Incidence of Congenital Heart Disease in Children With Recurrent Respiratory Tract Infection

Rajath Pejaver*, Suresh Babu MT, Raghavendra Krishnamurthy, Basavanthappa SP

Abstract

Background: Functions of the respiratory and cardiovascular systems have a close relationship and so are the pathologies that result in morbidities. Congenital heart disease (CHD) can affect the respiratory system and result in respiratory morbidities. Recurrent respiratory infection is one such morbidity resulting due to such an association.

Aim: To assess the incidence of CHD in patients presenting with recurrent lower respiratory tract infection (LRTI) and the incidence of different types of CHD in patients detected with congenital heart defects

Materials and Methods: A total of 100 patients with recurrent LRTI were studied (N = 100), which included 60 males and 40 females. All patients were subjected to clinical examination and were made to undergo chest X-ray, electrocardiography, and 2D echocardiography with color Doppler to detect CHD.

Results: Of the 100 patients, 41 patients (21 [52.8%] males and 20 [47.8%] females) with recurrent LRTI were found to have CHD.

Conclusions: The results reveal that CHD is a major cause for recurrent LRTI. Considering this, it would be prudent to screen all children presenting with recurrent LRTI for CHD in day-to-day practice.

Key Words: Pulmonary hypertension, Eisenmenger syndrome, pneumonia, low birth weight, preterm birth, immunization

*Correspondence
Dr Rajath Pejaver
Department of Pediatrics
Basaveshwara Medical College and Hospital
NH4 Bypass, KHB Colony
Chitradurga 577501, Karnataka
India

E-mail: rajath.pejaver@gmail.com

Introduction

In a healthy individual, a close relationship exists between the functions of the cardiovascular and respiratory systems such that changes in the metabolic requirements of the body are rapidly followed by changes in both cardiac output and minute ventilation. However, in the presence of congenital anomalies of the circulatory system, this relationship is almost always broken. Under such circumstances, the ability of the heart to increase systemic and/or pulmonary blood flow is often limited; arterial partial pressure of oxygen may be decreased by shunt lesions, affecting oxygen delivery to the tissues. Often the circulatory derangement also places stress on the respiratory system itself, resulting in signs and symptoms that mimic primary respiratory disease. Pathologies in both systems frequently coexist and affect each other, making diagnosis and management of congenital heart disease (CHD) challenging.[1]

Direct pulmonary complications of CHD are due to structural impact on the airways, abnormal pathophysiologic mechanisms leading to increased lung water, and/or significant pulmonary disease. Many children with CHD are at an increased risk of infections including respiratory tract infections (RTIs), which can cause prolonged hospitalization and delay of definitive cardiac repair.

Recurrent lower RTI (LRTI) refers to 2 or more hospitalizations in 6 months or 3 hospitalizations for RTI in any time frame.[1-3] The etiology of RTI is numerous, infections (viral, bacterial) being the most common. However, underlying CHD may be the predisposing factor for recurrent RTI.

Majority of CHDs have a subtle presentation during childhood, only showing up as recurrent RTIs and failure to thrive. CHDs, often considered as mild or trivial (especially if asymptomatic), when left undetected/untreated progress to irreversible and untreatable conditions such as pulmonary hypertension, Eisenmenger syndrome (eg, ostium secundum atrial septal defect [ASDs]). Many others, over a period of time, may develop left ventricular failure (small ventricular septal defect [VSD]), congestive heart failure (small subaortic VSD with aortic regurgitation), or an episode of infective endocarditis, which is known to have a high mortality rate.

Although, congenital defects in the small left-to-right shunts do have symptoms, such as recurrent LRTI and failure to thrive, during early childhood, screening this subset of patients for CHD is worthwhile. Early detection and appropriate management of CHDs can provide a child ample time for catch-up growth, reduce the morbidity and mortality risk associated with each episode of LRTI, significantly reduce the financial burden on the family, and prevent long-term morbidities.

Early and accurate diagnosis of CHD in children presenting under the disguise of recurrent LRTI requires prompt, effective, and systematic approaches including detailed medical history collection and thorough clinical examination.

Aim

To assess the incidence of CHD in patients presenting with recurrent LRTI and the incidence of different types of CHD in patients detected with congenital heart defects

Materials and Methods

This study was conducted at the Department of Pediatrics, Basaveshwara Medical College and Hospital (Chitradurga, Karnataka, India) between November 2012 and July 2014. The hospital is a major referral center for pediatrics (tertiary teaching hospital) in the region.

This is an exploratory study aimed at analyzing patients with recurrent LRTI for underlying congenital heart defects. All procedures and interventions were established only after obtaining adequate and appropriate consent in a prescribed form. Ethical clearance was obtained from the institutional ethical clearance committee.

Inclusion criteria

The patients were initially said to have recurrent LRTI based on the following Indian Academy of Pediatrics' (IAP) criteria.

1. At least 2 episodes of pneumonia occurring in 1 year or 3 episodes of pneumonia occurring over any period of time
2. Between 2 different episodes of recurrent pneumonia the individual recovers completely but without radiologic improvement

Hundred individuals aged between 3 months and 18 years, presenting with recurrent LRTI (according to IAP's criteria) were included in the study.

Exclusion criteria

1. Those unwilling to undergo chest X-ray, electrocardiography (ECG), and echocardiography (ECHO)
2. Those already operated for CHD
3. Known cases of bronchial asthma

Study procedure

Detailed medical history of all the 100 patients was collected. All patients underwent thorough clinical examination followed by investigative work up as per the pro forma.

Chest X-ray, ECG, and 2D ECHO with color Doppler were performed on these patients to detect CHD. ECHO was initially performed by a pediatrician and then the findings were confirmed by a cardiologist.

Routine investigations such as hemoglobin (Hb) level, total count (TC), differential count (DC), and erythrocyte sedimentation rate (ESR) were also conducted.

Results

A total of 100 patients with recurrent LRTI were studied (N = 100), which included 60 males and 40 females. Of the 100 patients, 41 patients (21 [52.8%] males and 20 [47.8%] females) with recurrent LRTI were found to have CHD.

Among the 100 patients with recurrent LRTI, 87 were born after 37 completed weeks of gestation and 13 were born prematurely. Among 41 patients detected with CHD, 31 were born after 37 completed weeks of gestation and 10 were born prematurely ($P = .37$; df = 0.097).

Of the 100 patients with recurrent LRTI, 53 had low birth weight (< 2.5 kg) and 47 patients had normal birth weight. Of the 41 patients detected with CHD, 21 had low birth weight and 20 had normal birth weight ($P = .016$; df = 19).

Tables 1 to 3 show the incidence of different types of CHDs in patients with recurrent LRTI detected with congenital heart defects.

Table 1. Type of CHD Detected in Patients With Recurrent LRTI

Type of CHD	No. of Patients	Percentage
Acyanotic	38	92.7
Cyanotic	3	7.3
Total	41	100

CHD, congenital heart disease; LRTI, lower respiratory tract infection.

Table 2. Types of ACHD Detected in Patients With Recurrent LRTI

Type of ACHD	No. of Patients	Percentage
VSD	16	42.10
ASD	12	31.57
PDA	6	15.78
VSD + ASD	3	7.89
MVP	1	2.63
Total	38	100

ACHD, acyanotic congenital heart disease; ASD, atrial septal defect; LRTI, lower respiratory tract infection; MVP, mitral valve prolapse; PDA, patent ductus arteriosus; VSD, ventricular septal defect.

Table 3. Types of CCHD Detected in Patients With Recurrent LRTI

Types of CCHD	No. of Patients	Percentage
TOF	2	66.66
Single Ventricle	1	33.33
Total	3	100

CCHD, cyanotic congenital heart disease; LRTI, lower respiratory tract infection; TTF, tetralogy of fallot.

Tables 4 and 5 present the age distribution of patients with recurrent LRTI and CHD, respectively.

Table 4. Age Distribution of Patients With Recurrent LRTI

Age Group	Percentage
< 1 y	28
1–5 y	45
6–10 y	21
> 10 y	6

LRTI, lower respiratory tract infection.

Table 5. Age Distribution of Patients With CHD

Age Group	Percentage
< 1 y	34
1–5 y	41.5
6–10 y	14.6
> 10 y	9.8

CHD, congenital heart disease.

Tables 6 and 7 present the immunization status of patients with recurrent LRTI and CHD, respectively.

Table 6. Immunization Status of Patients With Recurrent LRTI

Immunization Status	No. of Patients	Percentage
Complete	56	56
Incomplete	44	44
Total	100	100

LRTI, lower respiratory tract infection.

Table 7. Immunization Status of Patients With CHD

Immunization Status	No. of Patients	Percentage
Complete	22	53.7
Incomplete	19	46.3
Total	41	100

CHD, congenital heart disease.

Of the 41 patients with CHD, in 1 patient murmur could not be appreciated on clinical examination but CHD was detected on ECHO.

A cardiothoracic ratio (CTR) > 55% in infants and > 50% in older children was considered as cardiomegaly. Chest X-ray findings showed that 70.7% patients with CHD had a CTR > 50%.

ECG findings showed that 48.8% patients with CHD had a normal ECG; 51.2% patients with CHD had an abnormal ECG; and 9.8% patients with CHD had a tall P wave of 36.6% and a left axis deviation. Right bundle branch block was detected in 2 patients without CHD.

The mean Hb level in the CHD group was 10.01 g/dL and non-CHD group was 9.78 g/dL. The mean Hb level of the entire study group was 9.88 g/dL.

Discussion

Recurrent LRTIs have numerous causes, which need to be identified to ensure adequate growth of the child and to prevent catastrophic complications, which may be irreversible and may be a cause for fatality. CHD is one such underlying cause for recurrent LRTI, which when detected early and treated appropriately can prevent the child from developing irreversible and untreatable conditions such as pulmonary hypertension, Eisenmenger syndrome, thromboembolic phenomenon, and sudden death.

The incidence of CHD in the general population is 6% to 8%; however, it is necessary to know what the incidence of CHD is in children with recurrent LRTI, which was assessed in this study.

In this study, the incidence of CHD among children was found to be 41%. This is significantly higher than its incidence among the general population. This signifies that CHD is a major cause for recurrent LRTIs. Hence, it is important to identify children with recurrent LRTI and screen them for any underlying CHD using thorough physical and clinical examinations. Chandramouli,[4] in his study on 2613 children < 24 months old with CHD, reported that bronchiolitis (LRTI) was the commonest cause of hospitalization (54.1%). Gupte et al[5] reported that CHDs are present in 36% patients with recurrent LRTI.

The other rare causes of recurrent LRTI, found in this study, were ataxia telangiectasia (2), cystic fibrosis (2), immunodeficiency (HIV) (1), foreign body (2), recurrent aspirations with cerebral palsy (2), mediastinal mass (1), paratracheal lymph node involvement in tuberculosis (1).

Type of CHD in patients with recurrent LRTI

Majority of children had acyanotic congenital heart disease (ACHD) (38/41). In the general population,

the incidence of ACHD is reported to be much higher than that of cyanotic congenital heart disease (CCHD). Similar results were reported in studies conducted by Shreshta et al[6] and Suresh et al,[7] in India. Three cases were found to have CCHD, of which 2 cases had tetralogy of fallot (TOF). TOF can cause recurrent LRTI due to increased pulmonary blood flow in "pink TOF" and in the presence of "major aortopulmonary collaterals." One child was found to have a single ventricle. Other CCHDs such as transposition of great vessels, tricuspid atresia, total anomalous pulmonary venous return present dramatically in the neonatal period with conditions such as cyanosis and severe respiratory distress and are seldom missed.

Age distribution

Most of the children with recurrent LRTI were aged between 1 and 5 years. Most children diagnosed with CHD were also in the age group of 1 to 5 years. This is consistent with several studies, which state that large left-to-right shunts and some cyanotic heart diseases with increased pulmonary blood flow usually present with congestive cardiac failure around 1.5 to 3 months of age. Moderate shunts present with recurrent LRTIs and poor weight gain, while small shunts may present in adolescence or early adulthood with left ventricle dysfunction.

Children aged 1 to 5 years are also prone to repeated RTIs as they often come in contact with other children with RTI when they first join school/kindergarten. The incidence of CHD is common in children of this age group and is statistically significant ($P = .03$).

Preterm birth and low birth weight

The preterm birth rate in India is approximately 21% and in Karnataka it is around 23%. The preterm birth rate found in this study (within the recurrent RTI and CHD groups) is similar to the national and state preterm birth rates. Of the 10 children who were born prematurely and were detected with CHD, 70% of them had VSD and 30% had PDA. The incidence of PDA in preterms was much higher (30%) compared with its incidence in the entire study group (15.78%).

Of the 41 patients with CHD, 21 were low birth weight and 20 were normal birth weight. This is statistically significant ($P = .016$; df = 19) and hence, suggests that low birth weight is a predisposing factor for CHD.

Immunization

In the study group, 56% of them had up-to-date immunization status and 44% (44/100) had an incomplete immunization status according to the national immunization schedule. The national immunization coverage is 61% according to a 2012 press release by the government of India.

Among the children detected with CHD, 53.7% (22/41) had up-to-date immunization and 46.3% (19/41) had an incomplete immunization status ($P = .012$; df = 1) according to the national immunization schedule, which is statistically significant.

Murmur

Of the 41 children with CHD, in one child murmur could not be appreciated on clinical examination but was found to have CHD on ECHO. Though presence of a murmur is a very good indicator of underlying CHD, absence does not rule out CHD. Hence, good clinical skills are of utmost importance in diagnosing CHDs.

Hemoglobin

The mean Hb level in children detected with CHD was found to be 10.01 g/dL; the mean Hb level in the non-CHD group was 9.78 g/dL; and that of the entire study group was 9.88 g/dL. The higher Hb in children with CHD, a well-known phenomenon, is due to some amount of hypoxia leading to increased erythropoietin level.

Conclusion

This hospital-based, explorative study enrolled 100 patients with recurrent LRTI to identify any underlying CHDs in them. The results reveal that CHD is a major cause for recurrent LRTIs. Considering this, it would be prudent to screen all children presenting with recurrent LRTI for CHD in routine clinical practice.

References

1. Behrman RE, Kliegman RM, Jenson HB, eds. Congenital heart disease. In: *Nelson Textbook of Pediatrics.* 19th ed. Harcourt Asia Pvt Ltd; 2000:1549–1605.
2. Park KM. *Pediatric Cardiology for Practitioners*. 5th ed. Elsevier Health Sciences; 2007:119–326.
3. Subramanyam L. Recurrent respiratory tract infection - an approach. *Indian J Pract Pediatr.* 2012;14(3):245–257.
4. Chandramouli B. The neonate with congenital heart disease: diagnosis and management. *Indian J Pediatr.* 1991;58(4):453–469.
5. Gupte S, Saini G. Congenital heart disease: Clinicoechocardiographic profile in children. *Asian J Pediatr Pract.* 2004;8(2):30–34.
6. Shreshta NK, Padmavati S. Congenital heart disease in Delhi school children. *Indian J Med Res.* 1980;72:403–407.
7. Suresh V, Rao AS, Yavagal ST. Frequency of various congenital heart diseases: analysis of 3790 consecutively catheterized patients. *Indian Heart J.* 1995;47(2):125–128.