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ORGINAL ARTICLE

Arrhythmia in Postoperative Period After Cardiac Surgery for Congenital Heart Disease in Zagazig Children Hospital

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ABSTRACT

Background: Arrhythmias occur often in the early postoperative period, where hemodynamic variations are normal, rendering the patient unstable and can lead to low c ardiac output and cardiac arrest unless treated and resolved in a timely manner. The aim of this study was to analyze the possible causes and risk factors of early arrhythmias to determine the outcome of patients and prevention of arrhythmias after congenital cardiac surgery in pediatrics.

Methods: This Prospective observational study was conducted in the pediatric cardiothoracic intensive care unit (ICU) and pediatric cardiology unit of Zagazig university, the target sample included 24 patients <18-years of both sexes who underwent cardiac operation with or without cardiopulmonary bypass (CPB) between January to July 2020. All patients underwent echocardiographic examination before and after surgery. Children were monitored in the early postoperative period (72h) for the detection of any rhythm abnormality and followed until they were discharged from hospital.

Results: This study showed that early arrhythmias occurred after open heart surgery and all presented in the first 72 hours. The most common type of arrhythmias encountered in this study were JET (12.5%) in three cases diagnosed as ASD, VSD and TOF , SVT (4.2%) in one case of PDA+VSD.electrolyte disturbance one of causes of increase chance of arrhythmias occurrence in postoperative period in our study.

Conclusions: Early Postoperative arrhythmias are still a frequent complication in the early period of congenital cardiac surgery in pediatric patients, especially junctional ectopic tachycardia. Hemodynamically significant arrhythmia could be lethal in patients with severe underlying heart diseases.

Key words: Congenital heart disease; Arrhythmia; Pediatric cardiac surgery.

INTRODUCTION

Congenital heart disease (CHD) is the most common major congenital anomaly represented for nearly one-third of all major congenital anomalies and is responsible for most deaths in the first year of life. One quarter of these children will have critical congenital heart disease (cCHD), which requires surgery or catheter intervention in the first year of life **[1, 2]**.Cardiac arrhythmia is a group of conditions in which the heartbeat is too fast or too slowly or with an irregular rhythm. In recent years, much attention has been focused on postoperative arrhythmias which are common in the early postoperative period after cardiac surgery for congenital heart disease. Improvements in cardiac surgical techniques have dramatically changed the morbidity and mortality associated with congenital heart disease repairs, but Arrhythmias still have well-known complications after congenital cardiac surgery **[3].**Although transient and treatable in most cases, they are a cause of substantial morbidity and mortality especially when they occur in the early vulnerable period of unstable hemodynamics **[4].**These arrhythmias occur mostly in the early postoperative period when hemodynamic fluctuations are common, making the patient unstable and may lead to low cardiac output syndrome (LCOS) and cardiac arrest unless treated and resolved in a timely fashion **[5,6].**In particular, junctional ectopic tachycardia (JET) remains a notorious arrhythmia that prolongs intensive care unit (ICU) stay and sometimes leads to mortality. Several reports have looked at the incidence, risk factors, and management of these arrhythmias. However, the wide spectrum of congenital heart diseases and varying surgical approaches to manage them create endless possibilities for the type and outlook of these arrhythmias **[5, 7]**.The incidence of acute postoperative arrhythmias ranges from 7.3% to 48% **[8]**. Early arrhythmias occurrence ranged from the same day of operation to fifteen days after operation **[3].**There are many factors

known to increase the risk of post congenital heart repair surgeries, Cardiopulmonary bypass (CPB), intraoperative injury to the conduction system and myocardium, postoperative metabolic abnormalities and electrolyte disturbances are known factors associated with increased risk of arrhythmias following surgery **[6].**The incidence and types of arrhythmia after cardiac surgery vary with age, the underlying lesion, the type of surgery, and local practice patterns **[3].** This study aimed to analyze the possible causes and risk factors of early arrhythmia to determine the outcome of patients and prevention of arrhythmias after congenital cardiac surgery in pediatrics**.**

METHODS

This prospective observational study was carried out between January to July 2020 in the cardiothoracic ICU and pediatric departments of Zagazig University, after obtaining clearance from the Institutional Ethics Committee, written consent from parents were taken, the research was carried out in compliance with the Code of Ethics of the World Medical Association (Declaration of Helsinki) for studies involving humans.The study included 24 pediatric patients <18-years who underwent cardiac operation with or without cardiopulmonary bypass (CPB), they were 54% female and 45% male, with a mean age of patients was 4.39 ± 2.53 years , mean body weight was 18.31 ±6.41kg, mean height was 96.29± 19.53 cm .

Preoperative*:*

Patients in the study had been subjected to complete history taking, anthropometric measurements included weight (kilogram), length (centimeter), body mass index. Weight and length were performed according to standard WHO procedures. Z scores for weight for age (WAZ), length/height for age (HAZ). Heart rate, respiratory rate, Blood pressure, Pallor, Cyanosis, Jaundice, auscultation (S1 + S2 + murmur) and Laboratory investigations included (CBC, Serum Electrolytes: (Na - K – Ca), Blood sugar, kidney function test "BUN and creatinine, liver function test , ABG, CRP), thyroid function test, electrocardiograms (ECG) to detect arrhythmia and chamber enlargement , plain chest x-ray; postero-anterior view for detection of cardiomegaly, pulmonary vasculature, and other cardiopulmonary diseases. Echocardiographic measurements of the Aorta (AO), left atrium (LA) mm, left ventricle end systolic diameter (LvESD) mm, left ventricular end diastolic diameter (LvEDD)mm, Ejection Fraction EF%, fractional Shortening FS% and Pulmonary arterial pressure (PASP) mmHG.

Postoperative*:*

Standard electrocardiogram (ECG) was registered in all patients at time of ICU admission, using real time electrocardiograph with 3 channel recorder. Continuous ECG monitoring was performed during the entire ICU stay with monitors. Any sustained rhythm abnormality (those lasting for ≥30 s duration, recurrent and/or causing hemodynamic disturbance) detected on the ECG monitor was assessed by standard 12-lead electrocardiogram (ECG). The presence of Fragmented QRS complex (FQRS) was assessed by ECG were Its defined as the presence of R' or notching of R or S waves in both narrow and wide QRS complex on at least two contiguous leads of those representing anterior (V1–V5), lateral (I, aVL, V6), or inferior (II, III, aVF) myocardial segments and its important predictor of arrhythmias. Before hospital discharge, a 12-lead ECG was routinely done. Echocardiography for assessment of Aorta (AO), left atrium (LA) mm , left ventricle end systolic diameter (LvESD) mm, left ventricular end diastolic diameter (LvEDD) mm, Ejection Fraction EF%, fractional Shortening FS % and Pulmonary arterial pressure (PASP) mmHG.

All patients included in the study were intensively monitored in the early postoperative period (72h) for the detection of any rhythm abnormality and followed until they were discharged from hospital. For this study, an arrhythmia was defined as an alteration in the heart rate or rhythm that necessitated an intervention, such as a change in medication, use of temporary pacing wires, or electrical cardioversion/defibrillation.

Statistical Analysis

Data were checked, revised, entered and analyzed using SPSS version 23 for data processing. The data were presented as number and percentages for the qualitative data, mean, standard deviations and ranges for the quantitative data with parametric distribution and median for the quantitative data with nonparametric distribution**.**

RESULTS

This study showed that the cases that had SVT arrhythmias were diagnosed as PDA & VSD while among the 3 cases had JET arrhythmia one had ASD, one had VSD & one had TOF. **Table (1)**

Table (1): Diagnosis among the studied group according to type of arrhythmia

Variable		All patient (n=24)		No arrhythmia (n=20) 83.3%		Arrhythmia (n=4)17.6%		SVT Arrhythmia (n=1) 4.2%		JET Arrhythmia (n=3)12.5%	
		No	%	No	%	No	%	No	%	No	%
Diagnosis	ASD	3	12.5	2	10	1	33.3	0	0	1	33.3
	VS/D	9	37.5	8	40	1	33.3	0	0	1	33.3
	TOF	1	4.2	0	0	1	33.3	0	0	1	33.3
	PDA	8	33.3	8	40	0	0	0	0	0	0
	PDA+VSD	1	4.2	0	0	1	100	1	100	0	0
	PDA+PHTN	1	4.2	1	5	0	0	0	0	0	0
	PDA+TR	1	4.2	1	5	0	0	0	0	0	0

ASD:Atrial septal defect ,VSD:ventricular septal defect ,TOF :Tetralogy of fallots , PDA:patent ductus arteriosus , PHTN:pulmonary hypertension , TR:Tricuspid regurg

There was no statistical relation between arrhythmia & demographic characteristics, body measurements & diagnosis among the studied group. **Table (2)**

Table (2): Relation between arrhythmia & Demographic Characteristics, body measurements & diagnosis among the studied group preoperative

Variable			No arrhythmia (n=20)		Arrhythmia (n=4)		Test	P
Age (years)	Mean ± SD Median(Range)		4.81 ± 2.45 4 (1 – 9)		2.27 ± 1.93 1.79(0.5-5)		MW 1.83	0.07 NS
Weight (Kg)	Mean ± SD Median(Range)		19.45 ± 6.08 18 (10 – 30)		12.63 ± 5.41 11.5(7.5-20)		MW 1.79	0.07 NS
Height (cm)	Mean ± SD Range		99.7 ± 19.06 70 – 140		79.25 ± 12.61 65 - 95		T 2.04	0.06 NS
BMI (Kg/m^2)	Mean ± SD Range		19.53 ± 3.14 14.3 – 26		19.49 ± 3.85 14.9 – 23.11		T 0.02	0.98 NS
Variable		**Total**	**No**	**%**	**No**	**%**	**χ^2**	**P**
Sex	Female	13	11	84.6	2	15.4	0.03	0.86
	Male	11	9	81.8	2	18.2		NS
Birth order	1st	11	10	90.9	1	9.1	7.86	0.10
	2nd	6	4	66.7	2	33.3		NS
	3rd	2	2	100	0	0		
	4th	4	4	100	0	0		
	5th	1	0	0	1	100		

Sd: Standard deviation t: Independent t test MW: Mann Whitney $\chi 2$: Chi square test NS: Non significant (P>0.05)

There was a statistically significant increase in mean heart rate and frequency of pallor and cyanosis and decrease in SBP among cases that had arrhythmia compared to cases that hadn't. **Table (3)**

Table (3): Relation between arrhythmia and General & cardiac examination among the studied group preoperative

Variable		No arrhythmia (n=20)	Arrhythmia (n=4)	t	P
HR (beat/min)	Mean ± SD Range	130.15±10.87 110 – 155	148±12.62 137 – 165	**2.93**	**0.008 ****
RR (breath/min)	Mean ± SD Range	34.2±3.84 28 – 40	38 ± 0.82 37 – 39	1.93	0.06 NS
Temperature (^{0})	Mean ± SD Range	37.22 ± 0.47 36.2 – 37.8	37.68 ± 0.43 37.2 – 38.2	1.79	0.09 NS
SBP (mmHg)	Mean ± SD Range	113.95±12.08 99 – 140	95 ± 23.80 60 – 110	**2.43**	**0.02***

Variable			No arrhythmia (n=20)		Arrhythmia (n=4)		t	P
DBP (mmHg)	Mean ± SD Range		65.6 ± 9.76 50 – 87		57.75 ± 0.43 40 – 76		1.35	0.19 NS
Variable		**Total**	**No**	**%**	**No**	**%**	**χ^2**	**P**
Pallor	No Yes	23 1	20 0	87 0	3 1	13 100	**5.22**	**0.02***
Cyanosis	No Yes	21 3	19 1	90.5 33.3	2 2	9.5 66.7	**6.17**	**0.01***
Auscultation	S1+S2+machinery murmur S1+S2+ejection syst. murmur S1+S2+mild systolic murmur S1+S2+pan systolic murmur	10 2 1 11	9 2 1 8	90 100 100 72.7	1 0 0 3	10 0 0 27.3	1.81	0.61 NS

Sd: Standard deviation t: Independent t test χ^2: Chi square test
NS: Non significant (P>0.05). *: Significant (P<0.05), **: highly significant (P<0.01) HR: Heart rate, RR: respiratory rate, SBO: Systolic blood pressure, DBP: Diastolic blood pressure.
There was a statistical significant increase in mean K & CRP and decrease in mean Ca among cases that had arrhythmia compared to cases that hadn't. **Table (4)**

Table (4): Relation between arrhythmia and laboratory findings among the studied group preoperative:

Variable			No arrhythmia (n=20)	Arrhythmia (n=4)	Test	P
CBC	**WBCs ($x10^3/mm^3$)**	Mean± SD Range	10.94 ± 1.16 8.2 – 13	11.8 ± 0.57 11.2 – 12.5	T 1.43	0.17 NS
	RBCs ($x10^6/mm^3$)	Mean± SD Range	4.38 ± 0.49 3.7 – 5.2	4.05 ± 0.17 3.8 – 4.2	T 1.32	0.20 NS
	Hb (gm/dl)	Mean± SD Range	11.25 ± 0.97 9.7 – 13	11.03 ± 1.23 9.5 – 12.5	T 0.41	0.69 NS
	HCT (%)	Mean± SD Range	33.62 ± 4.37 21.3 – 37.9	31.9 ± 2.05 29.2 – 33.9	T 0.76	0.46 NS
Electrolyte	**Na**	Mean± SD Range	139.9 ± 2.57 134 – 145	139.53±3.03 136 – 142.1	T 0.26	0.80 NS
	K	Mean± SD Range	3.96 ± 0.34 3.4 – 4.5	4.65 ± 1.24 3.9 – 6.5	**T 2.26**	**0.03***
	Ca	Mean± SD Range	10.41 ± 0.73 9 – 11.5	9.38 ± 0.43 9 – 10	**T 2.72**	**0.01***
	Mg	Mean± SD Range	1.89 ± 0.24 1 – 2.1	1.89 ± 0.28 1.5 – 2.17	T 0.03	0.98 NS
Other	**CRP (mg/dl)**	Mean± SD Median(Range)	7.27 ± 1.50 7(5 – 12)	26.5 ± 39.1 7.5 (6 - 85)	**MW 2.04**	**0.04***
	RBS (mg/dl	Mean ± SD Range	102.2±13.64 75 – 122	106.5±17.14 90 - 130	T 0.55	0.58 NS
	Bun	Mean ±SD Range	10.35 ± 2.15 7 – 15	12.28 ± 4 9.1 - 18	T 1.41	0.17 NS

Sd: Standard deviation t: Independent t test MW: Mann Whitney test
NS: Non significant (P>0.05) *: Significant (P<0.05) **: highly significant (P<0.01). WBC: White blood cell count, RBC: Red blood cell Hb: Hemoglobine, HCT: Hematocrit Na: Sodium, K: potassium, Ca: Calecium, Mg: Magnesium, CRP: C reactive protein, RBS: Random blood sugar
There was no statistical relation between arrhythmia and ABG among the studied group preoperative.**Table (5)**

Table (5): Relation between arrhythmia and ABG among the studied group preoperative

Variable		No arrhythmia (n=20)	Arrhythmia (n=4)	T	P
PH	Mean ± SD Range	7.38 ± 0.10 7.22 – 7.50	7.48 ± 0.10 7.4 – 7.6	1.84	0.13 NS
PaO_2 (%)	Mean ± SD Range	98.6 ± 0.50 98 – 99	98.5 ± 0.58 98 - 99	0.36	0.73 NS
$PaCO_2$ (%)	Mean ± SD Range	40.52 ± 1.5 37.7 – 43.1	39.4 ± 1.85 37.1 – 41.5	1.32	0.20 NS
HCO_3 (%)	Mean ± SD Range	27.08 ± 0.90 25.5 – 29.3	26.48 ± 1.78 23.9 - 28	1.03	0.32 NS

Sd: Standard deviation t: Independent t test NS: Non significant (P>0.05)

There was a statistically significance increase in mean PASP and decrease in mean EF among cases had arrhythmia compared to cases hadn't.**Table (6)**

Table (6): Relation between arrhythmia and ECHO measurements among the studied group preoperative

Variable		No arrhythmia (n=20)	Arrhythmia (n=4)	Test	P
AO (mm)	Mean ± SD Range	17.95 ± 3.89 14 – 29	18.75 ± 5.68 23.9 - 28	T 0.35	0.73 NS
LA (mm)	Mean ± SD Range	23 ± 3.29 17 – 28	24.25 ± 4.35 20 - 30	T 0.66	0.52 NS
LvEDP (mm)	Mean ± SD Range	33.1 ± 5.74 21 – 42	28.5 ± 9.85 19 - 37	T 1.30	0.21 NS
LvESP (mm)	Mean ± SD Range	21.75 ± 3.19 15 – 28	19.75 ± 5.74 12 - 25	T 1.00	0.33 NS
EF (%)	Mean ± SD Range	65.55 ± 2.26 60 – 70	50 ± 10.68 40 - 65	**T 6.36**	**<0.001****
FS (%)	Mean ± SD Range	39.15 ± 3.77 30 – 49	42.75 ± 8.73 36 - 55	T 1.38	0.18 NS
PASP (mmHg)	Mean ± SD Median (Range)	28.15 ± 8.70 29 (11 – 45)	46.5 ± 20.63 40 (30 – 76)	**MW 2.27**	**0.02***

Sd: Standard deviation t: Independent t test MW: Mann Whitney test χ^2 : Chi square test NS: Non significant (P>0.05) *: Significant (P<0.05) **: highly significant (P<0.01) , AO: aortic opening, LA: left atrium, LvEDD: left ventricle end diastolic diameter, LvESD: left ventricle end systolic diameter , EF: ejection fraction, FS: fractional shortening , PASP: pulmonary artery pressure

There were no statistical relations between arrhythmia and ECG findings among the studied group preoperative and postoperative. **Table (7)**

Table (7): Relation between arrhythmia & ECG among the studied group preoperative and postoperative

Variable			No arrhythmia (n=20)	Arrhythmia (n=4)	Test	P
P amplitude (mv)	Mean ± SD Median(Range)	**Preoperative**	0.12 ± 0.05 0.11 (0.05-0.28)	0.15 ± 0.10 0.14(0.05-0.28)	MW 0.47	0.64 NS
		Postoperative	0.11 ± 0.04 0.10 (0.05-0.19)	0.11 ± 0.06 0.10(0.06-0.19)	MW 0.08	0.94 NS
P duration (sec)	Mean ± SD Range	**Preoperative**	0.09 ± 0.03 0.06 – 0.16	0.11 ± 0.03 0.08 – 0.16	T 1.19	0.25 NS
		Postoperative	0.09 ± 0.03 0.08 (0.06–0.19)	0.12 ± 0.05 0.10(0.08–0.19)	MW 1.56	0.12 NS
PR interval (sec)	Mean ± SD Median(Range)	**Preoperative**	0.14 ± 0.05 0.12(0.08-0.3)	0.15 ± 0.09 0.14(0.08-0.3)	MW 0.16	0.88 NS
		Postoperative	0.13 ± 0.05 0.11(0.08-0.3)	0.17 ± 0.10 0.15(0.08-0.3)	MW 0.79	0.43 NS
QRS	Mean ± SD	**Preoperative**	0.15 ± 0.09	0.16 ± 0.07	MW	0.48 NS

Variable			No arrhythmia (n=20)		Arrhythmia (n=4)		Test	P
duration (sec)	Median(Range)		0.10(0.05-0.3)		0.15(0.10–0.25)		0.70	
		Postoperative	0.13 ± 0.04 0.05-0.2		0.11 ± 0.03 0.08–0.15		T 0.66	0.52 NS
Variable			**No**	**%**	**No**	**%**	**χ^2**	**P**
T wave	Normal Depressed Peaked	**Preoperative**	18 1 1	90 50 50	2 1 1	10 50 50	3.84	0.15 NS
	Normal Depressed	**Postoperative**	19 1	95 5	3 1	75 25	1.75	0.19 NS
FQRS	-ve + ve (2 fragments)		20 0	95.8 0	1 3	4.8 100	17.1	>0.001

Sd: Standard deviation, t: Independent t test, MW: Mann Whitney, χ^2 : Chi square test,
NS: Non significant (P>0.05)

This study showed that the cases had +ve FQRS preoperative were diagnosed by VSD, TOF and VSD+PDA while the 2 more cases had +ve FQRS postoperative were diagnosed VSD. **Table (8)**

Table (8): Diagnosis among the studied group according to FQRS

Diagnosis:	All patient (n=24)		Pre				Post			
			No FQRS (n=21)		FQRS (n=3)		No FQRS (n=19)		FQRS (n=5)	
	No	**%**	**No**	**%**	**No**	**%**	**No**	**%**	**No**	**%**
ASD	3	12.5	3	14.3	0	0	3	15.8	0	0
VSD	9	37.5	8	38.1	1	33.3	6	31.6	3	60
TOF	1	4.2	0	0	1	33.3	0	0	1	20
PDA	8	33.3	8	38.1	0	0	8	42.1	0	0
PDA+VSD	1	4.2	0	0	1	33.3	0	0	1	20
PDA+ Pulmonary HTN	1	4.2	1	4.8	0	0	1	5.3	0	0
PDA+TR	1	4.2	1	4.8	0	0	1	5.3	0	0

There was a statistically significant increase in mean PASP and decrease in mean EF among cases that had FQRS compared to cases that hadn't. **Table (9)**

Table (9): Relation between FQRS and ECHO among the studied group

Variable		=-ve (n=21)	+ve (n=3)	Test	P
AO (mm)	Mean ± SD Range	17.9±3.79 14 – 29	19.33 ± 6.81 14 - 27	t 0.56	0.58 NS
LA (mm)	Mean ± SD Range	22.86±3.28 17 – 28	25.67 ± 4.04 22 - 30	t 1.36	0.19 NS
LvEDP (mm)	Mean ± SD Range	32.43±6.38 19 – 42	31.67 ± 9.24 21 - 37	t 0.18	0.86 NS
LvESP (mm)	Mean ± SD Range	21.29±3.77 12 – 28	22.33 ± 3.06 19 - 25	t 0.46	0.65 NS
EF (%)	Mean ± SD Range	64.76±4.23 49 – 70	50.33±13.05 40 - 65	**t 4.15**	**<0.001****
FS (%)	Mean ± SD Range	39.33±3.77 30 – 49	42.67±10.69 36 - 55	t 1.12	0.28 NS
PASP (mmHg)	Mean ± SD Median(Range)	28.48±8.61 30 (11–45)	50.33±23.46 45 (30 – 76)	**MW 1.98**	**0.04***

Sd: Standard deviation, t: Independent t test, MW: Mann Whitney test, χ^2 : Chi square test, NS: Non significant (P>0.05), *: Significant (P<0.05), **: highly significant (P<0.01), AO :aortic opening, LA: left atrium, LvEDD: left ventricle end diastolic diameter, LvESD: left ventricle end systolic diameter, EF :ejection fraction, FS: fractional f shortening, PASP: pulmonary artery pressure

DISCUSSION

Early postoperative arrhythmias are a frequent complication after congenital cardiac operation in pediatrics and remains an important factor for morbidity and mortality **[3,4]**.This study was included both closed and open heart procedure

and most congenital defects in the current study were VSD, PDA ASD and TOF (37.5%, 33.3%, 12.5 and 4.2 respectively) in addition to one case was PDA+VSD another one was PDA+ TR.

In our study, incidence of early postoperative arrhythmias was 17.6% near to previously reported studies like **(15%).**Some previous studies have shown low incidence of arrhythmias **valsangiacomo et al. [3]** about 5%-8%. On the other hand**, Grosses –Wortman et al. [9] showed** a high incidence of 79.1 %, which is considered higher than all previously reported studies. This high difference could be explained as being due to Holter monitoring which is a more sensitive method for detection of arrhythmias than bedside monitoring **[9]**. These variations may also be due to the difference in the definition of arrhythmias. (Only arrhythmias that require intervention and have hemodynamic effects were included in our study).Most common type of arrhythmia encountered in our study was JET 12.5%, similar to previous studies by **valsangiacomo et al. [3] & yueh et al. [4]**. The second type of arrhythmia was SVT (4.2%).Most patients in the current study with JET had a ventricular septal defect alone or with other cardiac defect which agree with study of **Sachin et al. [10]**.In our study arrhythmia doesn't occur after closed heart procedure (cases of only PDA) which may be due to technique neither affecting the myocardium nor conduction systems while in open heart surgery, many pathophysiological factors can be a cause of early postoperative arrhythmias such as direct injury to cardiac tissue after myocardial incision, suture that may be affecting AV conducting system, cannulation and rapid change of intracardiac pressure that occur by volume and pressure fluctuation **Hoffman et al [8].**

Also, **Delaney et al. [11]** detected the degree of myocardial damage by measuring the level of CK MB. In our study we didn't measure this enzyme.Different risk factors of arrhythmias have been described in the literature including younger age at surgery, long cross clamping time (ACC), prolonged CPB time , deep hypothermic circulatory arrest and type of surgery and its complexity**[8, 3] .In Pfammatter** and colleague's study **[3]**, arrhythmic patients were significantly younger than non- arrhythmic patients .The same significant presented by **Yildirim et al [6]** which is don't proved by our study, Where, there was no statistical significance between anthropometric measurements and patients age with arrhythmias due to a higher mean age of our patients like study **[6].**

This study was showed a statistically significant tachycardia (P value= 0.001), cyanosis (P value = 0.02), hypotension SBP (P value =0.001) among cases had arrhythmias compared to those had not, while other examination were statistically non-significant.Regarding electrolytes, in our study we have found significant increase in K level and decrease in serum Ca, while no significant change in Na and Mg levels were observed in arrhythmic group compared to non-arrhythmic one which agree with **Yildirim et al [6]** and not agree with the presenting data of **Sahu et al [12]** .

Some previous studies showed an association between hypomagnesemia and JET **[13]**. In our study there is no association because most patients' level of Mg was within normal or slightly high.

Normal or even high levels of Mg help in prevention of intracellular accumulation of Ca, so decrease the incidence of arrhythmia **[14].**Regarding arterial blood gases ABG, the statistical analysis showed no significant relation between arrhythmia and ABG among the studied group. In echocardiographic finding, arrhythmias significantly associated with increasing mean PASP range between (30-76 mmHg) (p value = 0.02) and mild decrease of EF% range between (40%-65%) (P value <0.001) which agree with **EL Boraey et al. [15].** However, there is no significant change in AO, LA, LvEDD and FS% among both groups.

According to ECG finding among studied group, before surgery, the mean P wave amplitude was 0.12 ±0.06 mv and after surgery was 0.11 ± 0.04 mv which show decrease in postoperative reading but without statistical significant, which agree with **Fang et al. [16],** p wave duration range from 0.06-0.16 sec before surgery, while after surgery was ranged from 0.06 to 0.19 sec with p value = 0.57. also, PR interval was 0.14 ± 0.05 sec preoperative and 0.15±0.06 sec postoperative that show significant increase in PR interval (p value = 0.03) in postoperative patients compared to preoperative which disagree with **kaya MG et al. [17]** study that show a significant decrease in the PR interval postoperative. The PR interval is determined by the conduction time from the sinus node to the ventricles and thus integrates information about a number of sites of conduction systems of the heart. Prolongation of PR interval may result from conduction delay in the atrium, atrioventricular node and/or His purkinje system that may be due to edema, ischemia and inflammation after surgery according to QRS duration, there was non-significant decrease in mean QRS duration in patients after procedure (0.13± 0.04 sec) compared to preoperative ones (0.13± 0.06) in agreement with **Kaya MG et al [17]**. ST segment was iso electrical in most of

patients per and post-surgery and T wave was depressed in two patients before surgery, and this depression was sustained after surgery and peaked in two patients before surgery and corrected postoperative. Also, there was no statistical significant relationship between arrhythmia and ECG finding in postoperative patients. Also, we assess the relationship between presence of Fragmented QRS (FQRS) and arrhythmia, and we found a significant statistical association between them, arrhythmias increased in cases with +ve FQRS **Deyell et al [18] & Das et al [19]** and to be associated with LV enlargement and VT **Kadi et al [20] and Bekar et al [21].**

Fragmentation of QRS complex is defined as the presence of R' or notching of R or S waves in both narrow and wide QRS complex on at least two contiguous leads of those representing anterior (V_1–V_5), lateral (I, aVL, V_6), or inferior (II, III, aVF) myocardial segments and its important predictor of arrhythmias **[22,18].**FQRS was established as a good marker of myocardial scar in patients with coronary artery disease **Das MK et al. [23]** and patients with congenital heart disease **[24]**.FQRS included various RSR′ patterns (QRS duration <120 ms), such as ≥1 R prime or notching of the R wave or S wave present.QRS fragmentation has been identified as a significant factor for arrhythmia in patients with ischemic or non-ischemic heart disease in adults **[22].**Also, FQRS was identified in adult patients with correction of fallot's tetralogy, and were found to indicate severe dilatation and scarring of Rt ventricle **[24]**.

There are many studies regarding FQRS in adult patients, but these studies were little in the pediatrics population. In this study we found FQRS complex in three patients before surgery (12.5 %) where two with large VSD and one was tetralogy of fallot. After surgery, FQRS was present in the same patients in addition to other two VSD cases (20.8 %) where FQRS correlated to larger ventricles **[21]** and the right and left ventricles hemodynamics may be associated with the number of leads showing FQRS. Arrhythmia was detected in three patients who had FQRS complex and one arrhythmic case without FQRS and this shows a statistical significance between arrhythmia and presence of FQRS which agree with **Chang et al. [25].**

Limitations:

The study had some limitations including small sample size and some laboratory investigation not done as S. Troponin, CK MB and Natriuretic peptides.

CONCLUSIONS

Early Postoperative arrhythmias are still a frequent complication in the early period of congenital cardiac surgery in pediatric patients, especially junctional ectopic tachycardia. Hemodynamically significant arrhythmia could be lethal in patients with severe underlying heart diseases. Fragmented QRS complex is an important noninvasive tool that helps in early detection of occurrence of postoperative arrhythmias.

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