The impacts of pericardial effusion on the heart function of infants and young children with respiratory syncytial virus infection

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Abstract

Patients infected with RSV may demonstrate clinical manifestations other than lower respiratory tract infection including cardiac involvement. The heart involvement following RSV infection varies from heart block, ventricular arrhythmia or a variable degree of pericardial effusion.

This study was conducted to assess the impact of RSV infection on pericardial effusion and to compare the heart function among those with and without effusion in infants and children less than two years of age. All infants and children below the age of 2 years admitted with lower respiratory tract infection due to RSV infection over four year period were included in the study. Children with congenital heart diseases were excluded from the study. Electrocardiography, chest X-ray, echocardiography and color Doppler was performed to all the cases. Pericardial effusion was assessed by 2D echocardiography standard views, and long axis parasternal view was chosen for comparison and measurements M-mode echocardiograms were used to determine right ventricular dimensions. Doppler flow through the tricuspid valve was performed in four chambers. Pulmonary flow velocities in late diastole and time intervals were measured using a pulsed Doppler. These studies were performed during the acute illness within 72 hours of hospital admission.

There were 83 children with a mean age was 7.05 months (±11) admitted with LRTI due to documented RSV infection and included in this study. Significant pericardial effusion (≥ 2.5mm.) was seen in 23 (27.7%) with a mean age of 8.4 months (± 8.8). There were significant statistical differences in heart function profiles studied between children with and without effusion.

From this study we concluded that pericardial effusion is not an uncommon association with lower respiratory tract infection (LRTI) due to respiratory syncytial virus (RSV) infections, its incidence in this study found to be 23/83 RSV infection has pericardial effusion that is around 27.7%. However, the presence of effusion is not associated with a statistical differences effect on the heart function profiles when compared to those without effusion.

Introduction

Respiratory syncytial virus (RSV) is the most important viral infection of the lower respiratory tract during infancy and early childhood [1]. It is associated with significant morbidity and is a common cause for hospitalization in infants(2). Of these hospitalized infants, the most severely affected are those with chronic lung diseases, congenital heart disease and immunocompromised infants The mortality rate in congenital heart disease infants is reported to be as high as 37% [3]. RSV infection is associated with myocarditis and heart block [4,5] and has been also suggested as a cause of pericardial disease with pericardial effusion and cardiac tamponade [5]. The noninvasive assessment of global cardiac function and pulmonary artery pressure is suitable to elucidate the pathophysiologic mechanisms underlying the cardio-pulmonary interaction in patients with acute RSV infection in young age group (6). This

prospective study was conducted to assess the impact of respiratory syncytial virus infection on the frequency of pericardial effusion and to study a comparison in the heart function in infants and children with and without pericardial effusion.

Subjects and Method

Patients admitted to the Pediatric Wards and Intensive Care Unit at King Khalid University Hospital (KKUH), Riyadh with lower respiratory tract infection (LRTI), over a four-year period (2003-2007) constitute the subjects of this study. All patients who were <2 years of age with LRTI and positive nasopharyngeal aspirate (NPA) for RSV (ELISA, Vidas, Beckton Dickinson, Oxford, UK) were included in the study. After detailed history and physical examination, each child had an ECG, chest X-ray, two-dimensional (2D) echocardiography examination and Doppler studies using a commercially available instrument (Philips model 5500, 5-8 MHz transducer). Initially, 2D-echocardiographic views were recorded in standard parasternal long axis, short axis, apical 4-chamber, subcostal and suprasternal. Color Doppler, and pulse and continuous wave Doppler analyses were also performed on all patients. All echocardiography studies were reviewed by one pediatric cardiologist. All patients with positive findings or impaired function were evaluated at least two times before being discharged from the hospital.

Infants with history or finding suggestive of an established cardiac disease were excluded from the study. Studies were performed during the acute illness within 72 hours of hospital admission. All infants were symptomatic at the time of the study and they were clinically assessed and followed up by the treating pediatric team daily. All studies were performed without sedation.

Pericardial effusion was assessed by 2D echocardiographic standard views, and long axis parasternal view was chosen for comparison and measurements. In the absence of accurate measures of pericardial effusion in infants and children, and since a thin layer of pericardial fluid up to 2 mm is commonly seen in infants, we have chosen 2.5 mm layer of pericardial effusion to be significant in this study.

M-mode echocardiograms were used to determine right ventricular dimensions.

Doppler flow, through the tricuspid valve, was performed in four chamber view, with E wave, A wave and the ratio E:A. Additionally, right ventricular out flow tract (RVOT), flow velocity in late diastole (DW), systole (SW) and its ratio DW/SW were measured. Pulmonary flow velocities in late diastole and time intervals were measured using a pulsed Doppler technique. A sufficient number of beats were chosen to overcome any variation due to respiration. Heart rate was calculated from the simultaneously obtained ECG.

Echocardiography was repeated for each patient before discharge from hospital and compared to the initial study.

Statistical analysis

The data was recorded in a structured data collecting sheet, and then entered into MS Excel. The statistical analysis was carried out using SPSS Pc+ version 10.0 statistical software. Descriptive statistics (mean and standard deviation) were used to describe the quantitative variables. A student's t-test for independent samples was used to compare the mean values of study variables of infants with and without pericardial effusion. And Mann-Whitney test was used to compare the median values of a non-normal study variable. A p-value of <0.05 was considered to be statistically significant.

Ethical Issue

The ethical committees of King Khalid University approve the study and a written consent was signed from each of patients guardian.

Results

A total of 83 patients satisfied the entry criteria and were enrolled in this study. Their mean (± SD) age was 7.05 months (±11) at presentation. There were 47 male and 36 females (M:F ratio 1.3:1), and the mean body weight was 6.3 kg (± 1.4). Two infants were excluded because they have CHD and both had ventricular septal defects.

Twenty-three infants (27.7%) were found to have a significant pericardial effusion (≥ 2.5 mm) during their acute RSV infection. Of this group, there were 11 males and 12 females (M: F = 0.92: 1). Their weight ranged from 2.5 – 7.5 kg, (mean ± SD)= 7.05 ±3.1 kg). The mean age was 8.4 months (± 8.8) and the mean duration of hospitalization was 8.8 days (± 3.9). Pericardial effusion measurements ranging between 2.5 mm and 4.9 mm (mean = 3.3 mm) was found in 23 patients (27.7%). Table 1 details a comparison of demographic and clinical characteristics of children, with and without pericardial effusion, namely the age (in months), weight, duration of hospital stay, duration of oxygen requirement and duration of fever, revealed no statistically significant difference between the two groups.

Table 1: Comparison of epidemiological and clinical characteristics of RSV patients in Relation to pericardial effusion.

Characteristics	Pericardial effusion		t-value	p-value
	Yes N = 23	No n = 60		
Age in (months) median [range]	6 [0.76-36]	3 [0.40-84]	-	0.15
Weight in kg [± SD]	7.05 [3.1]	6.0 [2.6]	1.53	0.13
Duration of hospital stay in days [± SD]	8.8 [3.9]	7.9 [3.5]	0.88	0.38
Duration of oxygen requirement in days [± SD]	3.9 [3.3]	4.2 [2.9]	-0.29	0.77
Duration of fever days [± SD]	2.4 [1.5]	1.96 [1.3]	1.15	0.25

Table 2: Comparison of mean (±SD) values of clinical and echocardiographic characteristics of RSV patients in relation to pericardial effusion.

Characteristics	Pericardial effusion		t-value	p-value
	Yes N = 23	No n = 60		
Oxygen saturation	96.5 (3.5)	96.8 (2.7)	-0.32	0.75
Respiratory rate on admission	51.7 (9.9)	56.5 (11.5)	-1.73	0.08
Long parasternal RV diameter	9.7 (2.0)	8.4 (2.3)	2.08	0.04*
Doppler four chamber: peak E wave	0.61 (0.26)	0.71 (0.18)	2.09	0.03*
Doppler four chamber: peak A wave	0.49 (0.24)	0.61 (0.19)	2.24	0.02*
Doppler four chamber: EA ratio	1.22 (0.48)	1.12 (0.26)	1.13	0.26
RVOT velocity: Late diastole (DW)	0.42 (0.25)	0.52 (0.18)	1.94	0.05
RVOT velocity: Late systole (SW)	0.43 (0.26)	0.53 (0.17)	2.06	0.04*
RVOT velocity: DW/SW	1.36 (0.49)	1.15 (0.5)	1.45	0.15

*statistically significant
Abbreviations: A, peak atrial flow velocity; DW, peak right ventricular outflow velocity during late diastole.; E, peak early diastolic flow velocity;RSV,respiratory syncytial virus; RVOT, right ventricle outflow tract. SW, peak right ventricular outflow velocity during late systole;

The finding of ECG and CX ray in the group with and without effusion were comparable without any statistical differences between the two groups.

At follow-up, all infants had completely recovered from the symptoms that prompted hospitalization and all cardiopulmonary findings were normal.

The mean (± SD) values of initial tricuspid inflow E wave, A wave, E/A ratio, right ventricular end-diastolic diameter, right ventricular out flow tract (RVOT) flow velocity in late diastole (DW), systole (SW) and its ratio DW/SW were compared between the pericardial effusion group and non-pericardial effusion group (Table 2). There were a significant statistical differences between these two groups in relation to long parasternal RV diameter, E wave, A wave and RV velocity in late diastole (SW) [$p < 0.05$], suggesting right ventricular dysfunction. And there were, no significant statistical differences found for the E:A ratio, RVOT late diastole (DW) and RVOT velocity DW/SW ratio (Table 2). Left ventricular function i.e. ejection fraction (EF) was within normal range for age at the initial and the pre discharge studies. Comparison between initial and pre discharge echocardiography showed variable degree of pericardial effusion regression. with a good outcome.

Discussion

Although several studies have been published regarding the epidemiology of RSV infection and its pathophysiology, there have been few published reports investigating the extrapulmonary complications of RSV infection. Respiratory syncytial virus (RSV) is the most important viral infection of the lower respiratory tract of infancy and childhood. It was reported that RSV infection is leading to 38% of hospitalization days for all respiratory infection and 6% of those hospitalized due to respiratory failure (7). In this study 83 children were admitted over 4 years duration because of LRTI due to RSVinfection.

2Dechocardiography was used to assess the presence of pericardial effusion. The presence of a significant pericardial effusion (≥ 2.5mm.) was seen in 27.7%. There are no statistical differences in the demographic and clinical characteristics between children with and without effusion as detailed in Table 1.

Right ventricular end diastolic diameter, as measured using M-mode echocardiography, and Doppler studies of tricuspid inflow waves and right ventricle outflow tract flow velocity were used to assess right ventricular function. Previous studies, in which these measurements were used, have shown a positive correlation between either right ventricular systolic time intervals or various Doppler flow measurements with pulmonary artery pressure and resistance. (8-12)

Several investigators have suggested that right ventricular systolic time intervals in individual patients cannot accurately predict pulmonary artery pressure due to the wide confidence intervals for regression lines generated from invasive studies and the variable effects of right ventricular contractility and loading condition of this measurement. (8,13-15)

Recent studies have recommended using right ventricular tract pattern and the inflow tract pattern, which we applied in our study. Furthermore, the DW and the DW/SW ratio may especially present good alternatives to traditional parameters (16). However, the objective of this study was not to predict pulmonary artery pressure, or resistance, in individual patients but to determine whether differences existed between groups with pericardial effusion and non-pericardial effusion associated LRTI due to RSV infection. Some differences in right ventricular function were demonstrated clearly in this study (Table 2) between infants with and without pericardial effusion which may suggest that an elevation of pulmonary artery pressure and/or resistance is associated with the development of pericardial effusion. This finding support the benign course of LRTI due to RSV infection whether non-significant pericardial effusion is present or no effusion in children with normal heart structure, However, this may be associated with sever morbidity or morality in children with a significant pericardial effusion and/or associated congenital heart disease.

Conclusion

From this study we concluded that pericardial effusion is not an uncommon association with LRTI due to RSV infections. However, the presence of effusion is not associated with a statistical differences effect on the heart function profiles specifically, long parasternal RV diameter, E wave, A wave and RV velocity in late diastole (SW), suggesting right ventricular dysfunction, as well as E:A ratio, RVOT late diastole (DW) and RVOT velocity DW/SW ratio. A larger multicenter center study is highly recommended to verify this finding.

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