birth with the time of onset of symptoms depending on the severity of ToF. Many neonates are detected through routine pulse oximetry examinations and the discovery of murmurs on neonatal examination. The classic picture is a neonate or young infant who is cyanotic, shows no signs of respiratory distress, fails to respond to oxygen therapy, and has signs of good cardiac output [13].

One of the treatments for ToF is a surgical procedure. The history of surgical repair of ToF has been at the forefront of the development of pediatric cardiac surgery. The initial intervention in the face of severe cyanosis is to provide pulmonary blood flow with the use of a systemic shunt to the lung, with pulmonary valve-sparing techniques and corrective surgery at an earlier age [14]. Regardless of what intervention is used, timely action is necessary when adverse symptoms occur to prevent significant long-term cyanosis and thereby reduce the risk of nerve damage. 8 The majority of ToF surgical cases involve corrective surgical procedures rather than palliative surgical procedures, and the majority of cases aim to achieve complete repair in one operation. In ToF with severe cyanosis unsuitable for early neonatal repair, a temporary measure is creation of a systemic to pulmonary shunt. This shunt will then act like a PDA by providing continuous flow from left to right. A shunt will increase pulmonary blood flow regardless of RVOTO, correct cyanosis, and give the child time to grow [15].

Complete corrective ToF surgery is usually performed at 3 - 6 months of age. Surgery is performed through an incision in the center of the chest along the sternum, and like other open intracardiac operations, it is performed under cardiopulmonary bypass to support circulation during surgery. 3,10 This operation is performed relatively early in life to reduce pathophysiological adaptations of ToF physiology. This timing has resulted in reduced mortality by increasing early pulmonary vascular development, reducing RVH, and subsequent fibrosis. The repair involves the use of a VSD closure patch, correcting the position of the aorta back into the left ventricle, resection of the RVOT muscle bundle, and reduction of the degree of RVOT

valve stenosis. A transannular patch may be necessary to enlarge the RVOT, but may also cause pulmonary regurgitation [16].

After surgery, babies are monitored in the ICU for a while, put on a ventilator to help them breathe, and receive medications to help the heart recover after surgery. A problem seen early after surgery is excess fluid in the lungs and body because the right ventricle does not pump effectively during the recovery period. 11 Diuretic drugs are used to help remove excess fluid [17]. Problems with abnormal heartbeat rhythms can also occur after surgery due to swelling or injury to the heart's electrical system, which is next to the ventricular septal defect. In a small number of cases, a pacemaker may be needed if the rhythm does not return to normal [18].

Arrhythmia Post Reconstruction Tetralogy of Fallot

Arrhythmias following pediatric cardiac surgery are an important cause of patient morbidity and mortality. 12 Despite advances in surgical technique, perfusion technology, and perioperative management over the past decade or so, arrhythmias still remain a frightening complication in the early stages following surgical repair of congenital heart disease [19].

Persistent or hemodynamically significant arrhythmias occur in 12% of patients after surgical repair of ToF usually occurring within the first 24 hours. Atrial arrhythmia, ventricular arrhythmia, Right bundle branch block (RBBB), Junctional ectopic tachycardia (JET), and Heart block (HB) are common arrhythmias experienced in the postoperative period of ToF repair. 13,14 Based on research conducted by Alp et al, it was found that the arrhythmias that most frequently occurred in patients after ToF repair surgery were JET and supraventricular extra systole. 2 Abdelaziz et al's research showed that the incidence of JET after open heart surgery using cardiopulmonary bypass was 27% and most often occurred after ToF repair surgery, namely 52%.15 The results of this study are supported by the results of research by Sahu et al and Ishaque et al, which show that the most common type of arrhythmia that occurs after ToF repair surgery is JET.1,16 The occurrence of this arrhythmia is associated with injury to the cardiac conduction system during surgery [20].

JET is a life-threatening tachyarrhythmia that occurs primarily after procedures near the AV node (AVN) such as ToF repair surgery, perimembranous VSD or ASD repair [21]. JET is a self-igniting autofocus that can be initiated spontaneously during surgery or immediately after surgery, most commonly occurring on the first postoperative day. The diagnosis of JET is usually based on electrocardiographic (ECG) findings showing narrow complex tachycardia, with a heart rate usually between 170 and 260, narrow QRS complexes and AV dissociation. simultaneously to the atria then antegrade to the ventricles which causes inter-atrial dissociation and ventricular conduction. 19 Abdelaziz et al, in their research carried out active avoidance of hyperthermia, hypothermia, optimal sedation and pain control, optimization of electrolytes, bolus of IV magnesium sulfate 30 mg/kg, minimization of catecholamines exogenous if possible, and the use of amiodarone as a strategy to treat JET. With this strategy, researchers can overcome JET as much as 86.5% [22].

Risk factors for postoperative arrhythmias include younger age, lower body weight, longer cardiopulmonary bypass time, longer cross-aortic clamping time, hypothermia, and heart attack [23]. 13 Based on research by Talwar et al, cardiopulmonary bypass time is a factor risks associated with a high incidence of arrhythmias [24].ta21 Myocardial injury due to ischemia and reperfusion during cardiopulmonary bypass is a suspected cause of arrhythmias after cardiac surgery Inflammatory mediators released in the early postoperative period are thought to contribute to the occurrence of arrhythmias by altering myocyte membrane potential, and facilitating micro re-entry into the atrium and atrioventricular node [25]. The same thing was stated by the study of Sahu et al. In this study, postoperative echocardiography was carried out which showed that patients with arrhythmias may experience myocardial injury during surgery due to various procedure-related causes, which will ultimately manifest as low cardiac output syndrome and heart failure due to myocardial dysfunction. in the early postoperative period. Myocardial injury may also be part of a systemic inflammatory response to cardiopulmonary bypass, changes in myocardial membrane potential, ischemia-reperfusion injury, and/or histamine release as described in several other studies [26]. Jain et al also explained the same thing regarding the timing of cardiopulmonary bypass. to be a risk factor, apart from that this study found age <1 year, Risk adjustment for congenital heart surgery (RACHS) category ≥ 3 , and Artery cross-clamp time (AXC) >67 minutes as independent risk factors for postoperative arrhythmia. Younger age group and lower body weight as well as longer AXC time have been reported as independent risk factors for postoperative arrhythmias in previous studies. 22

In research conducted by Sahu, et al, the prevalence of hemodynamically significant arrhythmias is quite low, namely 6.7%, a lower incidence rate compared to that described in previous studies. However, many recent studies show results similar to this study [27]. The low incidence of arrhythmias in Sahu et al's study may be related to surgical factors, including myocardial protection techniques. All operations in this study were performed by the same surgical team [28].

4. CONCLUSION

Tetralogy of Fallot (ToF) is one of the most common cyanotic congenital heart defects. One of the treatments for ToF conditions is corrective surgery. Problems seen early after surgery are excess fluid in the lungs and arrhythmias. Arrhythmia after pediatric cardiac surgery is a frequently encountered complication and is an important cause of patient morbidity and mortality. The most common type of arrhythmia following ToF repair surgery is JET. This arrhythmia is related to injury to the heart's conduction system during surgery. The main risk factor for postoperative arrhythmias is the duration of cardiopulmonary bypass.

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