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Mortality of Critical Congenital Heart Disease in the Neonatal Intensive Care Unit at Benghazi Pediatric Hospital

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Abstract **Original Research Article**

Background: The neonatal period, which encompasses the 1st twenty-eight days of life for an infant, is a period of extreme vulnerability during which newborns might develop specific serious problems that result in mortality. ***Aim:*** To assess the clinical characteristics of neonates with critical congenital heart disease (CHD) who have been admitted to neonatal care unit. ***Patients and Methods:*** This was a retrospective investigation carried out on 44 newborns hospitalized in the neonatal intensive care unit (NICU) of the hospital of children in Benghazi for two years. ***Results:*** 25% of patients had cyanosis, 18.2% had respiratory distress, 18.2% had circulatory collapse, 6.8% had heart failure, and 31.8% had cyanosis + RD. The mean PO_2 of the studied group was 80.02±11. 44. 27.3% of patients had PO_2 below 75%, 43.2% had PO_2 75-85%, 20.5% of patients had PO2 85-94, and 9.1% had PO2 more than 95%. 95.5% of patients had normal syndrome, and 4.5% had another syndrome. 4.5% of patients had associated congenital anomalies. 36.4% of patients had prostaglandin infusion; the mortality rate of studied group was 11.4%. ***Conclusion:*** Critical congenital heart disease (CCHD) is a major reason for newborn death, often due to transposition of the great arteries. Neonatologists and pediatric cardiologists play a crucial role in understanding and managing these defects, emphasizing the importance of prenatal diagnosis and follow-up. Screening newborns for CCHD using PO2 and prompt referral to specialized centers can improve patient outcomes.

Keywords: Mortality, CCHD, NICU.

INTRODUCTION

The neonatal period, which encompasses the 1st twenty-eight days of life for an infant, is a period of extreme vulnerability during which newborns might develop specific serious problems that result in mortality [1].

The death of newborns is most prevalent within the 1st twenty-four hours of life and constitutes roughly sixty-five percent of the deaths of infants. Neonatal death rate is the number of newborns who die before the age of twenty-eight days, expressed as a percentage of 1,000 live births in a given year [2, 3].

According to a report by the World Health Organization (WHO), the death rate for newborns has declined from thirty-six deaths per 1,000 live births in 1990 to nineteen cases per 1,000 live births in 2015. This suggests that the rate has reduced by forty to forty-seven percent through these years [4].

The occurrence of severe CHD needing expert cardiologic care ranges from 2.5 to 3 per 1000. 1 It is assumed that up to 25% of congenital heart disease, whether or not it includes extracardiac anomalies, has a genetic etiology that is identifiable, such as copy number variation, 2-7 chromosomal, 8, 9, or a single gene. 8 It is estimated that isolated, nonsyndromic congenital heart disease accounts for seventy percent of total congenital heart disease and is classified as multifactorial in the absence of a definite genetic cause [5].

Critical congenital heart defects are severe malformations that continue to be a major reason for newbom morbidity and death. Critical congenital heart defects might appear as cyanosis, respiratory distress, or shock, which might be comparable to those of other

newborn conditions. It is possible for acute cardiovascular collapse and mortality to occur as a consequence of failing to diagnose these conditions promptly following birth. Routine pulse oximetry screening is effective at identifying infants with critical congenital heart defects and other hypoxemic illnesses, which might otherwise be life-threatening [6].

The goal of this investigation was to evaluate the clinical characteristics of newborns with CCHD who have been admitted to the neonatal care unit.

PATIENT AND METHOD

This were a retrospective investigation conducted on 44 newborns hospitalized in NICU of the children's hospital in Benghazi for two years.

Inclusion Criteria: Neonates admitted with critical congenital heart diseases.

Exclusion Criteria: Any patient with simple congenital heart diseases, e.g. (A.S.D, V.S.D), acquired heart diseases, e.g., viral myocarditis, or age older than 28 days.

Method

All patients were subjected to the following: Collecting data: We reviewed medical records for each case and documented postnatal, prenatal, and intervention-related parameters that have been plausibly related to results of interest. Prior delivery and following delivery factors included a number of indicators indicating a nonreassuring fetal state before birth. These indicators included oligohydramnios, polyhydramnios, hydrops fetalis, and nonreassuring antepartum fetal testing. These indicators were included in the variables discussed. We determined whether or not the cases of CHD had been detected through pregnancy. The gender, one-minute and five-minute Apgar scores, weight birth, and whether or not the weight of birth was tiny for the age of gestation (measured as z-score-2) were all items that were documented for each individual case. All of the following have been documented: the occurrence of major noncardiac structural abnormalities (such as duodenal atresia or tracheoesophageal fistula), chromosomal anomalies, respiratory distress syndrome (RDS; identified by the requirement for surfactant), the utilization of prostaglandin-E1 (PGE) prior to intervention, and the requirement for mechanical ventilation or inotropic support prior to intervention. The data that was gathered concerning the intervention included the period of time that cardiopulmonary bypass was performed, as well as whether or not each individual patient underwent transcatheter or cardiac intervention. The primary cardiac intervention has been recognized as the decisive procedure that has been designed to make it possible for the case to be discharged from the hospital. Additionally, the cardiac intervention has been classified as either curative (for example, arterial switch operation for transposition of the great arteries) or palliative (for example, pulmonary artery ligation in the event of a ventricular septal defect [VSD] that has been diagnosed). We documented the age of the case at the time of the initial intervention, as well as the corrected gestational age. A Risk Adjustment in Congenital Heart Surgery (RACHS)-1 category (7) has been assigned to each individual instance. The Risk Adjustment in Congenital Heart Surgery-1 technique is a validated risk adjustment technique that arranges cardiac operative procedures with comparable expected in-hospital deaths into six predefined risk groups. Category 1 has a minimal probability of death (e.g., secundum atrial septal defect closure), while category six has the greatest probability of mortalities (e.g., stage 1 Norwood operation). The RACHS-1 system has been improved in order to incorporate two additional case categories. The first category is for cases that have undergone 1ry transcatheter intervention, and the second category is for surgical cases that were unable to be assigned an established Risk Adjustment in Congenital Heart Surgery -1 category. Take, for example, a hybrid procedure for hypoplastic left heart syndrome that consists of ductus arteriosus stenting, bilateral pulmonary artery banding, and a heart transplant. The 1ry finding parameter was the in-hospital death rate for cases who underwent cardiac intervention. Morbid events, including cardiopulmonary resuscitation (CPR; defined as the requirement of chest compressions), extracorporeal membrane oxygenation (ECMO), radiographically recorded central nervous system (CNS) injury (grade II or elevated ischemic stroke, periventricular hemorrhagic infarction or intraventricular hemorrhage), necrotizing enterocolitis (NEC; identified by the occurrence of pneumatosis or free air on abdominal radiograph), and unplanned reoperation or interventional cardiac catheterization for one or more residual anatomic lesions through the same hospitalization. It has been established a composite morbidity results variable for cases who survived and encountered one or more of the following five severe events: unplanned cardiac reintervention, CPR, ECMO, CNS injury, or NEC.

Statistical Analysis

The outcomes of the investigation were statistically analyzed using the social science software package version 17 (SPSS). Data has been collected, analyzed, and expressed as frequency distributions. Subsequently, percentages were calculated and presented in accompanying tables and figures. Ratio, mean, standard deviation, minimum, and maximum have been performed as basic descriptive statistical parameters. Category variables were subjected to a chi-square test to determine whether or not they were associated. Statistical significance has been presumed in all statistical analyses when the P-value was less than 0.05.

RESULTS

Table 1: Distribution of patient characteristic data in the group under investigation

		Studied group, N= 44	
		Mean	**±SD**
Age		9.18	±9.354
		N	**%**
Age	< 3 days	19	43.2%
	3D-7D	8	18.2%
	7-14D	6	13.6%
	14-30D	11	25%
sex	Male	29	65.9%
	Female	15	34.1%
Address	Benghazi	23	52.3%
	Eastern Region	7	15.9%
	Western Region	11	25%
	Southern Region	3	6.8%
GA	Preterm	2	4.5%
	Term	42	95.5%

±SD: standard deviation, GA: gestational age

Mean age of group under investigation was 9.18±9.354 days, 43.2% of patients below 3 days, 18.2% of patients ranged from 3 to 7 days, 13.6% of patients ranged from 7 to 14 days, 25% of patients ranged from 14 to 30 days, 65.9% of patients were males, 34.1% of patients were females, 52.3% of patients from Benghazi, 15.9% of patients from Eastern Region, 25% of patients from Western Region, 6.8% of patients from Southern Region, 4.5% of patients were born at preterm, and. 95.5% of patients were born at term (Table 1).

Table 2: Distribution of presentation in the studied group

		Studied group, N= 44	
		N	**%**
Presentation	Cyanosis	11	25%
	RD	8	18.2%
	Circulatory collapse	8	18.2%
	HF	3	6.8%
	Cyanosis +RD	14	31.8%

RD: respiratory distress, HF: heart failure.

25% of patients had cyanosis, 18.2% had respiratory distress, 18.2% had circulatory collapse, 6.8% had heart failure, and 31.8% had cyanosis + RD (Table 2).

Table 3: Distribution of Partial pressure of oxygen (PO_2) in the studied group

		Studied group, N= 44	
		Mean	**±SD**
PO_2		80.02	11.44
		N	**%**
PO_2	<75%	12	27.3%
	>75-85%	19	43.2%
	>85-94	9	20.5%
	>95%	4	9.1%

The mean PO_2 of the studied group was 80.02±11. 44. 27.3% of patients had PO_2 below 75%, 43.2% had PO_2 75-85%, 20.5% of patients had PO2 85-94, and 9.1% had PO2 more than 95% (Table 3).

Table 4: Distribution of patient Syndrome in the studied group

	Studied group, N= 44	
	N	**%**
Normal	42	95.5%
Other syndrome	2	4.5%

This table shows that, 95.5% of patients had normal syndrome, and 4.5% had other syndrome. (Table 4)

Table 5: Distribution of associated congenital anomalies and prostaglandin in the studied group

	Studied group, N= 44	
	N	%
Associated congenital anomalies	2	4.5%
Prostaglandin infusion	16	36.4%

This table shows that, 4.5% of patients had associated congenital anomalies. 36.4% of patients had prostaglandin infusion (Table 5).

Table 6: Distribution of mortality in the studied group

		Studied group, N= 44	
		N	%
Mortality	Alive	29	88.6%
	Died	5	11.4%

This table shows that; mortality rate of studied group was 11.4% (Table 6).

DISCUSSION

Congenital heart disease has been a crucial cause in the western globe's newborn death rate for the past two decades. Critical congenital heart disease might led to quick newborn deterioration and mortality if not observed and managed in a timely manner, despite the fact that the traditional contributors to the death of neonates, like birth asphyxia and infections, have decreased in prevalence in the majority of our country due to the enhancement of basic newborn medical care [8].

The main results of our study were as follows:

In our investigation, we detected that mean age of studied group under investigation was 9.18±9.354 days, 43.2% of patients below 3 days, 18.2% of patients ranged from 3 to 7 days, 13.6% of patients ranged from 7 to 14 days, 25% of patients ranged from 14 to 30 days, 65.9% of patients were males, 34.1% of patients were females, 52.3% of patients from Benghazi, 15.9% of patients from Eastern Region, 25% of patients from Western Region, 6.8% of patients from Southern Region, 4.5% of patients were born preterm, and. 95.5% of patients were born at term. Similarly to our results, MIR *et al*., [9] aimed to record the most prevalent presenting symptoms and signs in newborns with congenital heart disease, as well as their final diagnosis and result. They stated that nearly half of cases presented in the fourth week (forty-four percent), followed by those in the third week (twenty-six percent), second week (17.5 percent), and first week (twelve percent). Men comprised 52.9 percent of the cases, while women comprised 47.06 percent.

In addition, our findings are in accordance with the outcome of Gong *et al*., [10] who discovered that the average weight of birth was 3.2±0.7 kilograms, the average gestational duration was 37.7±1.6 weeks, and the mean age was 14.8±7.2 days.

In addition, I concurred with Abou-Taleb *et al*., [11] who wanted to investigate the clinical profile of critical congenital heart disease and the therapeutic methods that are now accessible. A study conducted on 50 neonates who have been diagnosed as having CCHD demonstrated that 78% of them were men and 22% were females; the mean age of presentation was 11.78 ± 9.4 days.

Regarding the distribution of presentation in the studied group, we reported that 25% of patients had cyanosis, 18.2% had respiratory distress, 18.2% had circulatory collapse, 6.8% had heart failure, and 31.8% had cyanosis + RD.

In accordance with our findings, MIR *et al*., [9] discovered that the most prevalent cardinal complaint was hurried respiration (43.46 percent), followed by feeding problems (20.7 percent), cyanosis (17.2 percent), shock (a reduced urinary output in 8.1 percent), rapid breathing, and cyanosis in twenty-three cases (4.3 percent). Thirty-two cases (6.02 percent) were asymptomatic, with the presence of a murmur being detected clinically.

According to the distribution of partial pressure of oxygen (PO2) in the studied group, we demonstrated that mean PO2 of studied group was 80.02 ± 11.44. 27.3% of patients had PO2 below 75%, 43.2% had PO2 75-85%, 20.5% of patients had PO2 85-94, and 9.1% had PO2 more than 95%.

In accordance with our outcomes, Taksande *et al*., [12] who aimed to find the precision of pulse oximetry for identifying clinically unrecognized critical congenital heart disease in the neonates, revealed that from 2110 neonates there were eight neonates with SpO2 lower than ninety percent, 102 newborns with SpO2

between ninety and ninety-five percent, and 2000 newborns with SpO2 greater than ninety-five percent.

Regarding the distribution of patient syndrome in the studied group, our results showed that 95.5% of patients had normal syndrome and 4.5% had other syndrome and revealed that 4.5% of patients had associated congenital anomalies. 36.4% of patients had prostaglandin infusion.

According to Dawson *et al*., [13] who wanted to determine whether maternal/household and a baby characteristic have been related to late CCHD detection, they reported that in infants with timely identified CCHD, 7.1% of cases had hypoplastic left heart syndrome, and in babies with late identified critical congenital heart disease, three percent of kids had hypoplastic left heart syndrome. This finding is in accordance with the findings that we obtained.

According to the distribution of mortality in the studied group, we found that the mortality rate of the studied group was 11.4%.

According to Alharam *et al*., [4], who conducted research at Benghazi Pediatric Hospital with the purpose of determining the main reasons for newborn deaths among neonates, they discovered that the death rate of the group that was analyzed was 7.5 percent. This conclusion is in accordance with our results.

CONCLUSION

We concluded from our study that critical congenital heart disease is a leading reason of death in newborns. Our patients exhibited transposition of the great arteries, the most frequent type of CCHD. Neonatologists and pediatric cardiologists are essential in understanding and managing these defects, emphasizing the importance of adequate prenatal diagnosis and follow-up. Utilizing PO2 to screen every newborn for CCHD is crucial. Prompt detection and referral to specialized pediatric cardiology centers for appropriate treatment can significantly improve patient outcomes.

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