

DISCUSSION

Bronchial asthma (BA) is a common chronic inflammatory condition affecting the airways. Bronchial asthma not only affects the lung but also affects other organs including the heart. Even with mild cases, subclinical cardiac dysfunction can be documented and the severity of cardiac affection is parallel to the severity of the disease. LV diastolic dysfunction was observed in severe BA. The occurrence of supraventricular tachycardia in BA is related to the presence of interventricular septal hypertrophy, LV dysfunction, and increased PAP.⁽⁹⁷⁾ Tissue Doppler Echocardiography was found to be more sensitive in detecting cardiac dysfunction than conventional Doppler. However, these cardiac dysfunctions may be reversible especially in acute cases.^(98,99)

The number of patients with asthma who seek medical attention is increasing and accurate noninvasive tests to detect significant secondary cardiac affection leading to decreased functional status of the heart and increased mortality, is necessary and could aid in the clinical management of these patients.⁽³⁾

Although many noninvasive and invasive parameters are available for assessment of ventricular function, right ventricular function remains difficult and challenging to quantify.⁽¹⁰⁰⁾

Conventional imaging techniques such as radionuclide ventriculography and standard echocardiography have limitations when applied to the right ventricle. Radionuclide ventriculography involves exposure to radiation, is relatively expensive, has restricted availability, and is not easily repeatable.⁽¹⁰¹⁾ Magnetic resonance imaging (MRI) yields high-quality images of the right ventricle and pulmonary arteries, but even with this ostensibly “perfect” technique, interpretation of right ventricle parameters should be age-, gender-, and body surface area-normalized to determine the normality or severity of the abnormality.⁽¹⁰²⁾ Echocardiography is a bedside, innocuous, and widely available technique, but the irregular shape of the right ventricle, its retrosternal location, and the frequent coexistence of lung hyperinflation make standard “gray-scale” imaging suboptimal for the routine assessment of right ventricular function. However, tissue Doppler echocardiography (TDE) allows the measurement of regional myocardial velocities and intervals of systole and diastole.⁽¹⁰¹⁾ Accurate and reproducible tracings can be obtained even when the grayscale image is suboptimal.⁽¹⁰³⁾ Because this new method provides quantitative measures of regional function, it may be more sensitive for detecting subclinical right ventricular abnormalities.⁽¹⁰²⁾ Because TDE may detect this impairment at a stage when conventional echocardiographic indices still are normal, the use of TDE is superior to that of conventional gray-scale imaging.⁽¹⁰²⁾

This study was a case control study included 30 young adult, 15 cases were diagnosed as having bronchial asthma and 15 healthy controls.

Subjects were selected between the age of 20 and 40 years, because from previous studies subjects between this age range have the highest point-prevalence rate of asthma across all age groups worldwide.⁽⁶⁾

Most of asthmatic patients were females (93.3%) as adult women have a higher rate of asthma than men.⁽⁵⁾

In this study it was found that both groups (asthma patients and controls) were properly matched together regarding age/years (35.07 ± 6.58 and 32.20 ± 4.80 , respectively,

p-value>0.05), height/cm (156.73 ± 4.25 and 160.07 ± 5.73 , respectively, p-value >0.05) and weight/kg (74.53 ± 17.82 and 68.47 ± 10.80 , respectively, p-value >0.05).

In this study there were no statistically significant differences in systolic blood pressure (p-value >0.05) and diastolic blood pressure (p-value >0.05) between bronchial asthma patients and controls. This finding is corresponding to the study done by Soad A. Shedeed⁽¹⁰⁰⁾ who found that there were no statistically significant differences between asthmatic children and controls regarding heart rate, systolic and diastolic blood pressure. Also M.E. Abdalla, H.A.E. Azeem⁽¹⁰⁴⁾ found that there were no statistically significant differences in age, weight, heart rate, systolic and diastolic blood pressures between bronchial asthma adult patients and controls.

In this study we found that there was statistically significant difference between the bronchial asthma group and the control group regarding the pulse (p-value <0.05). This finding not corresponding to study done by Soad A. Shedeed⁽¹⁰⁰⁾ who found that there were no statistically significant differences between asthmatic children and controls regarding heart rate & also study done by M.E. Abdalla, H.A.E. Azeem⁽¹⁰⁴⁾ found that there were no significant differences between asthmatic adult patients and controls. This tachycardia may be due to multiple causes including hypoxemia or medications Mahmoud et al.⁽¹⁰⁵⁾ The study done by Shelley R. Salpeter, et al.⁽¹⁰⁶⁾ found that B2 -Agonist use in patients with obstructive airway disease increases the risk for adverse cardiovascular events, the initiation of treatment increases heart rate and reduces potassium concentrations compared to placebo. Hirono et al.⁽¹⁰⁷⁾ concluded that Long-term use of oral B2 -Agonists impaired left ventricular diastolic function in patients with BA, and the cessation of B2 agonists reversed diastolic pump performance to the normal level.

This study showed that the right ventricular echocardiographic dimensions of the asthmatic patients had no significant differences from those of the control subjects. This result corresponding to study done by M.E. Abdalla, H.A.E. Azeem⁽¹⁰⁴⁾ who found that there were no statistically significant differences in the echocardiographic indices of RV dimensions and functions between asthmatic adult patients and controls. Also the study done by Soad A. Shedeed⁽¹⁰⁰⁾ who found same result in children. Also study done by Mahmoud et al.⁽¹⁰⁵⁾, Elmasry et al.⁽¹⁰⁸⁾ and Alpaslan et al.⁽¹⁰⁹⁾ found that there were no statistically significant differences in the echocardiographic indices of RV dimensions among asthmatic patients compared to control subjects. This finding not corresponding to study done by Meilan et al.⁽¹¹⁰⁾ who reported that markedly negative swings in pleural pressure that occur in patients with lung disease may also contribute to increase in pulmonary artery pressures(PAP) and increase in venous return to right heart, RV dilatation. Also study done by K.E. Sobhy et al,⁽¹¹¹⁾ at which, the study population was fifty persons subdivided into 30 asthmatic adults and 20 healthy control subjects, showed that the prevalence of right ventricular dilatation was statistically higher among asthmatic adults (66%) than controls (0%).

By conventional doppler study on tricuspid valve flow the Peak E velocity represents the peak velocity of right ventricular filling in the early phase of diastole⁽¹¹²⁾, Peak A velocity is the peak velocity of right ventricular filling during atrial contraction at the late phase of diastole.⁽¹¹³⁾ The ratio of peak E to peak A velocity is used to describe the pattern of ventricular diastolic filling.⁽¹¹²⁾

In this study there were no statistically significant differences between two groups according to TV inflow doppler study& isovolumetric contraction time and ejection time.

This finding is corresponding to study done by Mahmoud et al.⁽¹⁰⁵⁾ who observed no significant difference in the echocardiographic indices of RV performance between the asthmatic and non asthmatic group, M.E. Abdalla, H.A.E. Azeem.⁽¹⁰⁴⁾ who found that there were no significant differences in the echocardiographic indices of RV dimensions and functions between the two groups in adults (RV wall thickness, RV diameter, E velocity, A velocity, E/A velocity ratio, isovolumetric relaxation time, isovolumetric contraction time and ejection time), also Soad A. Shedeed⁽¹⁰⁰⁾ had same result of no significant difference according conventional echo of TV E, A E/A velocity between asthmatic and non asthmatic children. This finding is not corresponding to study done by Chicherina et al.⁽⁹⁷⁾ who concluded that diastolic dysfunction of the right ventricle was the earliest hemodynamic changes in bronchial asthma. Also Eniseeva et al.⁽¹¹⁴⁾ Doppler echocardiographic study of ventricular diastolic function in 90 BA patients gave evidence for diastolic left and right ventricular dysfunction in patients with moderately and gravely running BA. The above disorders were noted by changes in the speed of transmitral and transtricuspid flows: early filling rate (E) slowing, atrial systole filling rate (A) acceleration, E/A decrease. The degree of right ventricular diastolic dysfunction depends on right ventricular hypertrophy and total pulmonary resistance. Left ventricular diastolic function is related to right ventricular after-load. This could be explained by the younger age of our study group and the well controlled asthma in our patients so that; the clinical and echocardiographic findings of chronic lung diseases are not significant, also the study done by Bagnato GF et al.⁽¹¹⁵⁾ who found when study of BA ,COPD, control groups that patients either with BA or COPD, an early involvement of the right heart even if they had a clinical stable condition and no pulmonary hypertension, by Doppler pw the peak velocity of early tricuspid flow (V max E) was significantly higher in BA patients when compared to COPD patients ($p = 0.03$).

In the current study, TDE of right ventricle diastolic function showed that asthmatic patients had an impaired relaxation pattern of the right ventricle and a consequently impaired right ventricular diastolic function. This finding corresponding to study done by Zeybek, et al.⁽⁹⁹⁾ who found that tricuspid E velocity, E/A ratio and isovolumetric relaxation time (IVRT) were significantly different in mild asthmatics and control subjects compared to those among moderate and severe cases.

In this study we found that there were statistically significant differences between the bronchial asthma group and the control group regarding the isovolumetric relaxation time (p -value <0.05). This finding is corresponding to study done by Soad A. Shedeed⁽¹⁰⁰⁾ who found significant difference between asthmatic children, non asthmatic children according to IVRT. Also a study done by Chicherina et al.⁽⁹⁷⁾ who concluded that diastolic dysfunction of the right ventricle was the earliest hemodynamic changes in bronchial asthma& study done by Osman Ozdemir et al.⁽¹¹⁶⁾ who found that IVRT and myocardial performance index of the lateral tricuspid annulus was among asthmatic children differed significantly from those of healthy children. This finding is not corresponding to the study done by M.E. Abdalla, H.A.E. Azeem.⁽¹⁰⁴⁾ as they found no significance between two groups regarding Echocardiographic parameters of RV functions (E velocity (cm/s), A velocity (cm/s), E/A velocity ratio, Isovolumetric relaxation time (ms), Isovolumetric contraction time (ms)), may be the cause is due to small sample in this study. Also it is not corresponding to the study done by mahmoud et al.⁽¹⁰⁵⁾ who observed no significant difference in the echocardiographic indices of RV performance between the two groups.

In the present study it was found that more deleterious effects were found as the severity of asthma increased where severe asthmatic cases suffered more impairment in diastolic function (IVRT) of the right ventricle than mild and moderate cases. This means patients with bronchial asthma have right ventricular dysfunction and the severity of the functional impairment is parallel with the severity of the disease. This with study done by K. E. Sobhy et al.⁽¹¹¹⁾ found the same result ,also Ozdemir O. et al.⁽¹¹⁶⁾ who found statistical difference bet asthmatic children and healthy children according to IVRT,TDI TV(E),(A)

In this study we found that there were statistically significant differences between the bronchial asthma group and the control group regarding TDI TV (TDI TV (E), TDI TV (A)) and this finding corresponding to study done by Soad A. Shedeed ⁽¹⁰⁰⁾ which showed that the clinical and conventional echocardiographic findings of asthmatic children were apparently normal, TDE study demonstrated subclinical right ventricular dysfunction, which is positively correlated with the severity of asthma. These findings signify the diagnostic value of TDE in the early detection and monitoring of such deleterious effects among asthmatic patients.

In this study we found that there were no statistically significant differences between the bronchial asthma group and the control group regarding RV strain and strain rate which is not corresponding to Soad A. Shedeed et al. ⁽¹⁰⁰⁾ when they studied 60 asthmatic children and found the patients with bronchial asthma who were stable and free of clinically apparent right ventricular failure nonetheless had significantly lower systolic velocities than the control subjects. This suggests impaired systolic right ventricular function at this subclinical stage. This finding corresponding to study done by Osman Ozdemir et al. ⁽¹¹⁶⁾ which aimed to investigate subclinical ventricular dysfunction by using conventional and tissue Doppler echocardiography in asthmatic children without any cardiovascular symptoms found no statistical difference according RV systolic function.

A possible hypothesis that may explain subclinical right ventricular dysfunction could be that asthmatic children experience bouts of pulmonary hypertension during exacerbations of respiratory symptoms, which may exert a cumulative effect, leading to right ventricular hypertrophy. Support for this interpretation comes from studies in bronchial asthma and chronic obstructive pulmonary disease. ⁽⁵⁷⁻¹¹⁷⁾

The study done by Massoud, et al. ⁽¹¹⁸⁾ reported an evidence for the role of inflammation in patient with bronchial asthma particularly among severely asthmatics on myocardial functions where such patients have chronic and sustained inflammation, which increases at the time of an exacerbation of respiratory symptoms. Various mediators and cytokines are produced during the early and late phases, including interleukins such as IL-1 beta, IL-2, IL-6, IL-8, IL-10, as well as tumor necrosis factor-alpha (TNF-a).⁽¹¹⁸⁾ These mediators are potent depressants of cardiac contractility.⁽¹¹⁹⁾ Long-term expression of TNF alpha within the heart may produce cardiac decompensation.⁽¹²⁰⁾ It is likely that chronic or repeated bouts of pulmonary infection and inflammation have a cumulative effect on cardiac function.

Arterial blood gases is important in evaluation of asthmatic patients as in this study shows that PH (7.40 ± 0.02), PCO₂ mmHg (37.45 ± 2.92), PO₂ mmHg (93.57 ± 6.57), O₂ sat%. (96.03 ± 1.56) and this with agreement of study done by Gunen et al.⁽¹²¹⁾ who show that evaluation of asthmatic patients with arterial blood gases more objective and detailed method provides important additional clinical data.

SUMMARY

Bronchial asthma is a chronic inflammatory disorder of the airways, characterized by an obstruction of airflow

The rise in negative pressure during inspiration and positive pressure during expiration which exceeds the normal right ventricular preload and after load cycle may cause an increase in intrathoracic pressure.

Strain is a measure of tissue deformation and is defined as the change in length normalized to the original length. The rate at which this change occurs is called strain rate. Deformation in a one dimensional object, such as a thin bar, is limited to lengthening or shortening.⁽⁸¹⁾

Strain and strain rate values have been studied in a number of conditions affecting the right heart, including arrhythmogenic RV dysplasia,⁽⁸⁵⁾ pulmonary embolism,⁽⁸⁶⁾ pulmonary hypertension,⁽⁸⁷⁾ systemic right ventricle,⁽⁸⁸⁾ and amyloidosis.⁽⁸⁹⁻⁹¹⁾

The aim of this work was to assess right ventricular functions in patients with bronchial asthma using tissue Doppler strain rate measurement. Correlate it with the severity of asthma attacks.

The present study was conducted at Alexandria main university hospital, Cardiology and chest departments.

The subjects were divided into two groups:

- 1) **Group I:** This group included fifteen Patients with bronchial asthma.
- 2) **Group II:** This group included age and sex matched fifteen non asthmatic healthy subjects as control group.

All subjects were subjected to:

- 1) Informed consent will be obtained.
- 2) Complete clinical examination.
- 3) Echocardiography
- 4) Group I were subjected to:
- 5) Plain-X-ray chest and heart (P-A) .
- 6) Resting electrocardiography (E.C.G) standard twelve lead E.C.G.
- 7) Arterial blood gases.
- 8) Spirometry (FEV1, FEV1% of predicted value)

In the current study, TDI of right ventricle diastolic function showed that asthmatic patients had an impaired relaxation pattern of the right ventricle and a consequently impaired right ventricular diastolic function.

In this study we found that there were statistically significant differences between the bronchial asthma group and the control group regarding the pulse (84.47 ± 9.68 bpm and 77.07 ± 6.76 bpm, respectively, p-value <0.05)

In this study we found that there were statistically significant differences between the bronchial asthma group and the control group regarding the isovolumetric relaxation time (ms) (277.40 ± 57.18 and 206.40 ± 44.63 , respectively, $p\text{-value} < 0.05$).

In this study we found that there were statistically significant differences between the bronchial asthma group and the control group regarding TDI TV (TDI TV (E), TDI TV (A)).

In the present study it was found that more deleterious effects were found as the severity of asthma increased where severe asthmatic patients suffered more impairment in diastolic function (IVRT) of the right ventricle than mild and moderate cases. This means patients with bronchial asthma have right ventricular dysfunction and the severity of the functional impairment is parallel with the severity of the disease.