

Epidemiological, Clinical and Echocardiographic Profiles of Premature Newborns with Congenital Heart Disease at the Mother and Child Center of the Chantal Biya Foundation in Yaoundé

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Abstract

Objective: To describe the hospital prevalence, clinical signs and echocardiographic characteristics of congenital heart disease in premature newborns. **Methods:** We conducted a cross-sectional study with prospective collection from November 2023 to June 2024 on any preterm newborn whose gestational age was between 28 weeks and 36 weeks + 6 days. **Results:** A total of 6 cases of congenital heart disease were found out of 31 patients collected. The hospital prevalence of congenital heart disease in premature infants was 19.3%. Persistent ductus arteriosus (66.67%) and ventricular septal defect (33.33%) were the 2 main signs of congenital heart disease. No cyanogenic congenital heart disease was found. **Conclusion:** A more comprehensive analysis of prematurity, including congenital heart disease screening, could inform clinical practice and improve outcomes in preterm infants to reduce neonatal mortality in a context of resource-limited country.

Keywords

Congenital Heart Disease, Premature Baby, Cameroon

1. Introduction

According to the World Health Organization, prematurity refers to any live fetus

born after 22 weeks and before 37 weeks of gestational age. It is the leading cause of death among newborns [1]. During the period of embryonic and/or fetal development, various factors can lead to premature delivery and organ malformation [1]. The heart, responsible for the supply of oxygenated blood essential for the development and proper functioning of all tissues, is the preferred site of such congenital malformations.

Congenital heart disease (CHD) refers to structural and/or functional abnormalities of the heart and large vessels secondary to imperfect organogenesis [1]. They are the most common congenital malformations worldwide, with a prevalence of 8/1000 live births [1]. The association of these 2 entities aggravates mortality and morbidity in such newborns [2]. Not only do they face the challenges of immature lungs, brain and other organs, but they also have to undergo treatment for heart disease [2]. Two-dimensional echocardiography with pulsed Doppler and color Doppler represents the complementary investigation of choice in the diagnosis of these conditions [3]. Knowing that CHD remains a worrying problem in Cameroon [4] [5], particularly in terms of early detection and surgical treatment, a more comprehensive analysis of prematurity and congenital heart disease could inform clinical practice and ultimately improve outcomes in premature infants with heart disease. The main objective of this study was to determine the prevalence, clinical signs and echocardiographic features of CHD in newborn premature infants at Mother and Child Center of the Chantal Biya Foundation in Yaoundé.

2. Method

This was a cross-sectional analytical study in the neonatology department of Mother and Child Center of the Chantal Biya Foundation, Yaoundé. It lasted 8 months, from November 2023 to June 2024. This department only receives premature newborns, and has a capacity of 4 cradles, 11 incubators, 1 phototherapy tunnel and 2 radiators. Patients stay in hospital for relatively long periods; most of them are admitted at a low birth weight and are discharged weighing between 2 kg and 2.5 kg. This results in low patient turnover.

All neonates whose gestational age was between 28 and 36 weeks of amenorrhea (WA), and whose parents had given consent to their enrolment in our study, were included. Patients who were clinically unstable or who had died before cardiac ultrasound was performed were excluded. Sampling was consecutive and exhaustive.

Written informed consent has been obtained from the parents, and the confidentiality of the results has been ensured. Each newborn underwent a complete clinical examination (history + physical examination) before transthoracic cardiac echocardiography in TM and Doppler mode was performed at the patient's bedside by a Pediatric Cardiologist. The results of the examination were recorded on our previously tested and anonymous data collection form.

Variables to determine the epidemiological profile: gestational age, birth weight,

sex of the newborn, maternal age, consanguinity between parents, presence of a pathology during pregnancy, family history of congenital heart disease, alcohol and/or tobacco consumption during pregnancy.

Variables to determine the clinical profile: heart rate, respiratory rate, arterial oxygen saturation, weight, and heart murmur.

Echocardiographic variables: presence or absence of congenital heart disease, type of heart disease and hemodynamic complications, if any. Given that PDA is a common transitional finding in preterm infants, we considered it to be cardiopathy if it was found beyond 21 days of postnatal age.

Using SPSS version 26.0, Microsoft Word and Excel, qualitative variables were expressed as numbers and percentages, and quantitative variables as mean and interquartile range. The degree of association between the variables studied and the occurrence of congenital heart disease and preterm birth was expressed as an odds ratio with its 95% confidence interval. A P value of less than 5% was considered significant.

3. Results

During this study, 44 newborn premature babies were admitted to neonatology department A. Of these, 13 did not benefit from a cardiac ultrasound scan because they died within hours of admission or were discharged against medical advice before we had seen them. Finally, 31 newborn premature babies were included in our study. Of these, 6 patients presented with congenital heart disease, giving us a hospital prevalence of 19.3%.

We had 16 male and 15 female premature babies. The mean birth weight was 1865.7 ± 86.4 g with extremes of 920 g and 2700 g. The age groups of the mothers most represented were 20 - 25 years (9/31) and 30 - 35 years (9/31). Smoking was not mentioned by any of the mothers and 1 of them replied that she had regularly consumed alcohol during her pregnancy. Malaria was the main pathology during pregnancy with a frequency of 46.7%, followed by urinary tract infection 22.5% and genital infection 19.4%.

The most common functional sign was respiratory distress in 11 newborn premature babies. The mean pulse oxygen saturation was $93\% \pm 11\%$ with extremes of 35% and 99% in room air. There were no heart rate abnormalities in premature babies with CHD. The heart diseases found were mainly patent ductus arteriosus (PDA) in 4 patients and ventricular septal defect (VSD) in 2 patients. No non-cyanogenic CHD was found.

CHD were more frequently found in premature infants with a gestational age < 32 WA (2/6). Concerning the distribution of CHD according to maternal parity, it appears that pauciparous women had more often given birth to newborns with CHD; in the group of mothers with parity 3 or 4, ventricular septal defect (1/6) was the most frequent CHD (see **Table 1**). No maternal or neonatal factors were statistically associated with the occurrence of CHD (see **Table 2**), probably due to the small sample size linked to a low patient turnover.

Table 1. Clinical and echocardiographic characteristics of patients with congenital heart disease.

| Variables | Patients with CHD | | | | | |
|-----------------------------------|-------------------|-----|------|------|------|------|
| | 1 | 2 | 3 | 4 | 5 | 6 |
| Sex | M | F | M | M | F | M |
| Gestational age (WA) | 35 | 30 | 35 | 36 | 30 | 35 |
| Birth weight (grams) | 1810 | 920 | 1900 | 1930 | 1500 | 2300 |
| Oxygen saturation (%) in room air | 97 | 96 | 95 | 94 | 98 | 97 |
| Maternal age (years) | 21 | 29 | 24 | 31 | 30 | 32 |
| Heart rate (beats/minute) | 135 | 122 | 130 | 124 | 120 | 140 |
| Type of heart disease | PDA | PDA | VSD | PDA | PDA | VSD |
| Mother's parity | 1 | 1 | 2 | 4 | 2 | 2 |

CHD: Congenital heart disease; WA: Week of amenorrhoea; PDA: Patent ductus arteriosus; VSD: Ventricular septal defect.

Table 2. Maternal and newborn factors associated with the occurrence of congenital heart disease in premature infants.

| Variables | Congenital heart disease | | p-value | OR (IC 95%) |
|----------------------------------------------|--------------------------|-----------|---------|---------------------|
| | Yes (%) | No (%) | | |
| Maternal age | | | | |
| <35 years | 5 (17.9) | 23 (82.1) | 0.488 | 0.43 (0.03 - 5.78) |
| ≥35 years | 1 (33.3) | 2 (66.7) | | |
| Primiparity | | | | |
| Yes | 2 (9.5) | 19 (90.5) | 0.666 | 0.50 (0.08 - 3.06) |
| No | 4 (17.4) | 19 (50.0) | | |
| Urogenital infection during pregnancy | | | | |
| Yes | 2 (28.6) | 5 (71.4) | 0.596 | 2.00 (0.28 - 5.09) |
| No | 4 (16.7) | 20 (83.3) | | |
| Malaria during pregnancy | | | | |
| Yes | 3 (21.4) | 11 (78.6) | 1.000 | 0.72 (0.10 - 5.09) |
| No | 3 (17.6) | 14 (82.4) | | |
| Newborn gender | | | | |
| Male | 4 (25.0) | 12 (75.0) | 0.654 | 2.17 (0.33 - 14.06) |
| Female | 2 (13.3) | 13 (86.7) | | |
| Gestational age | | | | |
| <34 WA | 2 (14.3) | 12 (85.7) | 0.664 | 0.54 (0.08 - 3.51) |
| ≥34 WA | 4 (23.5) | 13 (76.5) | | |

WA: Week of amenorrhoea.

4. Discussion

We found a hospital frequency of 19.3%, which is close to that of Laas *et al.*, in France in 2012, who found a hospital frequency of 15% [6]. But it is far from that of Aly *et al.* in 2024 in the USA, who found a hospital frequency of 1.5%. This

figure can be explained by the fact that the sample sizes in these studies are very different; in the Aly *et al.* study, the sample size was 27,710 congenital heart defects for 1,798,245 preterm births [7], whereas in our study, we had 6 heart defects for 31 preterm births.

Respiratory distress (66.67%) was the main functional sign suggestive of CHD in preterm neonates. This finding differs from that of Ndongo Amougou *et al.* in 2022, who found heart murmur (97.1%) and hypotrophy as the main signs [3]. This could be explained by the fact that, according to Richmond *et al.* [8], the telltale signs of congenital heart disease change with age. In the study by Ndongo Amougou *et al.*, the most representative age groups were 1 to 5 months and 6 to 24 months, whereas in our study, patients were mainly in the neonatal period [3]. Also, heart murmurs in neonates with PDA or VSD can be absent or difficult to detect, particularly when pulmonary hypertension is present, because the increased pressure in the pulmonary arteries can equalize or even reverse the blood flow through the defect. This can lead to a reduction or disappearance of the turbulence that causes the murmur or alter the characteristics of the murmur [1].

The gestational age at which the most heart disease was found was AG > 34 WA; these figures differ from those of Norman *et al.* in 2020 [9] and Aly *et al.* [7] in the USA, who found respectively 27.8 WA and a gestational age range of 25 - 28 WA. In fact, these 2 studies were mainly based on extreme preterm infants, *i.e.*, those born before 28 WA.

The most common CHD in our study population was PDA and ventricular septal defect. This is in line with the literature, in which the most frequent CHD is ventricular septal defect, and in premature infants, delayed closure of the ductus arteriosus is a well-known entity [10]. The absence of cyanogenic CHD in our study population could be explained by the small size of our study population, but also by the fact that prematurity associated with cyanogenic CC would severely impair adaptation to life outside the uterus. Hence, the greater likelihood of these children dying in the first few hours of life, before we were able to perform a transthoracic cardiac ultrasound [11].

5. Conclusion

The frequency of CHD in premature infants is high in our study population. This underlines the importance of systematic echocardiographic screening and multidisciplinary management to improve clinical outcomes. Respiratory distress was the predominant clinical sign. Patent ductus arteriosus remains one of the major cardiopathies of the premature newborn. Due to the low patient turnover, the study was underpowered to detect statistically significant associations with the occurrence of CHD in preterm infants.

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Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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