

Clinical Characteristic and Outcome of Acute Lower Respiratory Tract Infection in Children with Congenital Heart Disease

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Abstract

Background: Acute Lower Respiratory Tract Infection (ALRTI) is the leading cause of deaths in children under 5 years of age worldwide, and has high morbidity and mortality in children with Congenital Heart Disease (CHD). The objective of this study was to obtain the incidence, clinical characteristic, and outcome of ALRTI children with CHD.

Methods: A retrospective hospital-based study was conducted from January 2007–December 2011 to medical record of child patients with ALRTI and CHD in the Department of Child Health of Dr. Hasan Sadikin General Hospital, Bandung. The diagnosis of CHD was determined by echocardiography. The collected data was analyzed and presented in percentage shown in tables.

Results : From 3,897 children who had ALRTI, there were 149 children with CHD (3.8%), with 11.4% of whom founded with recurrent episodes. This happened often in girls than boys with quite similar ratio of 1.37: 1. The majority of children (80%) was under 1 year old of age, 72.5% with malnutrition, and 24.8% with severe malnutrition. Clinical symptoms mostly found were difficulty of breathing (98%), fever (85.2%), cough (75.2%), and runny nose (63.1%). The most common types of CHD were Patent Ductus Arteriosus (47.6%), followed by Ventricular Septal Defect (47%). Bronchopneumonia (86.6%) was the common type of ALRTI. The length of stay was mostly less than 10 days (70.5%). From all the children 43.7% had complications, and 6.7% died.

Conclusions: The ALRTI in children with CHD is not common and has good outcome. The majority for CHD lesions are Patent Ductus Arteriosus and Ventricular Septal Defect while for ALRTI is Bronchopneumonia. [AMJ.2015;2(3):403–8]

Keywords: Acute lower respiratory tract infection, congenital heart disease, outcome, malnutrition

Introduction

Acute Lower Respiratory Tract Infection (ALRTI) is the most common cause of death in children under five. Most cases of ALRTI in the world occurred in developing countries and Indonesia is in the sixth place. In 2010, the National Health Profile showed that ALRTI is one of the ten most frequent cases among hospitalized patients in Indonesia and has the highest mortality rate of 1,315 death.^{1,2}

Recurrent ALRTI often occurred in children with history of congenital heart diseases (CHD). The CHD is a disease that is most frequently found in children all over the world with a percentage of 28% of all types of congenital abnormalities, and the prevalence is about 9 per 1000 live-births in the last 15

years.³ Children with CHD are more vulnerable to recurrent respiratory tract infection. Considering that the children with CHD has an anatomy defect that causes hemodynamic disturbances of lung circulation, and it ultimately put them at higher risk to suffer from recurrent respiratory tract infection than those who has no history of CHD.^{4,6}

The objective of this study was to obtain the incidence, clinical characteristic, and outcome of ALRTI children with CHD. The benefit of this study is to provide an early diagnosis for children with CHD in order to have a proper management plan.

Methods

A retrospective hospital based study was

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conducted to ALRTI children with CHD at the Department of Child Health of Dr. Hasan Sadikin General Hospital; the study was held from January 2007–December 2011. The inclusion criteria were all ALRTI children with CHD who had undergone echocardiography (confirmed CHD). The exclusion criteria were children who had not undergone echocardiography

(CHD suspect) or incomplete medical record.

The medical records were evaluated and ALRTI children with confirmed CHD were selected. The data were collected, tabulated, and analyzed by using the Statistical Package for the Social Sciences (SPSS). The results were shown in proportion, mean, or median.

Table 1 Characteristics of ALRTI Children with CHD

Characteristics	N = 149	%
Sex		
Male	63	57.7
Female	86	42.3
Age Groups		
1 month	8	5.4
2 months – 1 year	111	74.5
2–5 years	18	12.1
6–18 years	12	8.1
Nutritional Status		
Good	41	27.5
Mild malnutrition	71	47.7
Severe malnutrition	37	24.8
Clinical symptoms		
Difficulty of breathing	146	98
Fever	127	85.2
Cough	112	75.2
Runny nose	94	63.1
Others	37	24.3
Physical examination		
Chest retraction	133	89.3
Tachypnea	130	87.2
Tachycardia	112	75.2
Systolic murmur	95	63.7
Crackles	131	91.9
Cyanosis	21	14.1
Others	42	28.2
Lab		
Anemia	12	8.1
Leucocytosis	36	24.2
Chest x-ray		
Cardiomegaly	92	61.7
Increase bronchovascular pattern	113	75.8
Infiltrate	120	80.5

Table 1 Characteristics of ALRTI Children with CHD

CHD	N = 149	%
Acyanotic		
Left to right shunt		
ASD	27	18.1
VSD	70	47
PDA	71	47.6
Obstruction lesion		
Aortic stenosis	2	1.3
Pulmonary stenosis	13	8.7
Interrupted aorta	1	0.7
CoA	7	4.7
Cyanotic		
Decrease pulmonary blood flow		
TOF	7	4.7
Tricuspid atresia	1	0.7
Pulmonary atresia	5	3.4
Increase pulmonary blood flow		
TGA	4	2.7
DORV	9	6
TAPVR	3	2
Single ventricle	1	0.7
Dextrocardia	5	3.4
Valve anomalies		
Mitral regurgitation	20	13.4
Tricuspid regurgitation	7	4.7
Aortic regurgitation	1	0.7
Pulmonary regurgitation	3	2

Note: ASD: Atrial Septal Defect, AVSD: Atrioventricular Septal Defect, CoA: Coarctation of Aorta, DORV: Double Outlet Right Ventricle, PDA: Patent Ductus Arteriosus, TAPVR: Total Anomalous Pulmonary Venous Return, TGA: Transposition of Great Arteries, TOF: Tetralogy of Fallot, VSD: Ventricular Septal Defect

Results

There were 3,897 children who suffered ALRTI and 149 of them were with history of CHD, who had already been confirmed by echocardiography and written on medical record, therefore, the incidence was $(149/3,897) = 3.8\%$. Out of 149 children, 17 (11.4%) children had recurrent ALRTI.

The incidence of ALRTI in children with CHD were often found in girls than in boys with quite similar ratio of 1.37:1, and it occurred more frequently in children under 1 year of age (80%). The median of age in this study was 6 months with the range of 1–156 month (one-month old–13 years old). Most of the

children (72.5%) had malnutrition of whom 47.7% with mild malnutrition and 27.5% with severe malnutrition. Malnutrition was associated with additional diagnosis of Failure to Thrive (12.8%). Almost entire children who came to the hospital were complaining about breathing difficulty (98%), cough (75.2%), fever (85.2%), and runny nose (63.1%). Those are common signs and symptoms of ALRTI. Other symptoms were only complained by several children and probably associated with other common diseases that the children have e.g. diarrhea (10.1%), seizure (4.7%), vomit (4.7%), breast feeding difficulty (3.4%), decreased level of consciousness (0.7%), and icteric (0.7%).

Table 3 Type of ALTRI

ALTRI	N = 149	%
Bronchopneumonia	128	86.6
Bronchiolitis	16	10.7
Lobar pneumonia	4	2.7
Laringotracheo bronchitis	1	0.7

According to statistical data tabulation for vital signs, the median for pulse rate was 134 times/minute (64–182), the median for respiratory rate was 56 times/minute (18–82), and the mean for temperature was 37.60C + 0.95. Tachypnea (87.2%) and tachycardia (75.2%) were the most common signs found for vital abnormality. Most of the children (893%) had chest retraction, but cyanosis was found only in a small number (14.1%) of the children with cyanotic CHD. Abnormal heart sounds frequently heard on auscultation was systolic murmur (63.7%), and the most common additional breathing sound was crackles (91.9%). Other findings on physical examination were found in a small number of children such as continuous murmur (16.7%), wheezing (10.7%) and stridor (0.7%).

Only few children were with leukocytosis (24.2%), so most of the children had a normal number of white blood cells. Only a small number of children had anemia (8.1%). As shown in the chest x-ray, infiltrate (80.5%) and increase of Broncho vascular pattern (75.8%) were the common findings in children with ALRTI. Enlargement of the heart (cardiomegaly) was found in most of the patients (92%) related to CHD.

The CHD was commonly found in children hospitalized with ALRTI, and the most common defect were PDA (47.6%) and VSD (47%). Both diseases defected with the presence of shunt from left to right. The most common type of ALTRI was bronchopneumonia (86.6%).

Based on statistical data tabulation for length of stay, the median was 8 days (1–58). In this study, most of the children hospitalized were in range of 1–10 days (70.5%). As much as 83.9% of the children was discharged with good condition. Some of the children had complications, such as heart failure (22.8%) and respiratory failure (16.1%), however, only few children died (6.75%).

Discussion

The incidence of ALRTI in children with CHD is lower than a previous study by Owayed et al.⁷, which reported the incidence of CHD children hospitalized because of recurrent pneumonia was 9%. The low result of this study is probable since not all of the children have undergone the echocardiography, or as this is a single center study. In Indonesia, there are still many children who have no health service coverage

Table 3 Type of ALTRI

Outcome	N = 149	%
Length of stay		
1–10 days	105	70.5
11–20 days	33	22.1
21–30 days	10	6.7
>30 days	1	0.7
Outcome		
Good	125	83.9
Death	10	6.7
Complication		
Heart failure	34	22.8
Respiratory failure	24	16.1

because of the low socio economic status and the fact that the social health insurance does not cover the echocardiography cost yet.

Recurrent ALRTI in children with CHD was more frequently in baby under 1 year of age. This fact is due to the low capacity of children immune system and the small size of respiratory tract. The lesion commonly found was left to right lesion, which caused low vascular resistance that would increase the vulnerability of infection in child with CHD.⁵ Nutritional disturbances will affect immune system, therefore it will increase the risk of infection and slowing down the healing process. Study by Caulfield et al.⁸ in 2004 showed that 52.3% of death due to ALRTI was associated with malnutritions.⁸ In the study generated by Nataprawira et al.⁶, showed that malnutrition was one of risk factors for morbidity and mortality of severe pneumonia on children under age of 5. Malnutrition associated with Failure to Thrive (FTT). In this study, FTT was found in 12.8% children. Shah et al.⁹ reported FTT was found in 11.9% children with CHD. The FTT is a major symptom of CHD because of low energy expenditure, inadequate food intake, and malabsorption or feeding difficulties.

According to WHO classifications for pneumonia; if difficulty of breathing occurred, then a child should be diagnosed with severe pneumonia and required hospitalization. Tachypnea was symptoms of respiratory disturbance which has high both sensitivity and specificity in diagnosing pneumonia. Crackles (wet ronchi) was specific additional breath sound found in children with pneumonia.^{10,11}

The ALRTI, caused by neither virus nor bacteria, was often preceded by upper respiratory tract infection for several days.¹² Children with CHD are at risk for increased morbidity from viral lower respiratory tract infections because of anatomical cardiac lesions than can worsen an already compromised respiratory status.¹³ However, it is difficult to differentiate between bacterial and viral infection only by clinical symptoms and physical examination. Therefore, many broad spectrum antibiotics are empirically used in management of ALRTI.¹⁰ Based on our study, the most frequent initial antibiotic given were ampicillin (35.6%) and combination between ampicillin and gentamicin (14.1%). In our institution, ampicillin is the initial antibiotic given, but in severe clinical condition, initial antibiotic given is combination of ampicillin and gentamicin or ampicillin and chloramphenicol.¹⁴

Chest X-ray image inpatient with ALRTI can be in form of mild infiltrate in one lung until extensive consolidation in both lungs. The presence of infiltrate and the increase of Broncho vascular pattern are specific radiologic findings for bronchopneumonia.¹⁰ If cardiomegaly was present, then a patient is more likely to be diagnosed as heart failure. This phenomenon happened because of wide shunt from right side to left side of the heart.¹⁵ If heart failure exist, the child should be given anti heart failure drugs such as diuretic (furosemide), vasodilator (captopril) and digitalis (digoxin).¹⁵ Based on the study, the combination of those three drugs were the most frequent anti heart failure drugs given (11.4%).

In the study generated by Wilar and Wantania⁵, acyanotic CHD (61.7%) has greater number of patients than cyanotic CHD (38.3%), and ALRTI occurs more frequent in children with CHD than in normal children, especially children with bronchopneumonia (86.6%). Cahyono and Rachman⁴ reported that 50% of death case in children with CHD was underlined by pneumonia.

The child who was hospitalized only for 1 day was due to severe complication that causes death. In ALRTI without complications, length of stay within antibiotic administration was 7–10 days less or more.¹⁰ The most common indicator for the use of ventilator was acute respiratory failure which was frequently caused by bronchopneumonia (31.1%) and the majority was under the age of 1 year.¹⁶ A child who died is suspected due to improper management or severe complications. Respiratory and cardiac failure were two leading cause of death and death rate was significantly high in malnourished children.⁴

Limitations of this study were unavailable medical record or incomplete medical record data. Since this study was a hospital-based type, the data were obtained from a single health center only, therefore the result is not quite representative, and not all the patients underwent echocardiography.

As a suggestion, a further study in children with CHD who have been hospitalized due to ALRTI that involve several health centers is necessary. Clear registration and administration of medical records should be enforced thus, all data in medical records can be completed. Furthermore, improving the health services system in order to extend the coverage of health services especially for those with financial limitation is needed. Also it is important to increase suspiciousness

in the present of CHD and encourage echocardiography test for children with recurrent ALRTI and failure of thrive.

The incidence of ALRTI children with CHD is 3.8%, in which 11.4% children had recurrent ALRTI. Nutritional status for severe malnutrition, moderate malnutrition, and good nutritional status were 47.7%, 24.8%, and 27.5%, respectively. The most frequent clinical symptoms were difficulty of breathing (98%), fever (85.2%), cough (75.2%), and runny nose (63.1%). The most common type of CHD was PDA (47.6%) and VSD (47%), whilst type of ALRTI was bronchopneumonia (86.6%). The length of stay of patients was less than 10 days (70.5%) and the outcome was mostly good (83.9%) Even though almost half of the patients present were with complications (43.7%), but only a small number resulted in death (6.7%).

References

1. Wardlaw T, Johansson EW, Hodge M. Pneumonia: the forgotten killer of children. UNICEF. 2006 [Cited 2012 April 15]. Available from: <http://www.unicef.org>.
2. Kementrian Kesehatan RI. Profil kesehatan Indonesia. Kementrian Kesehatan RI. 2010 [Cited 2012 April 15]. Available from: <http://www.depkes.go.id>
3. van der Linde D, Konings EEM, Slager MA, Witsenburg M, Helbing WA, Takkenberg JJM, et al. Birth prevalence of congenital heart disease worldwide. *J Am Coll Cardiol*. 2011;58(21):2241-7.
4. Cahyono A, Rachman MA. The cause of mortality among congenital heart disease patients in pediatric ward, Soetomo General Hospital (2004-2006). *J Kardiologi Ind*. 2007;28(4):279-84.
5. Wilar R, Wantania JM. Beberapa faktor yang berhubungan dengan infeksi saluran pernapasan akut pada anak dengan penyakit jantung bawaan. *Sari Pediatri*. 2006;8(10):154-8.
6. Nataprawira HM, Alwi EH, Adriani N. Faktor risiko morbiditas dan mortalitas pneumonia berat pada anak usia balita. *Maj Kedokt Indon*. 2010;60(10):443-7.
7. Owayed AF, Campbell DM, Wang EEL. Underlying causes of recurrent pneumonia in children. *Arch Pediatr Adolesc Med*. 2000;154(2):191-4.
8. Caulfield LE, Onis Md, Blossner M, Black RE. Undernutrition as an underlying cause of child's death associated with diarrhea, pneumonia, malaria and measles. *Am J Clin Nutr*. 2004;80(1):193-8.
9. Shah G, Singh M, Pandey T, Kalakheti B, Bhandari G. Incidence of congenital heart disease in tertiary care hospital. *Kathmandu Univ Med J*. 2008;6(21):33-6.
10. Said M. Infeksi respiratori akut: Pneumonia. In: Rahajoe NN, Supriyatno B, Setyanto DB, editors. *Buku ajar respirologi anak*. 1st ed. Jakarta: Ikatan Dokter Anak Indonesia. 2010. p. 350-64.
11. Palafox M, Guiscafre H, Reyes H, Munoz O, Martinez H. Diagnostic value of tachypnoe in pneumonia defined radiologically. *Arch Dis Child*. 2000;82(1):41-5.
12. Sectish TC, Prober CG. Pneumonia. In: Kliegman RM, Behrman RE, Jensen HB, Stanton BF, editors. *Nelson Textbook of Pediatrics*. 18th ed. Philadelphia: Saunders; 2007. p. 1795-800.
13. Geskey JM, Cyran SE. Managing the morbidity associated with respiratory viral infection in children with congenital heart disease. *Int J Ped*. 2012;2012:646780.
14. Kartasmita CB, Suardi AU, Nataprawira HM, Sudarwati S, Wulandari DA. Respirologi. In: Garna H, Nataprawira HM, editors. *Pedoman diagnosis dan terapi ilmu kesehatan anak*. Bandung: Departemen Ilmu Kesehatan Anak Fakultas Kedokteran Universitas Padjadjaran; 2012. p. 781-878.
15. Firman A, Rahayuningsih SE, Kuswiyanto RB. Kardiologi. In: Garna H, Nataprawira HM, editors. *Pedoman diagnosis dan terapi ilmu kesehatan anak*. 4th ed. Bandung: Departemen Ilmu Kesehatan Anak Fakultas Kedokteran Universitas Padjadjaran; 2012. p. 477-559.
16. Hakim DL, Ismawaty N. Karakteristik penderita yang mendapat tindakan ventilasi mekanik yang dirawat di ruang perawatan intensif anak Rumah Sakit Hasan Sadikin Bandung. *MKB*. 2007;39(2):75-9.