American Journal of Clinical Cardiology

Research Article

Prevalence of Congenital Heart Disease at Live Birth in Hainan, China

Dufei Zhang[1], Renwei Chen[2], Zelai Mo[3], Ling Yang[4], Yazhou Wang[1] and Haifan Wang[2]*

[1]*Department of Cardiovascular Surgery, Hainan Women and Children's Medical Center, China*

[2]*Department of Cardiothoracic Surgery, Hainan Women and Children's Medical Center, China*

[3]*Department of Ultrasound, Hainan Women and Children's Medical Center, China*

[4]*Department of Neonatal Care, Hainan Women and Children's Medical Center, China*

Abstract

Objective: A multicenter, multiple-ethnic, cross-sectional screening study was performed to investigate the prevalence and risk factors of congenital heart disease (CHD) in Hainan, China.

Methods: This study enrolled 117005 consecutive neonates born at delivery institutions of 17 urban and rural regions in Hainan from January 1,2020 to December 31, 2020. Cases of CHD were identified by pulse oximetry (POX) combined with auscultation screening, echocardiography, and follow-up.

Results: A total of 572 newborns (50.7% males) were diagnosed with CHD, providing an overall CHD prevalence of 4.89 per 1000 live births in Hainan (nonsignificant, 2.13; significant, 2.25; serious, 0.28; critical,0.23). The most common congenital heart lesion was atrial septal defect (ASD), at a prevalence of 1.889 per 1000. Compared with those without CHD, the proportion of preterm births was obviously higher among the newborns with CHD, especially the newborns with significant and critical CHD. Compared with those without CHD, The proportion of low birth weight infants was obviously higher among the newborns with CHD (serious and critical). In comparison to the Chinese Han population, some other ethnic groups (Miao, Hani, and Mi) showed an obviously higher prevalence of CHD.

Conclusion: This study obtained accurate data on the prevalence and risk factors of CHD in Hainan, which provides the epidemiological information of CHD in Hainan, China.

Keywords: Congenital heart disease; Prevalence; Ethnic group; Risk factor

Introduction

Congenital Heart Disease (CHD) is an important contributor to infant mortality, forming a major global health burden [1]. Therefore, the exact prevalence and case burden of CHD must be determined in order to recommend appropriate health policy. Hainan is the southernmost underdeveloped province, and also the second largest island in China, with an area of about 35,000 square kilometers. In addition, it is also a multi-ethnic province in China, with over 20 ethnic groups. In China, epidemiological investigations on CHD have been conducted in many provinces, but the exact epidemiological data on CHD in Hainan is still lacking. The aim of this investigation was to collect epidemiological data and risk factors of CHD in Hainan.

Methods

A multicenter, multiple-ethnic, cross-sectional screening study was performed from January 1,2020 to December 31, 2020, in delivery institutions of 17 urban and rural regions in Hainan, China. There were 4 types of CHD cases included: (1) Cases of CHD in an asymptomatic group who were screened positive by pulse oximetry (POX) combined with heart auscultation, and then diagnosed using routine echocardiography within one week; (2) Cases of CHD in a symptomatic group (e.g., those with cyanosis or tachypnea) diagnosed using routine echocardiography; (3) late-presenting CHD cases in an asymptomatic group identified by clinical follow-up at age 3 months, along with telephone follow-up and feedback from parents at age 6 months (CHD screening protocol as Figure 1) [2]; and (4) newborns with prenatally diagnosed CHD; The CHD screening protocol. The cardiac diagnoses were based on the nomenclature of the International Pediatric and Congenital Cardiac Code of the Nomenclature Working Group [3].

The following conditions were excluded: (1) simple patent foramen ovale, (2) PDA that healed spontaneously within 3 months, (3) simple malformation without hemodynamic significance (e.g., permanent left upper vena cava or dislobular aortic valve without stenosis). Definitions of severity of CHD are as follows [4]: non-significant, no clinical signs, cardiac lesions are not lasting after age 6 months; significant, cardiac lesions are persisting beyond age 6 months, required regular monitoring or drug treatment, but are not classified as serious or critical; serious, cardiac lesions necessitating interventions (e.g., surgery cardiac or catheterisation) before age 1 year; critical, cardiac lesions needing intervention or causing death within the first 28 days of life. To guarantee consistency in screening and diagnostic criteria, all of the screening staff of participating

Citation: Zhang D, Chen R, Mo Z, Yang L, Wang Y, Wang H. Prevalence of Congenital Heart Disease at Live Birth in Hainan, China. Am J Clin Cardiol. 2021;2(1):1010.

Publisher Name: Medtext Publications LLC

Manuscript compiled: Oct 21st, 2021

***Corresponding author:** Dufei Zhang, Department of Cardiovascular Surgery, Hainan Women and Children's Medical Center, Hainan, China. 17, Changbing Road, Haikou, 57000, Hainan, China, E-mail: freezdfei@163.com

delivery institutions accepted training in methods of screening and criteria of diagnosis before launching the screening program. The first author constantly maintained close contact with delivery institutions to guide and assess the resolution of problems in the process of screening and diagnosis.

Statistical analyses

Clinical data were analyzed using SPSS version 17.0 software package. Categorical variables are expressed as count and percentage. Differences of categorical variables between groups were compared using the χ^2 test. P value of <0.05 was considered statistically significant. This study was performed after permission from the Ethics Committee of Hainan Women and Children's Medical Center, and informed written consent was got from the participating infants' parents.

Results

In 2020, the count of live births in Hainan Province was 122,626. A total of 117005 (95.42%) newborns were recruited for our analysis (59929 males). Of these, 116985 newborns were screened using the protocol (Figure 1), and 20 newborns with CHD were prenatally diagnosed. A total of 572 newborns (50.7% males) were diagnosed with CHD, providing an overall CHD prevalence of 4.89 per 1000 live births in Hainan (non significant, 2.13; significant, 2.25; serious, 0.28; critical, 0.23) (Table 1). The most common congenital heart lesion was atrial septal defect (ASD), at a prevalence of 1.889 per 1000, followed by ventricular septal defect (VSD; 1.376), patent ductus arteriosus (PDA; 0.983), pulmonary valvular stenosis (PS; 0.171), partial anomalous pulmonary venous connection(PAPVC; 0.111), tetralogy of Fallot (ToF; 0.103), atrioventricular septal defect (AVSD; 0.085), total anomalous pulmonary venous connection (TAPVC; 0.051), transposition of the great arteries (TGA; 0.043), single ventricle (SV; 0.034), interrupted aortic arch (IAA; 0.026), and double-outlet right ventricle (DORV; 0.017) (Table 2). Compared with those without CHD, the proportion of preterm births was obviously higher among the newborns with CHD, especially the newborns with significant and critical CHD (P=0.043, 0.027, respectively). Compared with those without CHD, The proportion of low birth weight infants was obviously higher among the newborns with CHD (serious and critical) (P<0.001, both). In comparison to the Chinese Han population, some other ethnic groups (Miao, Hani, and Mi) showed an obviously higher prevalence of CHD (P = 0.021, 0.004 and 0.003, respectively) (Table 3).

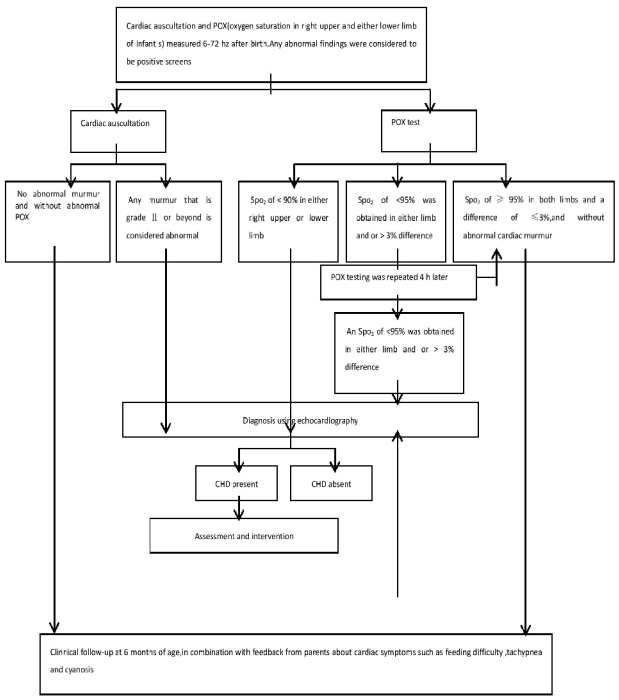

Figure 1: CHD screening protocol. Spo_2, pulse oxygen saturation.

Discussion

Depending on some previous studies, the CHD prevalence varied from 1.5 to 20 per 1000 live birth in China [5-9], which might had been owe to some reasons. First of all, the CHD detection rate can be greatly affected at the different participating institutions by variations in diagnostic methods, selection criteria, and definitions. Second, differences in the skills of screening staff also affect the CHD detection rate. Third, diversification of living environment and genetic factors can also lead to the different prevalence of CHD in different regions.

In comparison to previous studies in China, our study conducted a prospective multicenter screening project in all participating delivery institutions located in geographically diverse regions of Hainan to eliminate bias. More importantly, the screened-negative neonates were followed up at 6 months of age. Our CHD screening protocol has been proven to be economical, reliable and efficient [4]. The overall CHD prevalence in Hainan (4.89 per 1000) is basically consistent with that previous reported in some other regions [6,8]. The CHD prevalence in some of the minority ethnic groups (Miao, Hani and Mi) was higher than that in Han Chinese. We observed that premature birth and low birth weight were risk factors for CHD. ASD was the most common subtype of CHD in our study, which was consistent with some previous reports [10,11]. Previous reports have shown that the prevalence of CHD is 2 to 3 fold higher in preterm infants than in term infants [12]. Our study also observed this association, which was more pronounced in the infants with significant and critical CHD. We observed that Low birth weight was also more common in the total CHD group, which was consistent with the results of other reports [13,14]. Some previous investigations have shown that the CHD prevalence varies in different ethnic groups in China [15]. This may be relate to different environmental exposures, genetic differences, or consanguineous marriages. Our study had certain limitations. Due to parental in cooperation, not all live birth infants participated in this survey, which may cause an underestimated prevalence of CHD in Hainan. Furthermore, the applying of screening methods, such

Table 1: Characteristics of 117005 newborns in Hainan, China.

Characteristics	CHD (N = 572)					
	Critical (N = 27)	Serious (N = 33)	Significant (N = 263)	Non significant (N = 249)	All (N = 572)	No CHD (N = 116433)
Males/females, n	16/11	15/18	147/116	112/137	290/282	59639/56794
Maternal age (y) ≥35,n (%)	2(7.4)	2(6.1)	15(5.7)	14(5.6)	33(5.8)	7335(6.3)
Gestation age (wk) <37,n (%)	6(22.2)*	6(18.2)	35(13.3)*	31(12.4)	78(13.6)#	11207(9.6)
Birthweight (g) <2500,n (%)	12(44.4)#	7(21.2)#	13(4.9)	14(5.6)	36(6.3)*	4809(4.1)

*P < 0.05, #P < 0.01, compared with newborns without CHD.

Table 2: Subtypes of CHD among 572 newborns in Hainan, China.

Subtype of	Male		Female		Total	
CHD	N	Prevalence (‰)	N	Prevalence (‰)	N	Prevalence (‰)
ASD	138	2.302	83	1.454	221	1.889
VSD	82	1.368	79	1.384	161	1.376
PDA	68	1.135	47	0.823	115	0.983
PS	11	0.184	8	0.14	20	0.171
PAPVC	7	0.117	6	0.105	13	0.111
ToF	7	0.117	5	0.088	12	0.103
AVSD	4	0.067	6	0.105	10	0.085
TAPVC	2	0.033	4	0.07	6	0.051
TGA	3	0.05	2	0.035	5	0.043
SV	2	0.033	2	0.035	4	0.034
IAA	2	0.033	1	0.018	3	0.026
DORV	0	0	2	0.035	3	0.017

Table 3: Prevalence of CHD by Different Ethnicity.

Ethnicity	N	CHD	Prevalence(‰)
Han	98904	477	4.82
Zhuang	3954	12	3.03
Li	5774	23	3.98
Miao	3724	28	7.52*
Hui	2321	11	4.74
Hani	512	7	13.67#
Mi	393	6	15.27#
Bai	325	2	6.15
Man	194	1	5.15
Yao	195	1	5.13
Tai	182	1	5.49
Wa	176	1	5.68
Others	351	2	5.69

*$P < 0.05$, #$P < 0.01$, compared with the Chinese Han population

as auscultation and POX, may differ depending on the screening staff even though they accept the same medical training. Through this multicenter study with a large number of participants, we find that Pulse Oximetry (POX) combined with auscultation is suitable for CHD screening in remote areas. Our study obtained data on the prevalence and risk factors of CHD in Hainan, which provides additional information on the epidemiology of CHD as well as additional support for the establishment of diagnostic and treatment plans in Hainan, China.

Funding

- 2019 High-level Talent Project of Hainan Basic and Applied Basic Research Program (Natural Science) (2019RC392).
- project supported by Hainan Province Clinical Medical Center.

References

1. Liu Y, Chen S, Zühlke L, Black GC, Choy MK, Li N, et al. Global birth prevalence of congenital heart defects 1970-2017: updated systematic review and meta-analysis of 260 studies. Int J Epidemiol. 2019;48(2):455-63.
2. Zhao QM, Ma XJ, Ge XL, Liu F, Yan WL, Wu L, et al. Pulse oximetry with clinical assessment to screen for congenital heart disease in neonates in China: a prospective study. Lancet. 2014;384(9945):747-54.
3. Franklin RC, Jacobs JP, Krogmann ON, Marie JB, Vera DA, Colan SD, et al. Nomenclature for congenital and pediatric cardiac disease: historical perspectives and The International Pediatric and Congenital Cardiac Code. Cardiol Young. 2008;18(2):70-80.
4. Ewer AK, Middleton LJ, Furmston AT, et al. Pulse oximetry screening for congenital heart defects in newborn infants (PulseOx): a test accuracy study. Lancet. 2011;378(9793):785-94.
5. Yu Z, Xi Y, Ding W, Han S, Cao L, Zhu C. Congenital heart disease in a Chinese hospital: Pre- and postnatal detection, incidence, clinical characteristics and outcomes. Pediatr Int. 2011;53(6):1059-65.
6. Zhang X, Li S, Wu S. Prevalence of birth defects and risk-factor analysis from a population-based survey in Inner Mongolia, China. BMC Pediatr. 2012;12:125.
7. Zhao QM, Ma XJ, Jia B. Prevalence of congenital heart disease at live birth: An accurate assessment by echocardiographic screening. Acta Paediatr. 2013;102:397-402.
8. Wu L, Li B, Xia J. Prevalence of congenital heart defect in Guangdong province,2008-2012. BMC Public Health. 2014;14:152.
9. Liu X, Liu G, Wang P. Prevalence of congenital heart disease and its related risk indicators among 90,796 Chinese infants aged less than 6 months in Tianjin. Int J Epidemiol. 2015;44:884-93.
10. Bjornard K, Riehle-Colarusso T, Gilboa SM. Patterns in the prevalence of congenital heart defects, metropolitan Atlanta, 1978 to 2005. Birth Defects Res A Clin Mol Teratol. 2013;97:87-94.
11. Han S, Wei CY, Hou ZL. Prevalence of Congenital Heart Disease Amongst Schoolchildren in Southwest China. Indian Pediatr. 2020;57(2):138-141.
12. Tanner K, Sabrine N, Wren C. Cardiovascular malformations among preterm infants. Pediatrics. 2005;116:E833-8.
13. Archer JM, Yeager SB, Kenny MJ. Distribution of and mortality from serious congenital heart disease in very low birth weight infants. Pediatrics. 2011;127:293-9.
14. Wren C. Prematurity, low birth weight, and cardiovascular malformations. Pediatrics. 2011;127:385-6.
15. Liu F, Yang YN, Xie X. Prevalence of congenital heart disease in xinjiang multi-ethnic region of China. PLoS One. 2015;10:e0133961.