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Research Article

Outcome and Prevalence of Congenital Heart Diseases in Neonates at a Tertiary Hospital in the State of Santa Catarina

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Abstract

Objective: The present study aims to analyze the conduct and outcome of patients diagnosed with congenital heart disease (CHD) referred by the neonatology service of a tertiary hospital in the State of Santa Catarina.

Study design: This research is characterized by being a cross-sectional epidemiological design. To this end, we used the records of newborns admitted to the Neonatal Intermediate Care Unit, Neonatal Intensive Care Unit and the Delivery Room of the hospital service who had suspected CHD by transthoracic echocardiogram within 60 days after birth, in the period of June from 2017 to June 2022. During data collection, several variables were analyzed, including pregnancy, the characteristics of the newborn, and the relationship between the two in the outcome of the CHD condition.

Results: In the studied region, it was detected that 8 out of every 1,000 natives were diagnosed with CHD. Among newborns with CHD, it was found that 67.2% were born preterm, and 93% of pregnant women underwent prenatal care, with the number of consultations considered adequate in 58.6%. Furthermore, 59.4% of unborn children were classified as low weight. Clinical treatment occurred in 69.5% of cases, referral to a reference unit in 19.5% of patients and 10.9% of infants died.

Conclusion: Finally, it is important to highlight that knowledge of the prevalence of CHD is essential to establish appropriate conduct and management techniques for newborns (NB) with CHD, aiming to provide better care for these patients from the beginning.

INTRODUCTION

Congenital heart disease (CHD) can be defined as any malformation in the structure or function of the heart that occurs between the first 08 weeks of gestation. The prevalence of congenital heart diseases ranges from 6 to 13 in every 1,000 newborns [1].

Approximately 1% of newborns have some type of CHD and in 10% of live births diagnosed with CHD it evolves to death. Of newborns diagnosed with CHD, approximately ¼ need correction by surgery or a procedure with a catheter in the first year of life. Being some types of CHD, patent foramen ovale, patent ductus arteriosus, interatrial communication, interventricular communication, total atrioventricular septal defect, complex congenital heart disease [2].

Therefore, this article seeks to elucidate the outcome and prevalence of CHD in neonates at a tertiary hospital in Santa Catarina.

The general objective was to analyze the data collected regarding the clinical outcome of patients diagnosed with CHD.

In delimiting the theme, the following problem arises: the influence of personal conditions and the method of approach on the outcome of the treatment of congenital heart diseases in neonates at a tertiary hospital in Santa Catarina.

To solve the problem, the following hypothesis is proposed:

a) it is assumed that the patient's personal conditions, mainly the gestational age on the date of delivery and the performance of examinations and medical consultations during pregnancy, directly influence the method of approach used by the physician in charge, and, therefore, the outcome of congenital heart diseases.

The analysis of CHD was chosen in view of the scarcity of data on the development of the disease, in view of personal conditions and the approach method in the outcome of the treatment of CHD in newborns of a tertiary hospital in Santa Catarina.

METHODS

This research is characterized by being a cross-sectional epidemiological design, based on the medical records of a tertiary hospital in the Alto Vale do Itajaí Region in the State of Santa Catarina, Brazil. The research was approved by the Ethics Committee and Research in Human Beings of the University Center for the Development of Alto Vale do Itajaí (UNIDAVI), under opinion number 5,826,097.

For this purpose, the records of newborns admitted to the Neonatal Intermediate Care Unit (NICU), Pediatric / Neonatal Intensive Care Unit and the Emergency Room of the hospital service who had suspected CHD by transthoracic echocardiogram within 60 days after birth were used, in the interim from June 2017 to June 2022.

The population was initially 130 neonates, however, given the lack of information about the criteria analyzed, two medical records were eliminated, and the study was carried out on 128 patients.

For data collection, a research instrument was developed, in which the following variables were weighed: sex, gestational age at birth, classification of gestational age, age of the newborn when the transthoracic echocardiogram was performed, whether the pregnant woman had prenatal care, number of prenatal consultations performed, whether or not the number of prenatal consultations performed was adequate, whether a morphological examination was performed, whether a fetal echocardiogram was performed, type of delivery, Apgar score of the NB at birth (first and fifth minute of life), birth weight, weight classification, whether there was a need for resuscitation in the delivery room, postpartum referral, whether the NB received oxygen during hospitalization, type of ventilation, whether prostaglandins were used during hospitalization, whether there was use of vasoactive drug during hospitalization, days of hospitalization, outcome of the case, types of CHD, number of complications, characteristic of CHD.

Statistical Analysis

Inferential data analysis was performed using the IBM *Statistical Package for the Social Sciences* (SPSS) software, version 26.0. Descriptive analysis was performed, presenting discrete and continuous quantitative variables as mean ± standard deviation (SD), or median and interquartile range (IQR). Qualitative variables were presented by absolute number (n) and percentage (%).

RESULTS

A total of 128 patients with a diagnosis of CHD in the aforementioned period, after excluding the normal functional echocardiographic records unrelated to CH and born outside the studied hospital, took part in this study.

Regarding the gestational clinical-epidemiological profile brought in table 01, about the registered cases, it was verified that the patients were born with an average of 234 days (± 30.9). Regarding the classification of gestational age, the present study found a preponderance of preterm births, occurring in 86 (67.2%) of the cases, followed by full-term births in 33 (25.8%) of the patients and post -term in only 1 (0.8%) of the pregnancies, it is also verified that the identification was occluded in 8 (6.3%) of the medical records

As for prenatal care, it was inferred that 119 (93%) of the pregnant women underwent follow-up, 4 (3.1%) did not perform follow-up, and 5 (3.9%) of the cases were not identified in relation to carrying out or not of prenatal care. In addition, the number of consultations performed on average was 7.22 (± 3.5), with the number of consultations adequate in 75 (58.6%), not adequate in 52 (40.6%) and, not identified in 1 (0.8%) of the patients (Table 1).

Regarding the morphological examination, this was performed in 114 (89.1%), not performed in 10 (7.8%) and not identified in 4 (3.1%) of the pregnancies, in relation to the fetal echocardiogram this was not performed in most NBs, which are 101 (78.9%) of the cases, being performed in only 23 (18%) of the patients, and not identified in 4 (3.1%) of the medical records (Table 1).

Table 1: Gestational clinical-epidemiological profile

Gestational Profile Variables	Mean ± SD or n (%) (n=130) or median
Gestational Age on Delivery Date (days)	
Average	234 ± 30.9
Gestational Age Classification	
pre-term	86 (67.2)
In right time	33 (25.8)
post-term	1 (0.8)
Not identified	8 (6.3)
Prenatal	
Yes	119 (93)
No	4 (3.1)
Not identified	5 (3.9)
Number of Consultations	
Average	7.22 ± 3.5
Appropriate Number of Consultations	
Yes	75 (58.6)
No	52 (40.6)
Not identified	1 (0.8)
Morphological examination performed	
Yes	114 (89.1)
No	10 (7.8)
Not identified	4 (3.1)
Whether a Fetal Echocardiogram was performed	
Yes	23 (18)
No	101 (78.9)
Not identified	4 (3.1)
Type of Delivery	
Normal	43 (33.6)
Cesarean section	80 (62.5)
Not identified	5 (3.9)

Caption: n = sample size; N = population size. Data are expressed: absolute frequency (n) and percentage (%). Statistical Method Employed: Descriptive analysis of frequencies.

In the type of delivery, it was normal in 43 (33.6), cesarean in 80 (62.5%), and unidentified in 5 (3.9) of the pregnant women (Table 1).

About the data discussed in table 2, it was verified in relation to the clinical-epidemiological profile of newborns with diagnosed CHD, that 73 (57%) of the patients were male and 55 (43%) were female. Also, patients in this research had an average weight of 2189 grams (± 1057) at birth, and a median of 1910 grams, being classified as low weight in 76 (59.4%) of the neonates, normal in 41 (32%) of the infants, macrosomic in 6 (4.7%) of the patients, and unidentified in 5 (3.9%) of the NB.

Regarding age when the echocardiogram was requested, the median was 5 days (Table 2). The Apgar scale in the 1st minute of life of the newborns obtained an average of 6.48 (± 2.18), and in the 5th minute of life, the average was 7.91 (± 1.53), in addition, in 114 (89.1%) of the patients, resuscitation in the delivery room was not necessary, with resuscitation occurring only in 14 (10.9%) (Table 2).

After birth, none of the newborns was sent to the room, 30 (23.4%) were transferred to the Neonatal Intermediate Care Unit and 98 (76.6%) to the neonatal ICU (Table 2).

During hospitalization, 25 (19.5%) of the neonates did not need oxygen therapy, and 103 (80.5%) of the patients received oxygen therapy, of which 90 (70.3%) of the cases used invasive ventilation and 38 (29.7%) of the live births underwent non-invasive ventilation (Table 2).

With regard to the use of prostaglandin, this was introduced in 8 (6.3%) of the cases, not being applied in 120 (93.8%) NB, as for vasoactive drugs, these were used in 46 (35.9%) %) of neonates and were not used in 82 (64.1%) of live births (Table 2).

As for the days of hospitalization of the NBs, the median obtained in the analyzed cases was 21. As for the outcome, this was predominantly clinical treatment, which occurred in 89 (69.5%) cases, referral to the reference unit in 25 (19 .5%) patients, and 14 (10.9%) of the infants died (Table 2).

With regard to the types and characteristics of diagnosed CHD, shown in Table 3, there was a prevalence of acyanogenic CHD in 119 (93%) of the cases, which were described as ventricular septal defect 3 (2,3); interatrial communication 30 (23.4); patent ductus arteriosus 30 (23.4); patent foramen ovale 29 (22.7); and cyanogenic in only 9 (7%) of the patients, which were identified as Tetralogy of Fallot 0 (0); Transposition of the Great Arteries 0 (0); Tricuspid atresia 0 (0) and Atrioventricular septal defects 1 (0.8) and complex congenital heart disease 2 (1.6) .

Furthermore, it was observed that 95 (74.2%) of the patients had 1 complication, 29 (22.7%) of the cases had 2 complications, and 4 (3.1%) of the neonates had 3 complications (Table 3).

DISCUSSION

The prevalence of CHD in the South American continent is approximately 6 to 12 in every 1,000 NB, according to information published in the study *Global birth prevalence of congenital heart defects 1970–2017: updated systematic review and meta-analysis of 260 studies* by Yingjuan Liu et al., released by the *International Journal of Epidemiology.*

The region included by the present study detected that 8 out of 1,000 NBs were diagnosed with CHD, thus approximately 1%, in a sample of 128 live births from June 2017 to June 2022.

According to information from the DATASUS system, in the

Table 2: Clinical-epidemiological profile of newborns with diagnosed CHD.

Profile of newborns Variables	Mean ± SD or n (%) (n=130)
Age when the echocardiogram is requested (days)	
median	5
Sex	
Masculine	73 (57)
Feminine	55 (43)
Birth weight (grams)	
Average	2189 ± 1057
median	1910
Weight Classification	
Low weight	76 (59.4)
Normal	41 (32)
macrosomic	6 (4.7)
Not identified	5 (3.9)
Apgar 1st minute of life	
Average	6.48 ± 2.18
Apgar 5th minute of life	
Average	7.91 ± 1.53
Need for Resuscitation in the Delivery Room	
Yes	14 (10.9)
No	114 (89.1)
Referral to	
Room	0
NICU	30 (23.4)
neonatal ICU	98 (76.6)
Oxygen Therapy	
Yes	103 (80.5)
No	25 (19.5)
Type of Ventilation	
invasive	90 (70.3)
non-invasive	38 (29.7)
Use of Prostaglandin	
Yes	8 (6.3)
No	120 (93.8)
Use of Vasoactive Drugs	
Yes	46 (35.9)
No	82 (64.1)
Days of Hospitalization	
median	21
Outcome	
clinical treatment	89 (69.5)
Referral to reference unit	25 (19.5)
Death	14 (10.9)

Caption: n: sample size; N: population size. NICU: Neonatal Intermediate Care Unit. ICU: Intensive Care Unit. Data are expressed: absolute frequency (n) and percentage (%). **Statistical Method Employed:** Descriptive analysis of frequencies.

Table 3: Types and characteristics of diagnosed congenital heart diseases

Types and characteristics of CHD Variables	Mean ± SD or n (%) (n=130)
Types of CHD	
CIA	30 (23.4)
PCA	30 (23.4)
CIV	3 (2.3)
FOP	29 (22.7)
DSAV	1 (0.8)
CHDC	2 (1.6)
Other Presentations	33 (25.8)
Number of Complications	
1 complication	95 (74.2)
2 complications	29 (22.7)
3 complications	4 (3.1)
CHD feature	
Acyanogenic	119 (93)
cyanogenic	9 (7)

Caption: n: sample size; N: population size. FOP: Patent Foramen Ovale; PDA: Ductal Arterial Persistence; ASD: Interatrial Communication; IVC: Interventricular Communication; Total AVSD: Total Atrioventricular Septal Defect; CHDC: Complex congenital heart disease. Data are expressed: absolute frequency (n) and percentage (%). **Statistical Method Employed:** Descriptive analysis of frequencies.

aforementioned period, 15,831 newborns were born in the microregion of Rio do Sul [3].

Therefore, it was found that the prevalence of CHD found in the present study validates the data presented in several articles published worldwide. Bearing in mind that research on large population-based data has found similar incidences of CHD in NBs, despite the lack of precision in the diagnosis of CHD in live births, which occurs in view of the different variables in each type of CHD, the late diagnosis or absent, as well as, due to the lack of adequate referencing.

The analysis of the gestational profile presented reveals important information about the pregnant women included in the research. So, the mean gestational age on the date of delivery was 234 days, with a standard deviation of 30.9 days, and this information correlated with the classification and data below prematurity.

The gestational age of the pregnancies in the study was predominantly below 37 weeks, being considered preterm, it is important to emphasize that premature babies face a series of challenges in the transition from intrauterine to extrauterine life, in terms of physiological adaptation after birth, these may consist of respiratory, hemodynamic, metabolic, neurological problems, as well as infections and difficulties in adapting to life outside the womb [4]

From the data collected, we observed that most pregnant women received prenatal care, 3.1% did not, and in relation to 3.9% of cases, it was not possible to identify whether prenatal care was carried out or not.

The mean number of consultations during prenatal care was 7.22, with a standard deviation of 3.5, indicating variability in the number of consultations. In addition, regarding the adequacy of the number of consultations, most pregnant women performed a number considered appropriate, while, however, a significant portion (40.6%) did not reach this recommendation, in addition, 0.8% of cases do not have information about the appropriateness of queries.

The lack of prenatal diagnosis can significantly affect the postnatal course, with potential economic and public health consequences. Likewise, the quality of prenatal care, when performed, is a critical determinant of the detection of CHD by routine ultrasound, so that education programs for greater engagement in carrying out prenatal consultations with more detailed examinations and Fetal echocardiography would increase the prenatal detection of CHD, thus generating a better postnatal preparation [5,6].

Regarding the morphological examination, this was performed by most patients (89.1%), and in (11.9%) it was not complied with. In view of this, the postnatal course of babies with critical CHD can be negatively impacted if the diagnosis is delayed due to the non-performance of the test.

Therefore, there is evidence to support the fact that prenatal diagnosis enables better perioperative results after birth, so that the medical team can be prepared for possible complications associated with CHD, namely, heart failure, heart infections, arrhythmias, pulmonary hypertension, poor growth and development, and pulmonary complications. Treatment involves a multidisciplinary approach such as medication, surgery and regular medical follow-up [7].

On the other hand, only 18% of the patients underwent fetal echocardiography. To improve the accuracy of prenatal diagnosis, it is essential to perform fetal echocardiography when there is suspicion of CHD during pregnancy, thus ensuring the necessary family counseling regarding prognosis and appropriate prenatal planning [8,9].

As for the type of delivery, it was observed that the majority (62.5%) was performed by cesarean section, while 33.6% occurred by normal delivery. Vaginal delivery is safe in patients with CHD of all severities, and a higher cesarean rate does not translate into better outcomes. On the other hand, the literature suggests that a higher incidence of cesarean section is indeed associated with an overall increased risk of adverse outcomes, including mortality for the mother [10].

Starting from the relation to the newborn itself and its clinical aspects, shown in Table 2, it was verified, regarding the age when the echocardiogram was requested, the median of 5 days, allowing an early post-term detection and a diagnosis accurate, as soon as there were clinical parameters for the hypothesis of CHD.

Regarding sex, the newborns were mostly male, while the smallest portion (43%) were female. This statistic is slightly discrepant in relation to the sexual epidemiology of the prevalence of CHD worldwide and in South America, since in both the ratio is 1 to 1.

Birth weight was an important aspect to be considered, with an average of 2189 grams, so that most newborns were classified with low birth weight (59.4%), highlighting the importance of specialized care in these cases, only 32% were at normal weight at birth. In addition, some neonates were identified as macrosomic (4.7%), indicating a condition in which the baby is overweight.

At this point, it is urged to point out that low birth weight newborns with CHD have a higher risk of mortality than babies with CHD who are not low birth weight, since the increased risk is multifactorial, being related to the underlying etiology of CHD and technical issues related to the absolute size of the newborn, which may be correlated with the genetics of the parents [11].

The management of high-risk patients must consider the pathophysiology of CHD, the pathophysiology attributable to prematurity, intrauterine growth restriction, anomalies or associated syndromes, such as the absolute size of the newborn. It is still evident that even without CHD, premature or small-for-gestational-age (SGA) babies have higher morbidity and mortality than those born at term [11].

The Apgar score, which is an indicator of neonatal health, revealed an average of 6.48 in the first minute of life, and an average of 7.91 in the fifth minute. These numbers help in evaluating the initial adaptation of the neonate after birth. The 5-minute Apgar score, and particularly whether the score changes between 1 minute and 5 minutes, is a useful index of response to resuscitation. However, the Apgar score alone cannot be considered as evidence or consequence of asphyxia, and is not predictive of individual mortality or adverse neurological outcome [12].

The need for resuscitation in the delivery room was observed in 10.9% of cases, evidencing the importance of emergency measures in these crucial moments. Regarding referral, 23.4% were directed to the Neonatal Intensive Care Unit (NICU), while 76.6% went to the neonatal ICU, where they could receive specialized care.

With regard to oxygen therapy, it was necessary for 80.5% of the neonates, highlighting the importance of adequate respiratory support. Among the oxygen ventilation methods used, 70.3% received invasive ventilation, while 29.7% received non-invasive ventilation. At this point, it is important to emphasize that the administration of oxygen in infants with CHD must be personalized and carefully monitored, considering the specific nature of the cardiac condition and the individual respiratory needs of the neonate [13,14]. There are different methods for performing oxygen therapy, which vary according to the clinical condition and the severity of the heart disease, and the available options consist of the administration of supplemental oxygen through nasal cannulas, the use of non-invasive ventilation, or, in more severe cases, mechanical ventilation [15].

With regard to the use of prostaglandin, this was identified in only 6.3% of cases, indicating less use of this type of intervention. Prostaglandin is used in neonates with CHD to keep open the patent ductus arteriosus (PAD), a structure that connects the aorta and pulmonary artery before birth [15]. In addition, administration of synthetic prostaglandin, commonly intravenously, helps keep the DAP open, allowing blood to flow properly. Occurring in this way, the improvement of oxygenation and blood flow in the newborn with CHD, until additional procedures can be carried out, such as corrective cardiac surgery [16].

Regarding the days of hospitalization of the NB, the median obtained from the analyzed medical records was 21. The median of days of hospitalization in the patients can vary significantly, depending on the type and severity of the heart disease, in addition to other individual factors [17].

With regard to outcomes, most cases (69.5%) were clinically treated, demonstrating the effectiveness of non-invasive treatment. Furthermore, 19.5% of infants were referred to a reference unit, where they could receive specialized care. Unfortunately, 10.9% of cases resulted in death, emphasizing the complexity and severity of this condition.

The outcome of CHD varies widely, depending on the specific type of heart disease, the severity of the heart defect, timing of diagnosis, and access to specialized medical care. Clinical treatment, referral for cardiac surgery and risk of death are also influenced by these factors [18,19].

Certain CHDs can be very complex, thus presenting a significant risk of death, especially in cases of complex or severe heart defects. The prevalence of death in newborns with CHD ranges from 3% to 9% worldwide [20].

The most common types of CHD found in the present research were the Interauricular Communication (CIA) and the Patent Arterial Canal (PDA), both present in 23.4% of the cases. Furthermore, Patent Foramen Ovale (PFO) was found in 22.7% of cases, while other presentations of CHD were observed in 25.8% of cases.

It is also important to emphasize that Interventricular Communication (IVC) occurred in only 2.3% of cases and other types of CHD, such as Atrioventricular Septal Defect (AVSD) and Complex Congenital Heart Disease (CCHD) were less frequent, present in less than 3% of the cases.

CHDs are classified as acyanogenic or cyanogenic. When analyzing the characteristics of the CHD, it was observed that most of them were acyanogenic (93%), and the cyanogenic CHD were less common, present in only 7% of the cases. In a worldwide context, it is estimated that acyanogenic heart diseases represent about 70-80% of CHD cases, while cyanogenic heart diseases correspond to approximately 20-30% [21].

Acyanogenic heart diseases are characterized by an adequate blood flow of oxygen to the body. Cyanogenic heart diseases are characterized by an abnormal blood flow that allows mixing of oxygenated and deoxygenated blood [22].

Regarding the result of the number of complications

associated with CHD, it was observed that most cases (74.2%) had only one complication, 22.7% of patients had two complications, and 3.1% of the medical records had three complications.

Finally, the presence of complications in a significant number of patients highlights the need for multidisciplinary monitoring and treatment for these neonates, and it is also correlated that the greater the number of complications associated with CHD, the greater the evolution to death.

FINAL CONSIDERATIONS

Given the above, regarding infant mortality caused by congenital malformations, it was found that CHD are considered the most predominant cause. Early diagnosis of cardiac anomalies is essential to improve the outcome of CHD. The availability of prenatal exams that can detect these malformations early is crucial to refer complex CHD cases to specialized services, which have better technical conditions to perform cardiac corrections and act quickly.

In conclusion, as the understanding of the pathophysiology and treatment of diseases associated with CHD advances, several studies and guidelines are published. This is extremely relevant, as such data are essential to inform policy makers' priorities. Knowledge of the prevalence of CHD is essential to establish appropriate conduct and management of newborns with CHD, aiming at better care for these patients.

Therefore, it was possible to verify that the hypothesis was confirmed, since the pregnant women who performed the prenatal care properly, as well as the requested exams and medical recommendations, were already aware of the conditions of the unborn child, a fact that also benefits the tertiary health sector, given that it receives prior information collected by the primary health sector, thus enabling the preparation for carrying out a delivery with specific conditions of CHD.

In addition, statistics highlight the importance of a multidisciplinary and specialized approach in the care of newborns with CHD, considering that early diagnosis, monitoring and access to appropriate treatments are essential to improve outcomes and ensure the best possible quality of life for the infants.

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