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Congenital heart diseases in neonatal unit at Al-Wahda Pediatric Teaching Hospital, Aden, Yemen (2012- 2013)

Cardiopatías congénitas en la unidad neonatal del Hospital Docente Pediátrico Al-Wahda, Adén, Yemen (2012- 2013)

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ABSTRACT

Introduction: congenital heart diseases are serious and common conditions that have significant impact on morbidity, mortality, and healthcare costs in children and adults.
Objective: to identify the prevalence and pattern of congenital heart diseases in the neonatal unit of Al-Wahda Pediatric Teaching Hospital in Aden, Yemen.
Material and Methods: this descriptive cross-sectional study included all of the newborns at Al-Wahda Pediatric Teaching Hospital, from January 2012 to December 2013 (12987 newborns). Clinical examination, echocardiography and radiography were used for diagnostic and a total of 69 newborns were diagnosed with congenital heart diseases (41 males and 28 females) during the period. Clinical and demographic data were collected from the charts of patients for analysis.
Results: the prevalence of congenital heart diseases was 5.3/1000 live births. Ventricular septal defect (39.1%), atrial septal defect (24.1%) and complex

congenital heart disease (24.1%) were the more frequent forms. Respiratory distress was the commonest symptom (97.1%) and among the non-cardiac anomalies, Down's syndrome (10.1%) was predominant.
Conclusions: Congenital heart disease is a public health problem among newborns at Al-Wahda Pediatric Teaching Hospital in Aden, being the commonest forms ventricular septal defect, atrial septal defect and complex congenital heart disease, in which male predominance is found. Integrated effects from all authorities should be directed to families and doctors for prevention, early diagnosis and proper intervention.

Keywords: Congenital, heart disease, prevalence, Aden.

RESUMEN

Introducción: las cardiopatías congénitas son problemas de salud comunes con impacto significativo en la morbilidad, mortalidad y costos de salud en niños y adultos.
Objectivo: identificar la prevalencia y patrón de las cardiopatías congénitas en la unidad neonatal del Hospital Docente Pediátrico ¨Al-Wahda¨ de Adén, Yemen.
Material y Métodos: este estudio descriptivo transversal incluyó a los neonatos en el Hospital Docente Pediátrico ¨Al-Wahda¨ desde enero 2012 a diciembre 2013 (12987 neonatos). El diagnóstico se basó en examen clínico, ecocardiográfico y radiográfico por el cual se identificaron 69 neonatos con cardiopatías congénitas (41 niños y 28 niñas). Se obtuvieron datos clínicos y demográficos de las historias clínicas para su análisis.
Resultados: la prevalencia de cardiopatía congénita fue de 5.3/1000 nacidos vivos. Las formas más frecuentes fueron la comunicación interventricular (39,1%), la comunicación interatrial (24.1%) y la cardiopatía congénita compleja (24.1%), y predominó el sexo masculino. El distrés respiratorio fue el síntoma más común (97,1%) y entre las anomalías no-cardiacas el síndrome de Down predominó (10,1%).
Conclusiones: la enfermedad cardiaca congénita es un problema de salud pública entre los recién nacidos en el Hospital bajo estudio, y las formas más comunes son el defecto ventricular septal, el defecto atrial septal y la enfermedad cardiaca congénita compleja, con predominio del sexo masculino. Esfuerzos integrados de las autoridades deben dirigirse a familias y personal de salud para la prevención, diagnóstico temprano e intervención apropiada de estas afecciones.

Palabras clave*:* Congénito; enfermedad cardiaca, prevalencia, Adén.

INTRODUCTION

Congenital heart diseases (CHD) are serious and common conditions that have significant impact on morbidity, mortality, and healthcare costs in children and adults.[1] these are abnormalities of the heart's structure and function caused by abnormal or disordered heart development before birth.[2]

Prevalence of congenital heart disease is the rate of the total number of cases of congenital heart diseases divided by the total population, usually expressed as the number of babies born with congenital heart disease per 1,000 live births.[3]

The global prevalence of CHD among newborns ranges from approximately 3.7 to 17.5 per 1.000, which account for 30-45% of all congenital defects.[4] Continental variations in birth prevalence have been reported, from 6.9 per 1000 births in Europe to 9.3 per 1000 in Asia.[1]

According to a report, 45% of infant deaths owing to congenital anomalies were caused by CHD in Western Europe.[4]

Prevalence of congenital heart disease is underestimated due to home deliveries and early discharge of mothers along with their neonates from hospitals, without proper neonatal examination pertinent to cardiovascular system by a qualified and experienced person.[5]

Etiology of CHD is multi factorial and a large collection of environmental and genetic causes have a role in its pathogenesis.[6]

The most common CHD has been ventricular septal defect, followed by atrial septal defect, patent ductus arteriosus, tetralogy of Fallot, single ventricle, atrium ventricular septal defect and double outlet right ventricle.[7]

The warning signs of congenital heart disease in infants and children may include a heart murmur or abnormal heart sound, cyanosis (a bluish tint to the skin, fingernails and/or lips), fast breathing, anorexia, poor weight gain, an inability to exercise and excessive sweating. [8]

The present study made specific efforts to detect all possible cases of CHD by examining all neonates admitted in neonatal unit of Al-Wahda Pediatric Teaching Hospital in Aden. There are no authentic data regarding the prevalence of CHD at national level and it is almost nil in this hospital, where children with CHD are admitted for treatment and its catchments area is very large, covering many governments in Yemen. This factors increase the load of patient which ultimately increase the prevalence of CHD in infancy in this hospital.

This knowledge is important for providers of care for patients with CHD as well as for policy makers.

The objective of the work is to identify the prevalence and pattern of congenital heart diseases in the neonatal unit of Al-Wahda Pediatric Teaching Hospital in Aden, Yemen.

MATERIAL AND METHODS

This was a descriptive cross-sectional study carried out for two years (January 2012 to December 2013). It included all of the newborns at the hospital: Al-Wahda Pediatric Teaching Hospital from Aden, Yemen, in that period of time (12987 newborns), among which 69 newborns were diagnosed with CHD (41 males and 28 females, mean age 10.2 ± 9.8 days).

CHD was suspected in the presence of the following criteria defined by Mitchell et al.: [9] presence of cardiac murmur, presence of cyanosis or feeding difficulty only, cyanosis associated with feeding difficulty, presence of congestive heart failure or failure to thrive. Clinical examination, echocardiography and radiography were considered as definitive tools for diagnosis of CHD.[9] Babies of diabetic mothers, all Down's syndrome babies and babies with congenital malformations were screened additionally.

The studied variables included: admission weight in grams**,** gestational age (preterm: <37 weeks and term: 37- 42 weeks),[10] sex (male and female), residency of the children, clinical presentation of congenial heart diseases on admission, non-cardiac anomalies of congenial heart diseases on admission (Down's syndrome, cleft lip with palate, hernia and renal anomaly) and history of diseases during pregnancy (maternal infections, diabetes mellitus, hypertension, cardiac diseases) were obtained from the charts of the patients of the neonatal unit in Al-Wahda Hospital. The types of congenital heart diseases in this study were: ventricular septal defect (VSD, a hole in the wall separating the two lower chambers of the heart), atrial septal defect (ASD, a hole in the wall separate the top two chambers of the heart), complex congenital heart disease (CCHD, more than two congenital heart diseases), patent ductus arteriosus (PDA, an unclosed hole in the aorta), transposition of great arteries (a heart in which the two main arteries carrying blood away from the heart are reversed), dextrocardia (a condition in which the heart is pointed toward the right side of the chest instead of normally pointing to the left).[1]

Information collected was confidential, informed consents were obtained from hospital authorities and the project objectives were justified.

Data were tabulated and statistically analyzed using the appropriate statistical tests through SPSS software package version 1.5. The chi square test, with a significance level of 5% ($p<0.05$), was used to determine the possible relationship between the type of congenital heart disease and sex.

RESULTS

The total numbers of alive birth in this hospital were 12987 in this period and a total of 69 children (41 males and 28 females) were suffering from CHD. So, the prevalence of CHD was 5.3/1000 live births at the neonatal unit in Al-Wahda Pediatric Teaching Hospital, Aden.

Table 1 shows the distribution of neonates with CHD by age, birth weight, sex, and gestational age. The results indicated that the mean age of the newborns was 10.2 ± 9.8 days (range 1-28 days). Seven patients (10.1%) had gestational ages less than 37 completed weeks (preterm). It also shows that males were predominant (59.4%).

Table 2 shows types of congenital heart disease in the newborns under study. The results indicated that the proportion of patients with VSD was the highest (39.1%), followed by ASD and CCHD with 24.1%.

Table 1. Distribution according to sociodemographic and clinical characteristics

Age (days, mean ± SD)	10.2 ± 9.8 (Range 1-28 days)
Birth weight (g, mean ± SD)	2.733 ± 0.6747 (Range 1.2- 4.4 g)
Sex distribution:	
Male	41 (59.4%)
Female	28 (40.6%)
Gestational age:	
Preterm	7 (10.1%)
Term	62 (89.9%)
Total	69

SD: standard deviation

Table 2. Distribution according to type of congenital heart disease

Type of congenital heart disease	No. of patients (%)
Ventricular septal defect	27 (39.1)
Complex congenital heart disease	17 (24.1)
Atrial septal defect	17 (24.1)
Patent ductus arteriosus	4 (5.8)
Transposition of great arteries	2 (2.9)
Dextrocardia	2 (2.9)
Total	69 (100)

Table 3 shows that although the difference was not statistically significant (p> 0.05); cases of VSD, ASD and CCHD had male predominance (63.0%, 58.8% and 52.9 for males versus 37.0, 41.2% and 47.1% for females, respectively).

Table 3. Distribution according to sex and types of congenital heart disease

Type of Congenital Heart Disease	Males		Females		Total	
	No.	%	No.	%	No.	%
Ventricular septal defect	17	63.0	10	37.0	27	100
Atrial septal defect	10	58.8	7	41.2	17	100
Complex congenital heart disease	9	52.9	8	47.1	17	100
Patent ductus arteriosus	2	50.0	2	50.0	4	100
Transposition of great arteries	1	50.0	1	50.0	2	100
Dextrocardia	2	100	0	-	2	100
Total	41	59.4	28	40.6	69	100

Chi square, p= 0.847

Table 4 shows that among the different clinical manifestations of CHD, the commonest were respiratory distress (97.1 %), pallor (71.0%), anorexia (66.7%), cyanosis (52.2%) and fever (34.8%).

Table 4. Distribution according to clinical presentation of congenial heart diseases on admission

Clinical presentation on admission	Number	%
Respiratory distress	67	97.1
Pallor	49	71.0
Anorexia	46	66.7
Cyanosis	36	52.2
Fever	24	34.8
Vomiting	11	15.9
Convulsion	8	11.6
Heart failure	4	5.8
Jaundice	2	2.9

Table 5 shows associated non-cardiac anomalies which were present in 15 patients with CHD (21.7%). Down's syndrome was noticed in the higher proportion (10.1%).

Table 5. Distribution according to associated non-cardiac anomalies on admission

Non-cardiac anomaly	No. of patients (%)
No	54 (78.3)
Down's syndrome	7 (10.2)
Cleft lip with palate	3 (4.3)
Hernia	3 (4.3)
Renal anomaly	2 (2.9)
Total	69 (100)

Table 6 shows the history of diseases during pregnancy in 34 out 69 cases of congenital heart disease. The greatest proportion was found for maternal infections (36.2%), followed by gestational diabetes mellitus (10.1%).

Table 6. Distribution according to history of diseases during pregnancy

Variable	Type of disease during pregnancy	No. of Mothers (%)
History of diseases during pregnancy	No	35 (50.7)
	Maternal infections	25 (36.2)
	Diabetes mellitus	7 (10.1)
	Hypertension	1 (1.4)
	Cardiac diseases	1 (1.4)
	Total	69 (100)

DISCUSSION

This study was conducted to identify the pattern and the prevalence rate of CHD in Al-Wahda Pediatric Teaching Hospital, Aden, Yemen. The overall prevalence of CHD during the two-year period was 5.3/1000 live births, which is higher than the findings from India (3.9/ 1000).[9] on the other hand, it corresponds to the study in Al-Qassim, Saudi Arabia and Iran (5.4/1000 and 5.8/1000, respectively), but it is lower than what was found in Oman (7.1/1000). [11, 12, 13]

We found that CHD was more common in males (59.4%) than females (40.6%) with a male to female ratio of 1.46:1 (Table 1). This finding is similar to that reported in Iran (male to female ratio of 1.5:1) and Bangladesh (male to female ratio of 1.2:1), but it is not similar to that reported in Turkey (51% boys and 49% girls) and in Saudi Arabia, where the frequency was the same for males and females, while in Nigeria CHD was found to be more common in female births. [6, 14]

Also it was observed that CHD was more common in term (89.9%) than preterm (10.1%) children (Table 1). In this study, the prevalence of preterm was higher than what is reported in Nelson's study (3% in preterm).[2] the finding is not similar to a study in Korea where the frequency of the CHD was higher in the pre-term group.[15]

In this study, the common forms of CHD were ventricular septal defect (39.1%), atrial septal defect (24.1%), complex congenital heart disease (24.1%) and patent ductus arteriosus (5.8%) (Table 2). This finding is similar to a study in Egypt that showed the most common types were VSD (29.65%), ASD (17.93%) and PDA (12.41%) followed by complex congenital heart disease (10.34%).[16] Another report in Egypt found ventricular septal defect in 41.49%, complex congenital heart disease in 15.43% and pulmonary stenosis in 13.83%.[17] Also a study in Bangladesh shows that the more frequent CHD were found to be VSD (29%), ASD (24%), PDA (10%), and complex congenital heart diseases (8%).[5] While, a study in Oman shows that the common CHD were ventricular septal defect (24.9%), atrial septal defect (14.4%) and patent ductus arteriosus (10.3%).[13] In Saudi Arabia the ventricular septal defect was the most common lesion diagnosed (22.5%). Another study in Saudi Arabia found that ventricular septal defect was the commonest lesion (33.9%) followed by atrial septal defect (18.1%).[11, 18] The discrepancy of the results may be attributed to many factors such as sample size, age at detection and methods of identification of these defects.

A report of the New England Regional Infant Cardiac Program showed VSD as the commonest lesion, which is similar to the finding in the present study.[5]

Also it was observed in this study that the prevalence of CHD in males with VSD, ASD and complex congenital heart disease (63.0%, 58.8% and 52.9%, respectively) was higher than in females (37.0%, 41.2% and 47.1%, respectively). However, similar prevalence in PDA and transposition of great arteries was found for both sexes (Table 3). In Egypt, a study revealed that male predominance was seen in cases of VSD, aortic stenoses and complex congenital heart disease (1.7:1, 2:1 and 1.5:1, respectively), while female predominance was recorded for cases with PDA, ASD and pulmonary stenoses (0.6:1, 0.5:1 and 0.8:1, respectively). While a study in Iran found more VSD and ASD in males than females, but PDA and VSD+ASD were found to be more common in females than in males. [6, 16]

This could probably be explained by Carianne and Verheuget [45], who mentioned that several factors may account for observed gender difference in CHD. One

aspect likely to play a role is the biological distinction such as inflow and outflow tracts of the heart between males and females.[19]

In the present study it was found that respiratory distress, pallor, anorexia, cyanosis and fever were the main symptoms among cases of CHD where they represented 97.1%, 71%, 66.7%, 52.2% and 34.8% respectively (Table 4). A study in Bangladesh found that clinically respiratory distress (71%) was the commonest presenting symptom followed by cyanosis (26%) and anorexia (24%).[5] In Egypt, the study revealed that history of cough (56.55%), dyspnea (52.41%) and failure to thrive (42.75%) are the main symptoms and signs as mentioned by their mothers.[16] Also El Hag found that breathlessness, failure to thrive and cyanosis were the main symptoms and signs among children with CHD. Symptoms depend on the type and severity of the defect. [20]

The commonest non-cardiac anomalies associated with CHD in this study were Down's syndrome (10.1%), followed by cleft lip with palate (4.3%), hernia (4.3%), and renal anomaly (2.9%) (Table 5). This was similar to the studies in Turkey and Saudi Arabia were the most common syndrome was Down's syndrome (78.3% and 15%, respectively) from all syndromic CHD cases.[14, 11] However, in Czech Republic it was reported that the most frequent non-cardiac anomalies were congenital malformations of the nervous system (14.59%), the musculoskeletal system (12.44%), cleft lip and cleft palate (7.42%) and congenital malformations of the urinary system (6.70%).[21] It is concluded that chromosomal abnormalities resulting in genetic syndromes such as Down's syndrome are often associated with a higher incidence of complex congenital heart disease.[16]

Maternal disease like maternal infection, diabetes mellitus and hypertension might increase occurrence of heart disease in neonates. Regarding the history of diseases during pregnancy, in this study it was found that 50.7% of mothers of affected neonates had no history of disease during pregnancy period, while 36.2% of mothers gave a positive history suggestive of infection during their pregnancy period, 10.1% mothers were diabetic, 1.4% hypertensive and 1.4% had cardiac diseases (Table 6). This was similar to a study in Bangladesh which revealed that 78% of mothers had no history of disease during pregnancy period, while 10% of mothers were diabetic but there were no similarity in 8% hypertensive and 4% mother's infection during their pregnancy period.[5] Another study in Egypt showed that 8.27% of them were exposed to febrile illness. Jupta mentioned that maternal febrile illness during first trimester of pregnancy may be associated with increased risk of certain CHD that may reach two folds. [22]

The differences among these results in different parts of the world could be related to the study population, type of classification, and various selection criteria such as live births and still births in the study or methods of diagnosis and ethnic or genetic differences. This could be due to the severity of defects which might have led to the death of patients before accessing the medical facilities. This might also be due to differences in the improvement of diagnosis, attention or awareness among the medical authorities. Further study is needed to explore the exact etiological factors. Also, researchers have pointed out the effect of ethnicity on CHD prevalence. Ethnical differences in the prevalence of cardiac malformations in uterus and at live birth may have environmental components, e.g., nutritional status and teratogen exposure, in addition to genetic factors.[6]

This study has several limitations. All of the subjects of this study were inpatients of the neonatal unit only, and carried out in a single center. Since not all children underwent echocardiography, minor cardiac defects might have been missed and we cannot state the number of severely ill children who died during initial steps of

resuscitation (before the echocardiography could be performed). So the true incidence might be somewhat higher than that reported here. As we could not get detailed history of antenatal study with fetal echocardiography, we could not reveal the impact of fetal imaging to these changes of epidemiologic findings that might had affected.

Observed differences may be due to genetic, environmental, socioeconomical, or ethnic origin, and there are needs to perform further investigation to tailor the management of this global health problem.

In the light of the findings, it is recommended that concerted effort should be made to develop adequate diagnostic (ex. newborn echocardiography survey) and treatment programs (cardiac surgical intervention). Stress is pointed out to the importance of genetic counseling for women before becoming pregnant. In antenatal care program, it is important the health education of pregnant women to avoid maternal infection especially during first trimester of pregnancy. The aim should be directed to improve the outlook of CHD in the developing world, and to reduce mortality and morbidity in neonates.[23-25]

CONCLUSIONS

The present study shows that CHD is a public health problem among newborns at Al-Wahda Pediatric Teaching Hospital in Aden, Yemen. VSD, ASD and complex congenital heart disease are the commonest congenital heart diseases, in which male predominance is found. A good number of studied mothers have got some diseases during pregnancy. Down's syndrome is the predominant non-cardiac anomaly in this population.

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BIBLIOGRAPHY REFERENCES

1. American Heart Association. Statistical Fact Sheet, Congenital Cardiovascular Defects, American Heart Association. [Updated 2013; cited Apr 2014]. Cir. 2013; 127:e6-e245. Available from: http://www.uptodate.com/contents/congenital-heart-disease-chd-in-the -newborn-presentation-and-screening-for-critical-chd and http://www.heart.org/HEARTORG/Conditions/CongenitalHeartDefects/AboutCongenitalHeartDefects/Ventricular-Septal-Defect -VSD_UCM_307041_Article.jsp

2. Nelson K. Text book of pediatrics, 17th edition. Philadelphia**:** Saunders-Elsevier; 2004.p. 1499-1502.

3. Department of Health. Basic Statistics: About Incidence, Prevalence, Morbidity, and Mortality - Statistics Teaching Tools, New York, 1999 [cited Apr 2014]. Available from: https://www.health.ny.gov/diseases/chronic/basicstat.htm

4. Sayasathid J, Sukonpan K, Somboonna N. Epidemiology and etiology of congenital heart diseases, congenital heart disease - selected aspects, (2012), InTech, [cited Apr 2014]. Available from: http://www.intechopen.com/books/congenital-heartdisease

5. Islam MN, Hossain MA, Khaleque MA, Das MK, Khan MRH, Bari MS, et al. Prevalence of congenital heart disease in neonate in a tertiary level hospital. NJMS. 2013; 2(2):91-5.

6. Bagher N, Maliheh S, Arezo M, Mostafa Q, Mohammad JG. Prevalence and pattern of congenital heart disease among neonates in Gorgan, Northern Iran (2007-2008). Iran J Pediatr. 2011 Sep; 21 (3):307-12.

7. Zhao QM, Ma XJ, Jia B, Huang GY. Prevalence of congenital heart disease at live birth: an accurate assessment by echocardiographic screening. Acta Paediatr. 2013 Apr; 102(4):397-402.

8. Thomas T. What is a congenital heart defect (CHD)?. Children's Heart Foundation. 2012 [cited April 2014]. Available from: http://www.childrensheartfoundation.org/research/what-is-a-chd

9. Kapoor R, Gupta S. Prevalence of congenital heart disease, Kanpur, India. Indian Pediatrics. 2008; 45:309-11.

10. World Health Organization. International classification of diseases and related health problems. 10th revision. Geneva: World Health Organization; 1992. [cited April 2014]. Available from: http://www.who.int/mediacentre/factsheets/fs363/en/

11. Al-Mesned A, Al-Akhfash AA, Sayed M. Incidence of severe congenital heart disease at the province of Al-Qassim, Saudi Arabia. Congenit Heart Dis. 2012;7(3):277-82. doi: 10.1111/j.1747-0803.2011.00614.x. Epub 2011 Dec 30.

12. Shah GS, Singh MK, Pandey TR, Kalakheti BK, Bhandari GP. Incidence of congenital heart disease in tertiary care hospital. Kathmandu Univ Med J (KUMJ). 2008; 6(1):33-6.

13. Subramanyan R, Joy J, Venugopalan P, Sapru A, al Khusaiby SM. Incidence and spectrum of congenital heart disease in Oman. Ann Trop Paediatr. 2000 Dec; 20(4):337-41.

14. Baºpinar O, Karaaslan S, Oran B, Baysal T, Elmaci AM, Yorulmaz A. Prevalence and distribution of children with congenital heart diseases in the central Anatolian region, Turkey. Turk J Pediatr. 2006 Jul-Sep;48(3):237-43.

15. Seon YC, Jin-Hee O, Jung HL, Jae YL, Soon JL, Ji WH, et al. Recent incidence of congenital heart disease in neonatal care unit of secondary medical center: a single center study. Korean J Pediatr. 2012 Jul; 55(7): 232-7.

16. Sabry AS, El-Feky OA. Epidemiological study of congenital heart diseases among children attending outpatient clinics of Benha University Hospital. Egyp J Comm Med. 2011;28 (4): 69-87.

17. Fekry Y. Prospective study of children with congenital heart diseases attending to cardiology pediatric clinic of El Menoufia University Hospital [Master thesis], Pediatrics, Menoufia University; 2002.

18. Alabdulgader AAA. Congenital heart disease in Saudi Arabia: current epidemiology and future projections. E M H J. 2006; 12 (Supplement 2): S157.

19. Carianne J, Verheuget I. Gender and outcome in C.H.D. Academic Medical Centre, Amesterdam, Department of Cardiology, Am Heart Assoc. 2008; Cir .3 ; 118-32 .

20. El Hag A. Pattern of congenital heart disease in Sudanse children. East Afr Med J. 2004; 71 (9): 580-6.

21. Sípek A. Incidence of congenital heart defects in the Czech Republic—current data. Ceska Gynekol. 2010 May; 75(3):221-42.

22. Jupta I. Epidemiology of rheumatic and congenital heart disease in school children. J Indian Medial Assoc. 2002; 90:57-59. [cited Apr 2014]. Available from: http://www.ncbi.nlm.nih.gov/pubmed/20731304

23. Ramírez López MB, Pérez López H, Cáceres Lóriga FM, González Greck O. Resultados del trabajo del 1er. Equipo completo de Cirugía Cardiovascular enviado por Cuba en Misión de colaboración internacional en el marco de la cooperación Sur-Sur. Rev Cubana Cardiol Cirug Cardiovasc. 2014; 20(1). Spanish.

24. Vega Gutiérrez E, Rodríguez Velásquez L, Gálvez Morales V, LB Sainz Cruz, García Guevara C. Incidencia y tratamiento de las cardiopatías congénitas en San Miguel del Padrón. Rev Cubana Med Gen Integr. 2012 Jul-Sep; 28(3). Spanish.

25. García Guevara C, Arencibia Faire J, Savío Benavides A, García Morejón C, Hernández Y, Selman-Housein Sosa E. El pesquisaje prenatal sonográfico de las Cardiopatías Congénitas en Cuba. Rev Fed Arg Cardiol. 2011; 40 (3). Spanish.

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