Postoperative Complications In Patients Undergoing Paediatric Cardiac Surgery, Single Center Experience.

Ahmed Ibrahim Ismail[1*], Omar A. Sadek[2], Ahmed Gamal[3], Magdy Elshazly[4], Ahmed Nabil Malek[5], Ahmed Farouk[6]

[1*,2,3,5,6]Cardiothoracic surgery department, Faculty of medicine, Assiut University, Egypt.
[4]Cardiac surgery department, National Heart Institute, Cairo, Egypt.

***Corresponding Author:** Ahmed Ibrahim Ismail
*****Cardiothoracic surgery department, Faculty of medicine, Assiut University, Egypt.

Introduction
Complications from paediatric heart surgery can affect multiple organs and significantly influence the length of hospital stay as well as the outcome following discharge. Although the majority of complications are directly linked to the surgical procedure, respiratory issues remain a substantial and often underestimated cause of morbidity and death following congenital heart surgery.
Aim
This study set out to evaluate the connection between the overall result and the complications.
Patients and methods
235 children (ages 0 to 18, excluding preterm infants) who had open-heart surgery within a 2-years period at Assiut University Heart Center were included in this retrospective descriptive analysis. Data from preoperative, intraoperative, and postoperative procedures are included to assess the number of problems that occur.
Results
There is a significant correlation between the length of cardiopulmonary bypass time and the occurrence of complications following paediatric cardiac procedures; the longer the cardiopulmonary bypass time, the higher the likelihood of complications. Research on adult cardiac surgery has shown similar results to this one, demonstrating that difficulties following heart surgery are linked to longer hospital stays.
Conclusion
Surgery is the ideal treatment for paediatric cardiac diseases. Nearly 25% of paediatric cardiac surgery cases had problems following surgery. The majority of them had complex congenital anomalies characterized by varying degrees of respiratory or cardiac failure. Longer cardiopulmonary bypass time are associated with higher complications and mortality rate. This study's findings indicate that suitable timing of surgical intervention and closely monitored care are critical in reducing the frequency of serious consequences.

Keywords:
Cardiopulmonary bypass, paediatric cardiac surgery, tetralogy of Fallout, paediatric, postoperative complications.

Introduction
The most prevalent congenital abnormality, affecting 8–10 out of every 1000 live infants, is congenital heart abnormalities. Many of those people require surgical procedures to address their heart problems [1]. The majority of congenital cardiac defects can now be surgically treated because to the development of the heart-lung machine. The use of cardiopulmonary bypass varies between adults and children depending on factors such as the conditional occurrence of deep hypothermic circulatory arrest, the presence of aorto-pulmonary shunts, and the underdeveloped cardiovascular system. The prolonged time of cardiopulmonary bypass has negative impacts on several physiological systems. Longer cardiopulmonary bypass induce overloading the systemic circulation, which is mostly compromised by preceding cardiac failure. Multiple systemic problems may arise from anaesthesia, intraoperative drugs, cardiopulmonary bypass, and surgical techniques [2]. In order to restore cardiopulmonary function and prevent organ damage, postoperative care is extremely concerned with these potentially harmful effects [3]. In comparison to adult cases, paediatric postoperative care necessitates stricter observation due to differences in development, age, maturity, preoperative state, and surgical management. Due to the immaturity of their body organs, newborns are particularly susceptible to surgery-related problems, which can raise mortality and morbidity.
Children who have complicated congenital heart defects run the risk of developing several problems, including varying degrees of heart and pulmonary failure. Patients who require operations that are more complicated have a greater mortality rate. Currently, several canters reported a mortality rate of about 6%, compared to just 3% for adult heart surgery. There has been a discernible advancement in paediatric cardiac surgery during the past few decades. However, it is still

reasonable to expect early postoperative problems. Preventing poor cardiac output and organs failure is the primary goal of postoperative critical care. The worst general conditions are pulmonary hypertension and low cardiac output. It is typically linked to valve dysfunction, the existence of surgical residual shunts, or persistent of the ventricular outflow tracts obstruction. The study aims to identify complications following paediatric heart procedures and evaluate the relationship between these complications and the ultimate result.

Patients and Methods
Study population

A descriptive retrospective study was done on 235 paediatric patients who underwent cardiac surgery in Assiut University Heart Center who matched the inclusion criteria within 2-years period. Ethics committee approval number: 17100832.

Inclusion criteria
All patients were enrolled for cardiac surgery with/without usage of cardiopulmonary bypass (Range of age from 0 to18 years old).

Exclusion criteria
1. Heart and lung transplantations.
2. Preterm babies.
3. Redo cardiac surgeries.
4. Patients on mechanical ventilation before intervention.
5. Patients with concomitant medical diseases other than cardiac anomalies.

The preoperative and intraoperative data were listed including type of operation, cardiopulmonary bypass time, and ischemic time.
The postoperative data were listed including incidence of postoperative complications such as heart failure, arrhythmias, pulmonary complications, wound infection, and bleeding, as well as ICU and hospital stay of the patients.

Patient characters recorded were recorded as follows:
1. Age (years).
2. Sex.
3. Weight (kg).
4. Laboratory data.

Preoperative and postoperative variables recorded were as follows:
1. Hemodynamic measures.
2. Echocardiography.
3. ECG.
4. Pulmonary artery systolic pressure.
5. Laboratory data.

Results
Of the 235 patients, ventricular septal defect (VSD) closure is the commonest procedure (29.8%) followed by atrial septal defect (ASD) correction (15.8%), as shown in [Table 1]. Of these patients, only 22% had preoperative pulmonary hypertension, as shown in Fig. 1. Average cardiopulmonary bypass time (BT) and average cross-clamp time (CCT) were 101.66±24.11 and 70.43±18.25, respectively, as shown in [Table 2]. Of the top postoperative complications, chest infection is the commonest (12%) followed by wound infection (8%), heart failure (7%) and pulmonary hypertension (6% each), as shown in Fig. 2. Mortality rate was for 4.7%% in this study [Table 3]. Moreover, the study revealed that there is a significant relation between cardiopulmonary bypass time (BT), cross-clamp time (CCT) and outcome (hospital stay, complications, and mortality rate), as shown in [Table 4] and [Table 5], respectively. The study also showed a significant relation between complexity of procedure and outcome (complications and mortality rate increased in patients with tetralogy of Fallout as an example), as shown in [Table 6].

Discussion
Still, the best choice of treatment for the majority of congenital cardiac defects is surgery. Moreover, like other procedures, a number of complications are possible. Therefore, proper management and close monitoring following cardiac surgery are essential to preventing potentially fatal complications. Actually, not many studies discussed the complications, which were diagnosed at the time of admission. A small number of complications have been the subject of numerous studies. For example, nosocomial infections have been found to occur in approximately 22% of paediatric cardiac surgery patients

[4],[5],[6]. For surgical or medicinal reasons, dysrhythmia affected 18% of the postoperative patients [7]. Hepatic complications (9%) [8], cardiac tamponade (7%) [9], and diaphragmatic paralysis (5.4%) were recorded as additional postoperative complications [10]. Additional cases with individual problems were also reported [11],[12],[13],[14].

Our analysis confirms the same findings of earlier adult cardiac surgery studies, which indicate that prolonged hospital stays were substantially correlated with postoperative complications [15],[16]. Also, they demonstrate the strong relationship that has been shown in numerous studies between the postoperative complications and death rate [17],[18].

Actually, this study has certain limitations. 235 patients' postoperative courses were observed. In all, 21% of the patients were younger than one year old, 50% were between one and six years old, and 29% were older than six years old. 52% of the patients are men, and 48% are women. In our Center, VSD closure accounted for 30% of all operations, with ASD closure coming in at 18%, PDA ligation at 14%, TOF repair at 10%, Pulmonary stenosis repair in 8%, coarctation repair in 8%, atrioventricular septal defect repair in 4%, DORV repair in 3%, and others in 7.5%. Almost 78% of the patients do not have postoperative pulmonary hypertension, while 22% have varying stages of pulmonary hypertension (mild 12%, moderate 5%, and severe 5%).

We found that chest infection is the most frequent surgical complications and is represented by 12% of the patients. Wound infections, heart failure, pulmonary hypertension, postoperative haemorrhage, and arrhythmia follow closely behind with 8%, 7%, and 2% of cases, respectively.

The study's mortality rate was 4.6%. Cardiopulmonary bypass time (BT), cross-clamp time (CCT), and result (hospital stay, complications, and death rate) were found to be significantly correlated. The longer the bypass duration or cross-clamp time, the higher the likelihood of complications incidence. This study also demonstrated a strong relationship between operation complexity and results (e.g., higher death rates and problems in patients with tetralogy of Fallout).

When this study is compared to a previous one conducted at Assiut University hospitals and published by Ghoneim et al.[19] , the postoperative mortality rate (4.6% versus 5.6% in the previous study) is better. In Ghoneim et al. study, dysrhythmia was the most prevalent consequence (28%) followed by postoperative fever and chest infections (12%). However, in our study, the most common complications were postoperative chest infection (12%), wound infection (8%), and heart failure (7%). In general, the experience following paediatric cardiac surgical procedures has improved, and we anticipate that this trend will continue in the future. Overall, there has been an improvement in the experience with postoperative paediatric cardiac surgery care, and we expect sustained improvement by adhering to the most recent postoperative ICU management protocols.

Conclusion

Around quarter of the patients who underwent paediatric cardiac surgery showed postoperative complications, and it was mirrored on the ICU stay, hospital stay and mortality rate. Most of them have complex cardiac anomalies and longer cardiopulmonary bypass time are correlated to rising in mortality rate and complications. Postoperative complications include the heart and other organs like kidneys, lungs, and brain. It is crucial to identify high-risk patients prior to surgery in order to predict the emergence of complications. Even for high-risk patients with low birth weight, the development of ICU management strategies improves the outcome of their cases. Further research has validated the significance of additional variables, such as anaesthesia type, mechanical ventilation, and postoperative vasoactive medication management, in raising the risk of complications following surgery.

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Conflicts of interest

There are no conflicts of interest.

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Figure 1: Percentage of preoperative pulmonary hypertension.

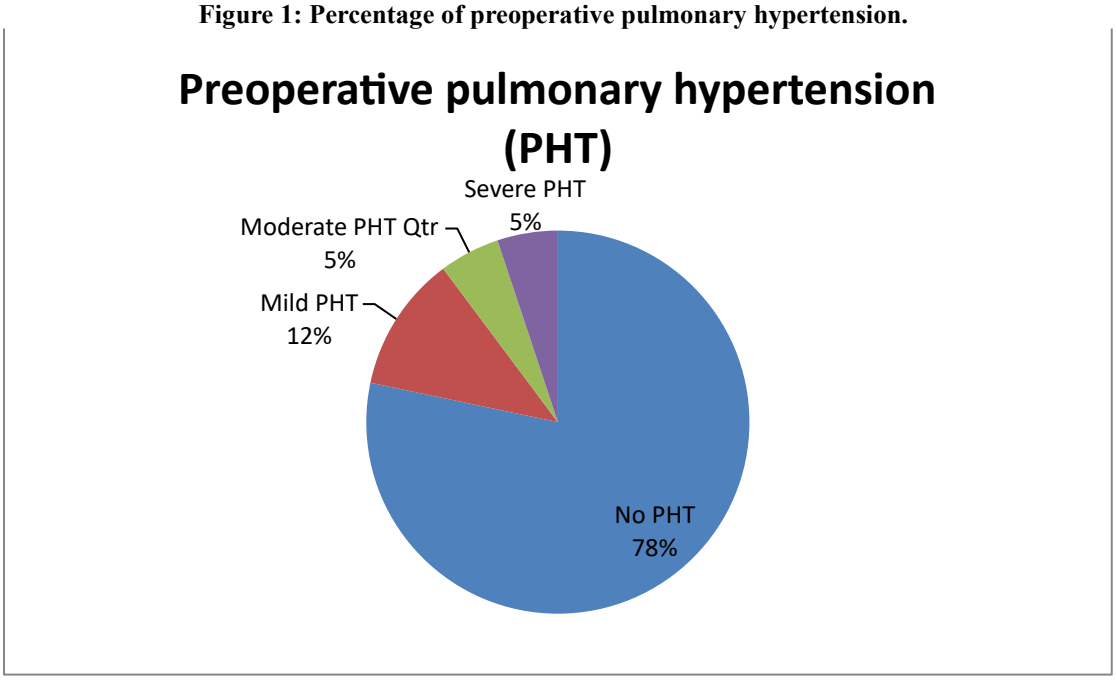

Figure 2: Percentage of the postoperative complications.

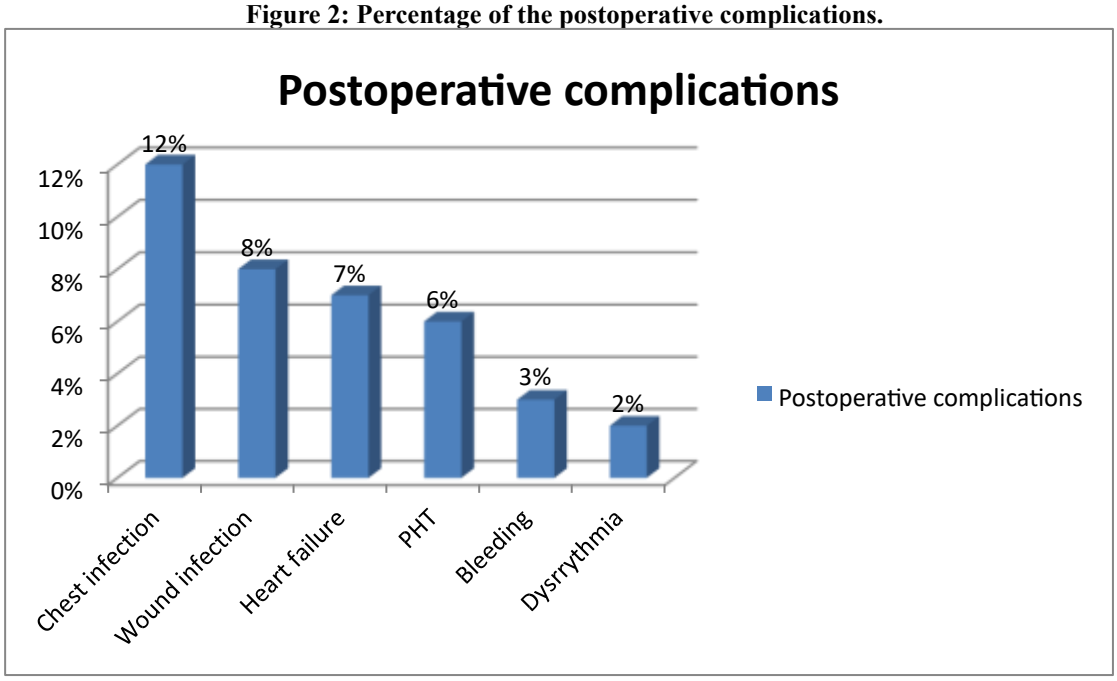

Table 1: Surgical procedure

Diagnosis	Number, Percentage
Ventricular septal defect (VSD)	**70, 29.8%**
Atrial septal defect (ASD)	**37, 15.8%**
Patent ductus arteriosus (PDA)	**32, 13.6%**
Fallot Tetralogy (TOF)	**24, 10.2%**
Pulmonary stenosis (PS)	**19, 8.1%**
Coarctation of aorta (CoA)	**19, 8.1%**
Atrio-ventricular septal defect (AVSD)	**9, 3.8%**
Double outlet right ventricle (DORV)	**7, 3%**
Aortic stenosis (AS)	**5, 2.1%**
Others	**13, 5.5%**
Total	**235, 100%**

Table 2: Cardiopulmonary bypass data

	Mean±SD	Range
Bypass time (min)	**101.66±24.11**	**35-190**
Cross clamp time (min)	**70.43±18.25**	**25-110**

Table 3: Outcome

Hospital Stay (in days)	%
1-7	**52%**
8-15	**33%**
>15	**15%**
Mean±SD (range)	**10.53±9.77 (1-60)**
Mortality percentage	**4.7%**

Table 4: Relation between bypass time (BT) and survival rate

	BT (min)		P value
Hospital Stay (days)	**Mean±SD (range)**	**Median**	
1-7	**93.01±23.68**	**93**	**0.05**
8-15	**102.43±16.33**	**99**	
>15	**110.89±23.24**	**109**	
Complications			
Yes	**114.35±28.46**	**115**	**0.01**
No	**96.44±17.89**	**99**	
Survival			
Yes	**97.78±19.3**	**99**	**0.003**
No	**133.89±26.28**	**145**	

Table 5: Relation between cross-clamp time (CCT) and survival rate

	CCT (min)		P value
Hospital Stay (days)	**Mean±SD (range)**	**Median**	
1-7	**64.23±22.78**	**66**	**0.143**
8-15	**70.45±16.21**	**79**	
>15	**72.54±14.33**	**79**	
Complications			
Yes	**73.66±16.28**	**78**	**0.055**
No	**66.63±14.72**	**69**	
Survival			
Yes	**68.55±14.25**	**67**	**0.01**
No	**84.89±16.1**	**88**	

Table 6: Outcome according to tetralogy of Fallot (FT):

	FT (n, %)		P value
Hospital Stay (days)	**Yes**	**No**	
1-7	**5 (20.8)**	**115 (54.5)**	**0.054**
8-15	**14 (58.3)**	**56 (26.5)**	
>15	**5 (20.8)**	**40 (19)**	
Complications			
Yes	**10 (41.7)**	**48 (22.7)**	**0.246**
No	**14 (58.3)**	**163 (77.3)**	
Survival			
Yes	**19 (79.2)**	**205 (97.2)**	**0.002**
No	**5 (20.8)**	**6 (2.8)**	