Original Article

Evaluation of Cardiac function changes in children with Bronchiectasis admitted to Mofid Children's Hospital

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ABSTRACT

Background: Bronchiectasis is a chronic respiratory disease which occurs as a consequence of inflammation and destruction of the structural components of the bronchial wall. This study was aimed to determine of cardiac function changes in children with bronchiectasis admitted to Mofid Children's hospital, Tehran, Iran. Methods: In this study, 30 patients with bronchiectasis were enrolled in this study and their identification data, weight and height were recorded in the data collection form. Modified Reiff Score was measured. The patients were referred to the pediatric cardiologic clinic and echocardiography was performed by a pediatric cardiologist at the resting state in supine or left-lateral position and compared them with 30 healthy age- and gender-matched control subjects. All data was entered and analyzed using SPSS version 21. Results: The mean age was 12.0 years and 17 patients (57%) were males. The severity of the disease was in 10 patients (33%) mild, 18 cases (60%) moderate and 2 cases (7%) severe based on clinical score. The mean score of the Modified Reiff Score was 8.4±3.5. The value of RVMPI and LVMPI in patients with bronchiectasis was higher compared with the control group. There was a positive correlation between the Modified Reiff Score and the clinical score ($r = 0.719$, $P < 0.001$), which is highly significant indicating the increase of clinical status along with Modified Reiff score. Conclusions: According to the findings, it can conclude that increasing the Modified Reiff Score can be a good predictor of the clinical status of patients with bronchiectasis.

Keywords: Bronchiectasis, Children, Echocardiography, Spirometry.

Introduction

Bronchiectasis is a destructive lung disease characterized by abnormal bronchial expansion associated with a lung-resistant inflammatory process. The prevalence of bronchiectasis is unknown. Severe bronchiectasis is less common in developed countries, possibly related to the improvement of social and economic conditions, vaccination against measles and pertussis, and effective antibiotic treatment for childhood and young childhood infections [1]. Bronchiectasis is a result of a wide variety of causes that are increasingly described [2].

The dilatation of airways caused by chronic airway infections gradually leads to impairment in lung function and quality of life, and the need for repeated antibiotic treatment is required [2, 3]. Non-CFC bronchiectasis is a chronic respiratory disorder associated with frequent coughing, sputum, and respiratory infections [4]. Pathologically, patients have a dilated abnormal bronchus, which leads to an impairment in host defense, chronic bacterial colonization and airway inflammation [5, 6]. Clinical decision-making relies on the accuracy of identifying patients at high risk of mortality, hospitalization and exacerbation of the disease. [2] In the 1950s, researchers reported the possibility of hemodynamic changes in the lung of patients with bronchiectasis [7], chronic hypoxia in patients with bronchiectasis may ultimately lead to Right Ventricular Hypertrophy (RVH), one of the conditions for functional and structural changes in the heart. Cardio-pulmonary failure has

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also been reported in children with cystic fibrosis [8, 9]. Bronchiectasis has also been shown to reduce the oxygen saturation and increase the resistance of the pulmonary arteries [10, 11].

In addition to the presence of emphysema, the reduction of carbon monoxide transport coefficient in patients with bronchiectasis can be explained by pulmonary hypertension (PH) [12, 13]. In a study of 94 patients, echocardiographic findings indicated that nearly one-third of people with high blood pressure had pulmonary hypertension [14]. However, due to the lack of studies on cardiac function changes in patients with bronchiectasis, the rate of cardiac involvement in this disease remains unknown. Therefore, this study was aimed to determine the changes in cardiovascular function in children with bronchiectasis who were referred to Mofid children's hospital.

Methods and Materials

This descriptive-analytic study was carried out on 30 patients. The data collection method was examination, observation and interview. The sample size was calculated according to Akalin F et al .[15] and the following formula was used:

$$P=0.21,\ d=0.15 \text{ and } \alpha= \%5$$

$$n = \frac{Z_{1-\alpha/2}{}^2 (p_1(1-p_1))}{(d)^2} = \frac{1.96^2(0.21 \times (1-0.21))}{(0.15)^2} \cong 28$$

Therefore, the sample size was 28 children eligible for entry. The sampling method was convenience and non-random. In this study, all patients with bronchiectasis who were admitted were studied. Initially, the objectives of the plan were presented to patients and their parents and, if they agreed to participate in the present plan, they received written informed consent. The data such as age and gender were entered into the data form and their weight and height were measured and recorded. The causes of bronchiectasis were determined following the recommendations of the British Chest Association (BTS) guidelines [6].

In physical examinations some variables such as exacerbation of symptoms in three months and one year ago, history of hemoptysis and surgery, persistent cyanosis or with severe symptoms, clubbing, lung auscultation, cough and sputum, weight loss, activity levels and drug treatments including Bronchodilators and how to use were recorded to evaluate the clinical status of patients in addition to expressing the frequency and severity of the symptoms.

The patients were referred to a pediatric cardiologic clinic and echocardiography was performed by an individual (pediatric cardiologist). In the supine and left-lateral. In cardiac echocardiography, the cardiac status was evaluated for both systolic and diastolic function and the size of the heart cavity and the size of the valves, valvular deficiency and pulmonary artery pressure. Echocardiographic findings were also entered in the patient's form.

Also, 30 apparently matched healthy individuals were considered as control group regarding age and gender and underwent echocardiography. Echocardiographic findings of patients with bronchiectasis were compared with those in the control group.

Statistical analysis

In this study, quantitative variables have been used as the mean and standard deviation, and for qualitative variables, frequency and proportion have been used. T-test, χ^2, and Fisher tests were performed.

Results

A total of 30 patients were evaluated, in a such way that 13 patients (43%) were female and 17 patients (57%) were male. The mean age of the children was 12 $\pm$ 4.3 years with a range of 5.2-18 years (chart 1).

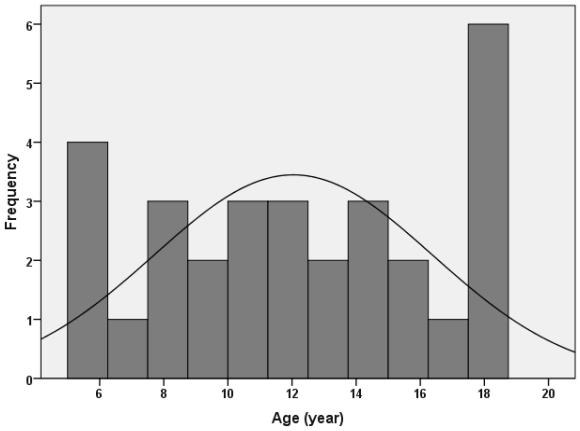

Chart 1: Distribution of age of patients with bronchiectasis referring to the Mofid children's hospital

The mean vital signs of patients are summarized in table 1. Hence, 10% of patients had hypoxemia, 20% had tachycardia and 10% had hypertension, as well as growth indices are presented in table 2.

Table 1: Distribution of vital signs in patients with bronchiectasis referring to Mofid children's hospital

Variable	Mean	Stand. Deviation	Min	Max
Heart rate	91	7.6	85	110
Spo2	93.7	4.2	75	99
Systolic blood pressure	112.5	11.3	95	145
Diastolic blood pressure	74.6	7.1	63	90

Table 2: Distribution of growth indices in patients with bronchiectasis referring to Mofid children's hospital

Variable	Mean	Stand. Deviation	Min	Max
Height (cm)	140.1	20.3	105	173
Weight (kg)	33.6	14.8	13.4	61.6
BMI (kg/m^2)	16.3	4.2	10.7	26.6

Findings from the underlying cause in patients indicated that 21 patients (70%) had cystic fibrosis and 9 patients (30%) had PCD (Chart 2).

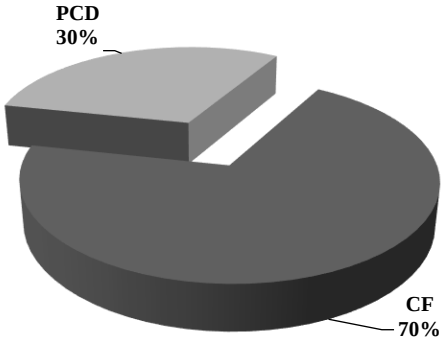

Chart 2: Distribution of underlying cause of bronchiectasis in patients referring to the Mofid children's hospital

The mean score of the Modified Reiff Score was 8.4±3.5 (**Chart 3**). Based on the Modified Reiff Score, the severity of the disease was mild in 9 patients (30%), moderate in 19 patients (63%) and in 2 patients severe (7%) (Chart 4).

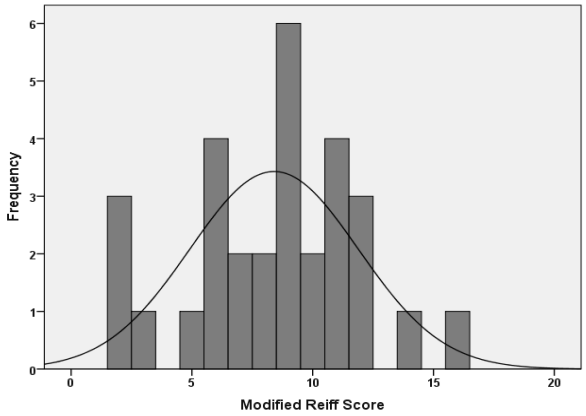

Chart 3: Distribution of Modified Reiff Score in patients with bronchiectasis referring to the Mofid children's hospital

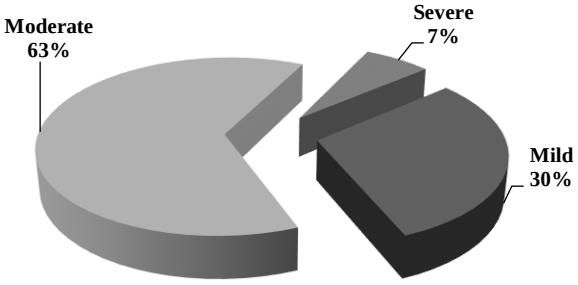

Chart 4: Distribution of severity of bronchiectasis based on the modified Reiff score in patients referring to the Mofid children's hospital

In our study, the clinical score of 30 patients was between 6 and 30 (12.2±5.2). Based on the clinical score, the severity of the disease was mild in 10 patients (33%), moderate in 18 patients (60%) and severe in 2 patients (7%).

There was a positive correlation between the Modified Reiff Score and the clinical score (r = 0.719, P <0.001) (Chart 5).

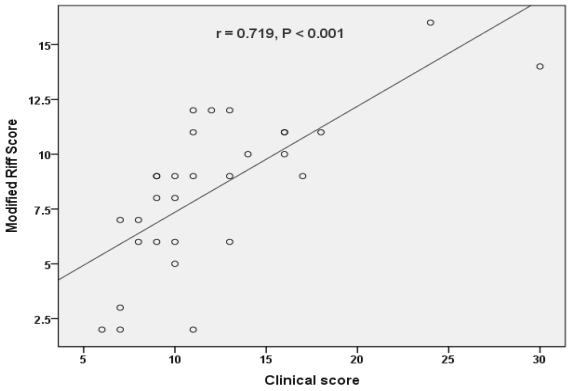

Chart 5: The correlation between Modified Reiff Score and clinical score in patients referring to the Mofid children's hospital

To evaluate echocardiographic findings, an age-matched control group with bronchiectasis patients was studied.
Echocardiography findings of the left heart showed that Am, Em / Am, Deceleration time of Em, IRT, IcT, ET and LVMPI in bronchiectasis patients had a significant difference with the control group (Table 3).

Table 3: Comparison of the distribution of left heart echocardiography findings in patients with bronchiectasis compared with control group referring to the Mofid children's hospital

Left echocardiography	Bronchiectasis	Control	P value
Left atrium (mm)	28.6±1.9	29.0±1.7	0.442
LVEDD (mm)	36.9±2.0	37.5±1.7	0.164
LVESD (mm)	24.6±2.1	25.5±1.7	0.083
IVSd (mm)	7.3±0.6	7.5±0.6	0.289
Pwd (mm)	7.1±0.6	7.2±0.6	0.425
LVFS (%)	32.7±4.3	32.0±3.4	0.510
LVEF (%)	59.8±5.5	60.8±4.0	0.640
Em (cm/s)	71.4±5.9	73.1±4.9	0.247
Am (cm/s)	47.2±7.9	42.8±5.4	0.015
Em/Am	1.5±0.2	1.7±0.1	<0.001
Deceleration time of Em (ms)	251.7±12.8	234.0±13.6	<0.001
IRT (ms)	73.6±6.9	68.8±5.2	0.004
IcT (ms)	50.7±6.8	46.8±6.9	0.029
ET (ms)	301.7±6.7	307.5±6.9	0.002
LVMPI	0.41±0.04	0.37±0.03	0.001
Diameter mV (mm)	18.7±1.7	18.5±1.5	0.746
AO (cm)	2.84±1.9	2.8±1.5	0.845

The results of right echocardiography showed that the values of Right atrium, RVESD, At, Et / At, IRTr, ICTr, ETr and RVMPI in patients with bronchiectasis were significantly different with those in the control group (Table 4). TR in 6 patients (20%), PR in 2 patients (7%), Systotic PAP in 6 patients (20%) and Mean PAP in 2 patients (7%) were high bronchiectasis group.

Table 4: Comparison of the distribution of right heart echocardiography findings in patients with bronchiectasis compared with control group referring to the Mofid children's hospital

Right echocardiography	Bronchiectasis	Control	P value
Right atrium (mm)	32.0±2.9	30.4±1.5	0.047
RVEDD (mm)	28.4±2.6	27.2±2.8	0.096
RVESD (mm)	19.3±2.6	18.0±1.8	0.026
RVFS (%)	31.8±4.0	33.5±4.1	0.101
TAPSE (mm)	19.1±3.1	20.2±2.0	0.132
Et (cm/s)	58.1±5.5	59.4±3.6	0.271
At (cm/s)	39.3±6.5	35.0±3.6	0.002
Et/At	1.5±0.2	1.7±0.2	<0.001
Deceleration time of Et (ms)	235.3±31.8	224.1±28.9	0.159
IRTr (ms)	75.7±10.7	69.2±5.1	0.009
ICTr (ms)	52.4±7.7	47.7±5.6	0.009
ETr (ms)	303.3±7.3	308.1±8.0	0.017
RVMPI	0.42±0.06	0.37±0.03	<0.001
Diameter PA (mm)	19.6±3.0	18.4±1.7	0.158
Diameter TV (mm)	28.2±2.4	27.2±1.6	0.072

Discussion

Bronchiectasis was often a lethal or severe disease in the pre-antibiotic period. However, in developed countries, other infections do not lead to structural abnormalities and functional disorders. In developing countries, bronchiectasis is still a challenge for pediatricians [16]. In this study, 30 patients with bronchiectasis with mean age of 12 years were studied, 17 patients (57%) were males. Also, thirty apparently healthy matched individuals were considered as control group regarding age and gender, so that underwent echocardiography. Echocardiographic findings of patients with bronchiectasis were compared with those in the control group.

In our study, the clinical score of 30 patients was between 6 and 30 (12.2±5.2). There were 8 patients with chronic cough and three cases of hemoptysis. Two cases of bronchiectasis undergone surgery, twenty patients had a history of exacerbation of their lung disease in the last 3 months, 29 patients used bronchodilators continuously or alternately. Based on the clinical score, the severity of the disease was mild in 10 patients (33%), moderate in 18 patients (60%) and severe in 2 patients (7%). In the present study, the mean Modified Reiff Score in the patients was 8.4 ± 3.5. In our study, 90% of patients had bipolar bronchiectasis, but in Gencer M et al., 40% of patients had bilateral bronchiectasis [17].

In the study of Akalin et al., the clinical score of 21 patients was between 0 and 25 (17.13 ± 5.7). It was found that seven had chronic cough and three cases had hemoptysis. The seven patients had been exacerbated in last year. Thirteen patients used bronchodilators continuously or intermittent [15].

Meanwhile, similar to the study of Alkalin et al., each clinical sign obtains a score with a maximum score of 34 [15]. The higher the score points to the severity of the patient's clinical status. In this study, the severity of the disease was determined by clinical scoring as follows:

Mild bronchiectasis: score < 10, moderate bronchiectasis: score 10-20; Severe bronchiectasis: score > 20.

Our goal was to evaluate the function of right ventricle (RV) and left ventricle (LV) in patients with bronchiectasis using the MPI function index, which is a new and more sensitive parameter than conventional ventricular function parameters.

The MPI index is a combination index of systolic and diastolic function of both ventricles. In our study, similar to the Gencer et al. [17], the systolic function of RV (assessed by TAPSE and RVFS) and LV systolic function (assessed by LVEF and LVFS) were not significantly different between bronchiectasis patients and the control group (P> 0.05).

Similar to Gencer et al. [17], the increase in RVMPI and LVMPI in patients not only prolonged the diastolic distance (IRTr and IRT), but also caused the difference in systolic distance (ICTr, ETr, ICT and ET). Therefore, this finding can indicate both systolic and diastolic dysfunction of the ventricles in patients with bronchiectasis. In the present study, there was a statistically significant relationship between LVMPI and RVMPI with systolic PAP and Mean PAP. (P>0.001)

In the present study, there was no significant difference between the two groups of patients with bronchiectasis and control regarding mitral, pulmonary and aortic valves diameters. A study by Rached et al. [18] entitled "Heart rate variability in patients with bronchiectasis" was performed on thirty-two patients with bronchiectasis in Brazil. In this study, 11 males and 21 females with mean age of 46 ±15 years with mean FEV1 of 60 ± 20% and 9 healthy subjects of the same age including 3 males and 6 females with mean age of 39 ± 11 years and mean FEV1 of 15 ± 99 % were examined.

Conclusion

According to the findings, it can conclude that both systolic and diastolic function of RV and LV in patients with bronchiectasis is impaired

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Conflict of interest

The authors declare that there is no conflict of interest in this study.

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