Characteristics of Congenital Heart of Premature Newborns

Características das Cardiopatias Congênitas de Recém-Nascidos Prematuros

Giuliana de Souza Sena*; Sabrinne Suelen Santos Sampaio; Vanessa Braga Torres; Ingrid Guerra Azevedo; Nivia Maria Rodrigues Arrais; Ingrid Fonseca Damasceno Bezerra; Silvana Alves Pereira

*Federal University of Rio Grande do Norte, School of Health Sciences of Trairi, Stricto Sensu Graduate Program in Physiotherapy, RN, Brazil.
†Maternidade Escola Januário Cicco, RN, Brazil.
‡University Hospital Ana Bezerra, RN, Brazil.
§Federal University of Rio Grande do Norte, School of Health Sciences of Trairi, Stricto Sensu Graduate Program in Rehabilitation Sciences and Collective Health, RN, Brazil.
*E-mail: giulianasena.29@hotmail.com
Recebido em: 19/02/19
Aprovado em: 05/08/19

1 Introduction

Congenital heart disease - CHD is considered the most common malformation found in neonatology. At birth, these infants have structural or functional abnormalities in the heart, which can lead to complications in the neonatal period. These defects may decrease and increase the pulmonary flow and depend on the severity result in death, raising the rate of infant mortality, and making the disease an important public health problem.

Its prevalence continues to increase in the population and is one of the main causes of neonatal morbidity. It is estimated that about 0.9% of live births are affected by some cardiopathy, and 20% to 30% occurs due to serious structural changes. However, when considering the early and late fetal losses, the value of the incidence increases. It is known that one third of deaths that occur between the twentieth week of pregnancy and the first year of life are due to a heart problem.

It is believed that half of the CHD is presented in a benign form, which can be treated by available therapeutic and outpatient follow-up, and the other 50% manifest in such a severe way, requiring more time consuming and complex treatment, and may evolve to severe sequelae and death.
Early diagnosis of this category of diseases is increasing, even in preterm infants. This becomes even more worrying due to the risks caused by the immaturity of these babies.

The fact that several CHD evolve with cardiac insufficiency, early diagnosis is an important instrument for better clinical evolution and preventing further aggravation of these children. The preventive measures are directed to an outlined profile, however there are few studies that present a profile of CHD in premature newborns. For that reason, the aim of this study was to characterize the CHD of premature newborns (PN) in the Neonatal Intensive Care Unit (NICU) of a high-risk maternity unit.

2 Material and Methods

This was an observational retrospective, descriptive character study carried out in the NICU of a maternity school, reference in high-risk gestation in the state of Rio Grande do Norte, composed of 23 beds. All preterm infants admitted to NICU and who presented some alteration in the echocardiogram were included. Those who presented as cardiac alteration abnormality the patent foramen ovale (PFO), those who closed in the neonatal period and the in PN which had no cardiac abnormality, isolated pulmonary hypertension, heart valves without repercussion and those with persistent ductus arteriosus (PDA) by use of prostaglandin were excluded.

The research was carried out in the period from December 2016 to December 2017, through the Management Application for University Hospitals (AGHU), which corresponds to the system of maternity where the records of hospitalization of all patients are located from their entry until their leaving. A single researcher examined all the 371 records of PN.

Initially the search was performed to identify those premature babies who presented some alteration in the echocardiogram, from then on, the researcher collected the data, the cardiac diagnosis, neonatal complications associated with heart disease, days of hospitalization, need for mechanical ventilation, quantity of planned and accidental extubation failure of extubation, days on oxygen therapy, need for sedation and vasoactive drugs, use of prostaglandin, use of ibuprofen, surgical indication and the outcome (discharge, transfer to another service or death).

The data analysis was performed using the Statistic Package for Social Sciences (SPSS), version 20.0. Descriptive evaluated variables were presented through measures of central tendency (median) and their measure of dispersion (quartile) and by means of relative and absolute frequencies. The Mann-Whitney test was used for comparison among the groups (p<0.05).

The study was submitted to the Committee for Ethics in Research in accordance with the notes of the Resolution nº 466/2012 of the National Health Council, receiving approval with the favorable opinion number 1.707.627. Anonymity and confidentiality were maintained, as well as all the ethical issues during the course of the research.

3 Results and Discussion

Of the 371 PNs admitted to NICU, 87 were premature infants who presented some cardiac findings on the echocardiogram and 58 comprised the sample. Figure 1 shows the flowchart.

![Flowchart of the sample](Image)

### Table 1 - Characterization of newborn infants during hospitalization

| Variables                  | PDA (n=38) | PN (n=20) | p   |
|---------------------------|------------|-----------|-----|
| Mother’s Age (years)      | Median     | Quartile  | Median | Quartile | 0.93 |
| IG (Weeks)                | 25         | 21-32     | 25    | 21-30     | 0.93 |
| Birth weight (g)          | 1,075      | 908.2-1,452.5 | 1,370 | 1,008-1,744 | 0.08 |
| Apgar score at 1st minute | 6          | 4-9       | 7     | 4-8       | 0.89 |
| Apgar score at 5th minute | 8          | 7-9       | 8     | 7-9       | 0.99 |
| Days of hospitalization   | 44         | 21-62     | 38    | 22-61     | 0.79 |
| Physiotherapy             | 35         | 16-79     | 37    | 11-66     | 0.45 |
| Days of oxygen            | 21         | 9-50      | 17    | 5-32      | 0.16 |

PDA: Persistence of the ductus arteriosus; CHD: congenital heart defects; IG: Gestational age. *The number of times that the patient underwent physiotherapy during hospitalization.
Maternal characteristics of the sample.

Of the 20 PNs in group CHD, 14 (70%) had some CHD of low pulmonary flow. The most common diagnosis was pulmonary stenosis n=12 (60%). Table 2 presents the distribution of these heart diseases from the variation of pulmonary flow.

Table 2 - Description of heart diseases of group CHD from the variation of the pulmonary flow

| Diagnosis                          | n  | %  |
|-----------------------------------|----|----|
| Low pulmonary flow                |    |    |
| Pulmonary stenosis                | 12 | 60%|
| TGA                               | 1  | 5% |
| Double outlet right ventricle     | 1  | 5% |
| Total                             | 14 | 70%|
| High pulmonary flow               |    |    |
| CIA                               | 3  | 15%|
| CIV                               | 3  | 15%|
| Total                             | 6  | 30%|

TGA Transposition of the great arteries; RV: Right ventricle; CIA: Atrial Septal Defect, CIV: Ventricular Septal Defect

Source: Research Data.

Just a baby of the group with CHD presented dependent cardiopathy of ductus arteriosus, requiring the use of prostaglandin, and 3 (15%) underwent surgical indication. All the three PNs with surgical indication presented low pulmonary flow. In the PDA, 25 did not use pharmacological or surgical measure for closure of the ductus, 12 made use of ibuprofen, and only a baby received surgical indication.

In our sample, among the 38 patients diagnosed with PDA, 12 required the use of ibuprofen for closure of the channel, and only a baby received surgical indication.

Maternal characteristics of complications of the sample are described in Table 3.

Table 3 - Maternal characteristics of the sample.

| Variables             | PDA (n=38) | PN (n=20) |
|-----------------------|------------|-----------|
| Type of delivery      |            |           |
| Vaginal               | 18         | 7         | 47.4%  | 35%  |
| Caesarian             | 18         | 11        | 47.4%  | 55%  |
| Not informed          | 2          | 2         | 5.3%   | 10%  |
| Complications in pregnancy |      |           |
| Yes                   | 20         | 10        | 52.6%  | 50%  |
| No                    | 18         | 10        | 47.4%  | 50%  |
| DHEG/HAS              |            |           |
| Yes                   | 7          | 5         | 18.4%  | 25%  |
| No                    | 31         | 15        | 81.6%  | 75%  |
| DM                    |            |           |
| Yes                   | 2          | 2         | 5.3%   | 10%  |
| No                    | 36         | 18        | 94.7%  | 90%  |
| ITU                   |            |           |
| Yes                   | 13         | 6         | 34.2%  | 30%  |
| No                    | 25         | 14        | 65.8%  | 70%  |

PDA: Persistence of the ductus arteriosus; CHD: congenital heart defects; DHEG Specific hypertensive disease of pregnancy; DM: Diabetes mellitus; ITU: Urinary tract infection

Source: Research Data.

The main indication for NICU of the two groups was the presence of respiratory distress, in 16 infants (42.1%) of the group with PDA and 12 (60%) of the group of other CHDs. Almost the whole, 55 (86.2%), required some ventilatory support, and of these, 36 presented the PDA and 14 of the group CHD presented low pulmonary flow.

The majority of the sample, 48 (82.7%) used invasive mechanical ventilation (IMV) as ventilatory support, 32 of the group with PDA and 16 of the group with CHD; 11 with low pulmonary flow and 5 high flow.

Among the PSs who used VMI, 14 (29.1%) had at least one of extubation failure during the hospitalization period, the majority (n=9) was the group with PDA. On the remainder (n=5) belonging to the group with the other PDA, 3 had low pulmonary flow and 2 high flow.

As associated complications, 8 (13.7%) showed atelectasis in some period of hospitalization, and only 2 were from group CC, and both had high pulmonary flow. The six patients (10.3%) who presented pulmonary hypertension were from group PDA.

In relation to the outcome of the sample, 38 (65.5%) were discharged from the hospital. The majority (n=25) belonged to the group PDA, of the 13 of the group CHD 9 had low pulmonary flow and 4 high flow. On transfers, 4 PNs (5.8%) were transferred to another institution, 2 were from group PDA and 2 from Group CHD. Sixteen subjects (27.5%) died, the majority (n=11) of the group with PDA. And only 1 baby of the group CHD that presented a high pulmonary flow.

The data of this research show that 5.3% of 371 infants admitted to NICU were identified as premature infants with some cardiac malformation, being the most frequent PDA. And in the group of other CHDs, the pulmonary stenosis was the most found heart disease.

The description of CHD in preterm infants is still something little explored in the literature. Pérez et al.9, upon assessing the main causes of admission of 472 preterm infants in NICU, saw that 2.3% of the babies were referred with the diagnosis of CHD, in spite of not informing what is the most frequent heart disease.

The high prevalence of PDA was something expected in the case of a study with preterm infants. Other studies13,14 had already demonstrated that PDA is a common finding in newborns with less than 28 weeks.

Santos et al.15, in a study with 168 infants diagnosed with CHD met in a high-risk maternity, identified that 44.64% presented PDA. Among these, 112 were premature, being 64 with gestational age less than 30 weeks. Rivera et al.16 also showed a high incidence, 36% of PDA. Both studies justify their findings considering the prematurity of the sample.

The ductus arteriosus is a fetal communication that regularly closes at birth, in preterm infants, and with the increase in pulmonary resistance this channel remains patent, increasing the comorbidities during hospitalization17. In our sample, among the 38 patients diagnosed with PDA, 12 required the use of ibuprofen for closure of the channel,

Source: Research Data.

J Health Sci 2019;21(3):193-197

Sena GS, Sampaio SSS, Torres VB, Azevedo IG, Arrais NMR, Damasceno Bezerra IFD et al.
and only 1 had surgical indication. The 25 remaining cases underwent conservative treatment with indomethacin, because they had none or mild repercussion. Ibuprofen is a therapeutic alternative for the closure of PDA\textsuperscript{18,19}. In several controlled and randomized clinical trials, ibuprofen was as effective as indomethacin in the promotion of the closing of the canal, and had less effect on mesenteric, renal and cerebral perfusions\textsuperscript{20,21}.

In the group of other CHDs, those of low pulmonary flow were the most common, which may have contributed to a better prognosis for these babies, since the majority of the PNs of Group CHD who were discharged from the hospital (n=9) presented low pulmonary flow. It is known that the pulmonary hyperflow often causes respiratory dysfunction in children with heart disease\textsuperscript{19} and this fact is even more worrying in newborn infants, due to pulmonary immaturity alone already generate serious consequences to the patient, which associated with pulmonary hyperflow may worsen the population in question\textsuperscript{20}.

Unlike our study, some studies show the IVC as the most frequent malformation\textsuperscript{21}. Aragon et al.\textsuperscript{21}, upon examining the profile of 300 patients with heart disease, identified 63 diagnosed with IVC. However, the sample was composed by children of various ages, when almost half of the studied sample (n=141) corresponded to infants, which differs from our study, that was carried out with newborn infants.

Cristovam et al.\textsuperscript{22} considered the heart murmur as the major cause of referral of these PNs to NICUS. However, this finding was present in less than half (25.8\%) of our sample, and it was the presence of respiratory distress the main indication for the babies’ hospitalization. The pulmonary immaturity of this population hinders the gas exchange and makes the dyspnea the main sign in newborn infants after birth, which may justify our results\textsuperscript{20}. Almost half of our sample needed the use of vasoactive drugs and the vast majority required the use of a ventilatory support, moreover, they had a prolonged hospitalization with excessive time in therapy.

Oxygen is the most commonly used therapy in neonatal care units as an integral part of the respiratory support\textsuperscript{23}. Its goal is to achieve adequate oxygenation to the tissue without creating toxicity to the PN. However, recent studies have demonstrated that the oxygen supply has been greater than the need of the PN, and its deleterious effects has contributed to the maintenance of the subject inside the hospital\textsuperscript{24}.

The most common pulmonary complication found in our study was atelectasis, with 4 cases in patients of group PDA and 4 in the group with the other CHD. These numbers were not highly discrepant from other studies\textsuperscript{25}. In the study by Oliveira et al.\textsuperscript{26} about the profile of children with heart disease undergoing surgery, 53\% of the evaluated patients presented some postoperative complication, and the most frequent was the pleural effusion (8 cases), followed by atelectasis (6 cases).

Regarding the risk factors for the development of CHD, some authors show that infectious diseases during pregnancy may be related with cardiac abnormalities in the fetus\textsuperscript{4,5}. Araújo and collaborators\textsuperscript{14} (2014) when registering the CHD in the state of Paraíba, saw that almost 50\% of the sample were born to pregnant women who presented some acute disease during pregnancy.

Pinto et al.\textsuperscript{27} upon assessing the maternal risk factors associated with CHDs saw that 58\% of the expectant mothers had some systemic disease prior to pregnancy, being ITU the most prevalent, with 52\% of the cases. This percentage was followed by diabetes and/or hypertension, with 10\% of the cases\textsuperscript{27}. These findings corroborate with our research, when approximately 50\% of mothers had some complications during pregnancy, and ITU as the most frequent in both groups, both in the PDA and CHD. According to the Ministry of Health\textsuperscript{28}, ITU is the most common urinary problem of gestation and is associated with premature rupture of membranes, triggering a premature birth, which could justify the prematurity of our newborns.

Studies show that the prematurity and birth weight seem to influence the mortality rate of children with heart disease\textsuperscript{21-29}. Curzon et al.\textsuperscript{29} compared groups of children with birth weights above and below 2500g and verified that the group of lower weight showed significantly greater difference in mortality. Andrews et al.\textsuperscript{30} reported a rate of 72\% death rate in premature children with CHD upon evaluating the pregnancy and the evolution of babies. As our sample was composed by preterm infants, this fact may have influenced the mortality rate found, which was 27.5\%.

The largest part of the NICU prematures studied in this research corresponded to babies born by cesarean, diagnosed with PDA or with some other CHD with decreased pulmonary blood flow. This research was carried out at the maternity unit reference in high-risk pregnancies in the state of Rio Grande do Norte. In recent years, there have been changes in the team and the infrastructure of the sector, and today the unit benefits from the team of pediatric cardiology and a greater number of beds, which contributed to the georeferencing of cardiac PNs. However, this contribution is recent, and the organization of medical records is still incipient. In this way, it is intended to follow with the continuation of this study so that we can get even more relevant data on diseases in the population of preterm infants.

4 Conclusion

PDA and the pulmonary stenosis were the most common cardiological findings among the studied preterm infants. The heart disease of low pulmonary flow was diagnosed in its majority in preterm infants who needed some ventilatory support but had as outcome the hospital discharge.

References

1. Liang Q, Gong W, Zheng D, Zhong R, Wen Y, Wang X. The influence of maternal exposure history to virus and medicine during pregnancy on congenital heart defects of
16. Rivera IR, Du Silva MA, Fernandes JM, Thomaz AC, Soriano CF, De Souza MG. Cardiopatia congênita no recém-nascido: da solicitação do pediatra à avaliação do cardiologista. Arq Bras Cardiol 2007;89(1):6-10. doi: 10.1590/S0066-782X2007001300002

17. Yang EM, Song ES, Choi YY. Comparison of oral ibuprofen and intravenous indomethacin for the treatment of patent ductus arteriosus in extremely low birth weight infants. J Pediatr 2013;89:33-9. doi: j.jpedp.2012.08.003

18. Aranda JV, Thomas R. Systematic review: intravenous ibuprofen in preterm newborns. Semin Perinatol 2006;30:114-20.15. doi: 10.1053/j.semperi.2006.04.003

19. Gimenez S, Teixeira ML, Miyashiro R, Carmona MJC, Auler JJ, Malbouisson LMS. Avaliação pulmonar em crianças portadoras de cardiopatia congênita acianótica e hiperfluxo pulmonar através de tomografia computadorizada. Rev Bras Anestesiol 2009;59(5):545-57. doi: 10.1590/S0034-70942009000500003

20. Lanza FC, Barcellos PG, Corso S. Benefícios do decúbito ventral associado ao CPAP em recém-nascidos prematuros. Fisioter Pesq 2012;19(2):135-40. doi: 10.1590/S1809-29502012000200008.

21. Aragão JA, Mendonça MP, Silva MS, Moreira NA, Aragão ME, Reis FP. O perfil epidemiológico dos pacientes com cardiopatias congênitas submetidos à cirurgia no Hospital do Coração. Rev Bras Cienc Saúde 2013;17(3):263-8. doi: 10.4034/RBCS.2013.17.03.08

22. Cristovam MAS, Pavesi J, Bresolin AC, Câmara JPP, Plewka ACL, Seki HS, et al. Prevalência de desordens cardiológicas em uma UTI Neonatal. Rev Med Res 2013;15(4):272-82.

23. Tin W, Gupta S. Optimum oxygen therapy in preterm babies. Arch Dis Child Fetal Neonatal 2007;92:143-7. doi: 10.1136/adc.2005.092726

24. Sweet DG, Carnielli V, Greisen G, Hallman M, Ozek E, Plavka R, et al. European consensus guidelines on the management of respiratory distress syndrome - 2016 update. Neonatology 2017;111(2):107-25. doi:10.1159/000448985

25. Gomes PJ, Leina Z, Augusto B, Demarchi A, Oliveira CV, Fernando CL et al. Tumores cardíacos em crianças: análise retrospectiva. Arq Bras Cardiol 2013;100(2):120-6. doi: 10.5935/abc.20130024

26. Oliveira PMN, De Held PA, Grandal RA, Ribeiro MA, Bobbio TG, Schivinski CI. Perfil das crianças submetidas à correção de cardiopatia congênita e análise das complicações respiratórias. Rev Paul Pediatr 2012;30(1):116-21.

27. Pinto CP, Westphal F, Abrahão AR. Fatores de riscos materno associados à cardiopatia congênita. J Health Sci Inst 2018;36(1):34-08

28. Brasil. Ministério da Saúde. Secretaria de Atenção à Saúde. Departamento de Ações Programáticas Estratégicas. Gestação de alto risco: manual técnico. Brasília: MS; 2010.

29. Curzon CL, Milford-belands S, Li JS, O’brien SM, Jacobs JP, Welke KF, et al. Cardiac surgery in infants with low birth weight is associated with increased mortality: analysis of the Society of Thoracic Surgeons Congenital Heart Database. J Thorac Cardiovasc Surg 2008;135(3):546-51. doi:10.1016/j.jtcvs.2007.09.068.

30. Andrews RE, Simpson JM,Sharland GK, Sullivan ID, Yates RW. Outcome after preterm delivery of infants antenatally diagnosed with congenital heart disease. J Pediatr 2006;148(2):213-6. doi: 10.1016/j.jpeds.2005.10.034

J Health Sci 2019;21(3):193-197