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A COMPARATIVE STUDY OF CYANOTIC & ACYANOTIC PATIENT'S OUTCOMES IN A POSTOPERATIVE INTENSIVE CARE UNIT AT AFIC/NIHD

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ABSTRACT

Objective: To compare the outcome of cyanotic and Acyanotic patients undergone congenital cardiac surgery.
Study Design: Descriptive cross sectional study.
Place and Duration of Study: Paeds cardiac surgical intensive care unit of AFIC/NIHD, Rawalpindi, from Jan to Sep 2016.
Methodology: This Retrospective cross sectional study was conducted at AFIC/NIHD, from Jan 2016 to Sep 2016. A total of 431 patients were monitored from the time they entered the Paediatric Cardiology Intensive Care Unit till their final discharge. SPSS version 22 was used for statistical analysis and $p<0.05$ was considered statistically significant.
Results: A total of 431 patients were enrolled in this study, out of which 209 (48.5%) were cyanotics and 222 (51.5%) were acyanotic cases. The complications in cyanotic patients 30 (57.7%) were more as compared to acyanotic cases 22 (42.3%) *p*-value <0.001. Cyanotic CHD had a higher mortality rate than acyanotic lesions ($p<0.04$). Cardiac procedure, mortality, longer mechanical ventilation, ICU stay, rhythm problem, and post op O2 saturation were associated with cyanosis and the differences were highly significant.
Conclusion: In our setting, cyanotic young infants had more complications than acyanotic lesions. Cyanotic patients had longer ICU stay and Prolonged mechanical ventilation and increased risk of mortality.

Keywords: Acyanotic, Congenital heart disease, Cyanotic.

INTRODUCTION

Recent improvements in facilities in paediatric intensive care units (ICUs) have increased the survival rates among children suffering from congenital heart diseases (CHD), including those suffering from the more complex conditions[1]. The patient's course after a successful heart surgery depends on such diverse factors as the severity of the CHD, age and condition of the patient before surgery, events in the operating room, and the quality of postoperative care[2]. Ideal post-operative care following either corrective or palliative operations requires a thorough understanding and systemic evaluation of the underlying anatomic defect, the patho-physiology of pre-operative state, the anesthetic regime used during surgery, the cardiopulmonary bypass (CPB), and the details of operative procedures[3]. The post-operative myocardium that has been exposed to the effects of CPB, aortic cross clamping, deep hypothermia, or myocardial ischaemic damage may be incapable of increasing stroke volume to confront an acute increase in after-load following surgical procedures. This is especially true if myocardial performance is weakened by ventriculotomy as required for repair of a variety of CHDs[3]. Complete correction of the intracardiac defect and adequate intraoperative myocardial protection generally result in good cardiac function after the operation. Children who undergo an uncomplicated cardiac surgery, with good intraoperative care should need little post-operative management for a smooth recovery[4].

In developing countries, several other factors affect the outcome of the paediatric cardiac surgery. Some of these factors depend on

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the condition of the patients or their parents such as, high incidence of malnutrition in children[5,6], financial constraints of the parents, lack of awareness about signs and symptoms of heart disease and late presentation of the cases[5]. There are other factors related to limitations in healthcare facilities of these countries, such as limited human and material resources for

Table-I: Comparison of cyanotic & acyanotic patients.

Variables	Cyanotic (n=209)	Acyanotic (n=222)	*p*-value
Gender			
Male	138 (48.3%)	148 (51.7%)	0.839
Female	71 (49.3%)	73 (50.7%)	
RACHS Category			
class-1	26 (50%)	26 (50%)	
class-2	165 (47.3%)	184 (52.7%)	0.697
class-3	9 (50%)	9 (50%)	
class-4	6 (66.7%)	3 (33.3%)	
Disease			
VSD	76 (52.8%)	68 (47.2%)	
PDA	--	5 (100%)	
PS (Pulmonary Stenosis)	1 (50%)	1 (50%)	
TGA	9 (33.3%)	18 (66.7%)	
TOF	53 (45.3%)	64 (54.7%)	
TAPVR/PAPVR	8 (53.3%)	7 (46.7%)	0.100
COA	5 (56%)	4 (44%)	
AVSD/AVCD/CAVSD/PVSD	13 (59%)	9 (41%)	
ASD	21 (55.3%)	17 (44.7%)	
AR/MR/AVR/MVR	5 (45%)	6 (55%)	
Single ventricle anomaly	10 (45%)	12 (55%)	
Procedure			
CoA	5 (56%)	4 (44%)	
ASD Closure	21 (55%)	17 (45%)	
Arterial switch operation	3 (60%)	2 (40%)	
AVSD repair	8 (72.7%)	3 (27.3%)	
BDG	12 (29.3%)	29 (70.7%)	
Fontan	2 (50%)	2 (50%)	
BT Shunt	10 (41.7%)	14 (58.3%)	
PA Banding	9 (64.3%)	5 (35.7%)	
PDA Closure	--	5 (100%)	0.007
PPM placement	3 (50%)	3 (50%)	
Rastelli	--	1 (100%)	
Senning/mustard procedure	1 (25%)	3 (75%)	
PAPVR/TAPVR	10 (56%)	8 (44%)	
Total correction	15 (22.7%)	51 (77.3%)	
VSD closure	69 (53%)	61 (47%)	
Valve replacement	6 (50%)	6 (50%)	
PA plasty (MPA/RPA/LPA)	--	1 (100%)	
Kawashima	1 (100%)	0	
Type of surgery			
Open	185 (49%)	193 (51%)	0.764
Close	23 (46%)	27 (54%)	
Mortality (13) 3%	10 (77%)	3 (23%)	0.034
Rhythm			
Sinus rhythm	65 (53.7%)	56 (46.3%)	
Sinus Tachy	22 (59.5%)	15 (40.5%)	0.057
Sinus Brady	3 (100%)	--	
Pacing	20 (74%)	7 (26%)	
Irregular rhythm	--	2 (100%)	
Major Complications	30 (57.7%)	22(42.3%)	
CPR	4 (100%)	3 (43%)	
Reopening in OT	1 (100%)	--	<0.001
Bradycardia	3 (100%)	--	
Tachycardia	22 (59.5%)	15 (40.5%)	
Redo surgery	0	4 (100%)	

corrective heart surgery in early neonatal period and young infants, inadequate facilities for paediatric cardiac anesthesia, non-existence of pediatric cardiac surgery anesthesiologist, insufficiently trained staff in pediatric cardiology ICU (PICU), poor health infrastructure and referral systems[7,8]. Pakistan is a developing country with a relatively well-established healthcare system. However, there are still insufficient facilities for corrective cardiac surgery in neonates and specialists for cardiac surgery anesthesia. In review of the literature no local reference was found on the study subject. The current study was undertaken to determine the frequency of complications, the rate of mortality and morbidity of cyanotic/Acyanotic patients and its associated factors in children with CHD who underwent cardiac surgery and were hospitalized in the PICU[9].

METHODOLOGY

The retrospective observational study was conducted at AFIC/NIHD, from Jan 2016 to Sep 2016. A total of 431 patients were monitored from the time they entered the Paediatric Cardiology Intensive Care Unit till their final discharge.

All patients admitted to the paediatric cardiology ward, first undergo a thorough evaluation and upon diagnosis, if required, are referred to the cardiac surgeon. After surgery, they are bought to PICU for post-op management. Upon discharge from the PICU, they return to the paediatric cardiology ward for complete recovery prior to final discharge from the hospital. During the period of this observational study, from Jan 2016 to Sep 2016, 431 patients underwent operation at the department. Patients above 18 year of age were excluded. All the patients undergoing congenital cardiac surgery were included. Each case was enrolled only once. The study was approved by the Ethical Review Board of the institution. All our patients had CHD. All the patients had a complete medical record containing demographic characteristics, past and present medical history, physical examination, diagnostic evaluation, and operation notes. The monitoring devices to be used in the PICU were placed in the operating room, usually with the help of the anaesthesiologist. The PICU care was provided by a team of trained ICU nurses, paediatric cardiologists, anaesthesiologists, cardiac surgeons, and in some cases by necessary paediatric subspecialists. The cardiac surgeons were responsible for the patient's course of care, including interactions with the other services. The post-operative course of each patient from entering the PICU until being discharged from it was carefully monitored and the following data was collected: age, gender, type of cardiac malformation, type of cardiac surgery, history of previous cardiac surgery, if applicable, pump time, cross-clamp time, intubation time, ICU-stay time, type of complication, and outcome.

Categorical data were expressed as frequencies and percentage and tested with chi square test or Fisher's exact test. Quantitative variables were expressed as mean ± standard deviation (SD) and analysed with student's t-tests. T-test and chi-square tests were used to determine the outcome of cyanotic & acynotic patients. The data was analysed using the SPSS version-22, and $p<0.05$ was considered statistically significant.

RESULTS

A total of 431 patients, out of which 209 (48.5%) were cyanotics and 222 (51.5%) were acyanotic cases. Of the 209 cyanotic patients, 138 (66%) were male and 71 (34%) were female. The average age of the patients was 5.38 ± 4.36 years, ranging from few days to 16 years. The median age of the group was 3 years. Acyanotic heart lesions consisted of 14 (6.3%) different types of left-to-right shunts; 6 (2.7%) valvular disease; 4 (1.8%) coarctation of aorta, 5 (2.25%) patent ductus arteriosus (PDA). Cyanotic heart lesions consisted of 53 (25.4%) tetralogy of Fallot; 9 (4.3%) different combinations of transposition of great arteries (TGA); and 76 (36.3%) VSD. Of the total, 378 (88.3%) patients underwent open heart surgery. Most patients (n=427; 99%) experienced

their first cardiac surgery and for 4 (1%) cases, this was their second heart operation. For cyanotic patients aortic cross-clamp time was with a mean of 51.8 ± 44.1 minutes and CPB or pump time was 82.03 ± 42.7 minutes. While in acyanotic patients cross clamp time was 56.02 ± 48.8 minutes and CPB time was 83.7 ± 48.1 minutes. Mean ICU stay time for cyanotics was 4.2 ± 4 days and for acyanotics it was 2.5 ± 2.4 days.

Most of the patients had a smooth and uncomplicated course in ICU and were discharged from the PICU and subsequently from the hospital, while 52 (12%) experienced some kind of complication. Of the 52 complicated cases, 13 (3%) died, and the remaining 418 (97%) cases recovered and were discharged from PICU and the hospital. The complications in cyanotic patients 30 (57.7%) were more as compared to acyanotic cases 22(42.3%) *p*-value=0.001. Cyanotic CHD had a higher mortality rate than acyanotic lesions (*p*=0.04). As mentioned in table- I & II cardiac procedure, mortality, longer mechanical ventilation, ICU stay, rhythm problem, and post op O2 saturation were associated with cyanosis and the differences were significant (*p*=0.007, *p*=0.03, *p*=0.004, *p*=0.04, *p*=0.05, *p*=0.009) respectively.

DISCUSSION

Cyanotic heart diseases are usually complex lesions which require difficult surgical techniques and longer operation time for correction. The technique difficulty, the case complexity, and the surgery duration have been reported to be associated with higher mortality and morbidity in previous reports[1,10-13]. In the present study, mortality was higher in cyanotic patients than acyanotic and it was a significant finding. According to a study mortality in neonatal period is higher than that in infancy and childhood, while in another study the number of cyanotic CHD were about half of the acyanotic lesions, but mortality in cyanotic patients was significantly more than that of acyanotic cases[9]. In our study critically ill cyanotic children suffering from complex heart lesions usually had more complications (*p*=0.001). Congenital heart disease patients usually suffer from severe metabolic acidosis and tissue hypoxaemia which predispose them to complications and death. The standard management for such patients is quick and safe transfer to a well-equipped, specialised ward and effective treatment by corrective surgeries[2]. The majority of our cyanotic newborns and young infants suffered from various combinations of TGA. We did not find significant differences

Table-II: Comparison of cyanotic & acyanotic patients with Mean ± SD.

Variables	Presence of Cyanosis	Mean	Std. Deviation	*p*-value
Age in Months	Acyanotic	76.50	75.412	0.108
	Cyanotic	64.64	76.369	
Height in Centimeters	Acyanotic	100.84	32.927	0.223
	Cyanotic	97.00	32.220	
Weight in Kilograms	Acyanotic	18.15	15.544	0.407
	Cyanotic	16.89	16.199	
CPB Time in minutes	Acyanotic	83.70	48.072	0.811
	Cyanotic	82.03	42.7	
X-Clamp time in minutes	Acyanotic	56.20	48.842	0.365
	Cyanotic	51.81	44.115	
Total ICU stay in days	Acyanotic	2.5	2.4	0.042
	Cyanotic	4.2	4.0	
Total ventilation time in hours	Acyanotic	18.51	31.192	0.004
	Cyanotic	35.81	79.905	
O2 Saturation % (0-6 hrs)	Acyanotic	67.19	27.791	0.009
	Cyanotic	111.56	136.537	

between open and closed heart surgeries, while there was a significant difference between simple and complex procedures. Higher mortality and morbidity such as central nervous system (CNS) problems in redo operation were reported in previous studies[1,14]. Our findings suggests a significant difference between outcome of first operation, and of second (redo) operation. Intraoperative support techniques, including CPB, can precipitate a complex systemic inflammatory response that impairs the function of multiple organs and results in more haemodynamic instability and early morbidity in newborns, more so than in infants and children[15]. In several previous reports, prolonged CPB and aortic cross clamp times were cited as risk factors for major postoperative complications and increased mortality[1,10,16]. In this study, no significant relation was found with cross clamp time and CPB time. Longer mechanical ventilation is usually associated with longer ICU stay and both are associated with higher mortality[17]. A study showed that the longer intubation time and shorter ICU stay were associated with higher mortality. While in another study 10 of the 25 deaths occurred in young infants with complex cyanotic heart lesion who were in shock and/or were intubated before operation. They died due to low cardiac output state within the first several hours after surgery. Their short ICU stay was due to their poor condition in the early postoperative period[19,20]. The complication rate in our patients was 12% (52), and 13 of the 52 complications resulted in death (p<0.001). The overall mortality rate was 3% (13). In large pediatric cardiac centers of North America, post-operative mortality after complete repair of CHD in neonates was <5%[15]. One study looked at 184 consecutive CHD patients with a median age of 9 months (range, 10-165 months); 11 (5.9%) patients who required reintubation died[18]. In another study, 200 newborns younger than 45 days underwent cardiac surgery requiring CPB. The whole series mortality was 19% and fell to 14% within 5 years of experience[19]. In other study, the major complications which resulted in death were in young cyanotic infants with complex heart lesions who were affected by cardiovascular or CNS problems. Patients with CNS problem had longer duration of mechanical ventilation and ICU stay. The frequency of vaso-occlusive stroke in children with CHD undergoing cardiac surgery is reported to vary from 0.5 to 10% in different studies[14,20,21]. Hypoperfusion, long CPB, redo operation, complex anomaly, and metabolic acidosis were reported as risk factors for stroke. The same risk factors have been reported for fatal arrhythmias after CHD surgery[22,23]. We had arrhythmias in our study group (p<0.05). We did not find a significant difference between open and closed heart surgery. However, complications in complex procedures were significantly higher. This study was conducted in a single tertiary cardiac surgery unit with limited number of cases. A multi-central study, with a larger cohort of patients is recommended.

CONCLUSION

In our setting, cyanotic young infants had more complications than acyanotic lesions. Cyanotic patients had longer ICU stay and Prolonged mechanical ventilation and increased risk of mortality.

CONFLICT OF INTEREST

This study has no conflict of interest to declare by any author.

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