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Original Research Article

Pulmonary Function Test in Asthmatic Pregnant Women at Different Trimesters

Ahmed Abdullah Ajrash Al-Khafaji[1*] Yesar Mohammed Hassan Al-Shamma[2]
[1]Babylon Health Directorate, Marjan Specialized Hospital, Hilla, IRAQ
[2]Faculty of Medicine, University of Kufa, Kufa, Al-Najaf, IRAQ

[*]E-mail: ahmedalkhafaji46@yahoo.com

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Abstract

A cross sectional study carried out in Gynecological consultancy department of AL-Zahraa Teaching Hospital for Gynecology and Pediatrics in AL-Najaf city for period from 1st of November, 2014 to end of May, 2015 on convenient sample two hundred pregnant women. The data were collected through direct interview (in private room) and fulfilling of prepared questionnaire. Pulmonary function test parameters (FEV_1, FVC, FEV_1% and PEFR) changes were estimated by using Spirolab III tool. A significant lower means of FEV_1% and PEFR were observed among asthmatic pregnant women than non – asthmatic ($p< 0.001$), there is a statistically significant lower means of BMI and FEV_1% of pregnant women in 2nd trimester than 3rd trimester ($p< 0.001$). A significant higher means of FVC, FEV_1 and PEFR for pregnant women were observed in 2nd trimester than 3rd trimester ($p< 0.001$).

Key words: Pulmonary function test parameters (FEV_1, FVC, FEV_1% and PEFR), asthma, pregnancy.

الخلاصة

اجريت دراسة مقطعية في قسم الاستشارات النسائية في مستشفى الزهراء التعليمي لأمراض النساء وطب الاطفال في مدينة النجف للفترة من١ تشرين الثاني ٢٠١٤ الى نهاية شهر مايس, ٢٠١٥ على عينة ملائمة من ٢٠٠ امرأة حامل (١٠٠ امرأة مصابة بالربو و ١٠٠ ذات حمل طبيعي غير مصابة بالربو). تم جمع البيانات عن طريق المقابلة المباشرة (في غرفة خاصة)وانجاز استبيان معد مسبقا. تم قياس التغيرات الناتجة في اختبار وظائف الرئة بواسطة جهاز Spirolab III .

حيث لوحظ وجود متوسط مهم اقل من $\frac{\text{حجم الزفير القسري الثانيةفي الواحدة}}{\text{السعة الحيوية القسرية}}$ واقصى معدل لجريان الزفير بين النساء الحوامل المصابة بالربو من غير المصابات بالربو ($p< 0.001$) , وكان هناك متوسط ذات اقل دلالة احصائية لمؤشر كتلة الجسم و $\frac{\text{حجم الزفير القسري الثانيةفي الواحدة}}{\text{السعة الحيوية القسرية}}$ من النساء الحوامل في الثلث الثاني من الثلث الثالث ($p< 0.001$) . وقد لوحظ متوسطات اعلى بكثير من السعة الحيوية القسرية, حجم الزفير القسري في الثانية الواحدة و اقصى معدل لجريان الزفير للنساء الحوامل في الثلث الثاني من الثلث الثالث ($p< 0.001$) .

Introduction

The normal pregnancy is distinguished into three trimesters (first (1st), second (2nd), third (3rd) trimesters). The typical duration of all trimesters around 38 to 39 weeks after conception [1].

The normal pregnancy undergoes different physiological, anatomical, biochemical and historical changes which can adversely affect maternal health [2]. Physiological dyspnea is common throughout normal pregnancy, it is between 18% and 42%. Rhinitis in pregnancy is often noted early in the first

trimester which continues in late pregnancy and disappears within 48 hours of delivery. [3].

Although the pregnant women have a hyperdynamic circulation due to pregnancy itself and also due to mechanical changes especially at the third trimester of pregnancy when more growing fetus and profound enlarging of uterus cause elevation of diaphragm upward about 5 - 7 cm than normal level [4]. So the hypoxia in pregnancy is also attributed to increase level of both estrogen and progesterone hormones [5,6].

Asthma is chronic disease characterized by recurrent attacks of wheezing and breathlessness which vary in severity and frequency from person to person. In an individual, they may occur from hour to hour and day to day. This condition is due to inflammation of the airway passage in the lungs and affects the sensitivity of the nerve ending in the airway which is easily irritated during attack where the lining passage is swell. Causing narrowing airway passages and reducing the flow of air in and out of the lungs [7].

The typical symptoms of Asthma include cough, shortness of breath, wheeze and sensation of chest tightness. Asthma attacks all age groups but often starts in childhood [8].

Asthma affects approximately 300 million people worldwide, about 250 thousands deaths attributed to the disease itself almost all of these deaths are avoidable [9].

Asthma is most common disease during pregnancy it is estimated thatabout 3 to 8 percentage of pregnant women have asthma [10].

The course of Asthma during pregnancy is related to the severity of asthma itself so the sever Asthmatic pregnant women have exacerbation during pregnancy more than mild asthmatic pregnant women[11].

It was reported that only 10 percent of Asthmatic pregnant women have worse effect during labour and delivery. The careful monitoring during pregnancy will prevent serious exacerbations and complication of asthma. [12] because uncontrolled Asthma will affect the fetus and cause decrease amount of oxygen supplied because the fetus needs constant amount of oxygen for normal growth and development. [13].

Pulmonary Function Test (PFT) permits an accurate measurement of the functional state of respiratory system and allows qualification of the severity of asthma during pregnancy compared to normal values that are estimated according to the basis of the height, age and race of the patient[14-16]. Many studies show decrease in the parameter of Pulmonary Function Test forced expiratory volume in first second (FEV1), peak expiratory Flow Rate (PEFR), forced vital capacity FVC, and ratio of $FEV1/FVC$ ($FEV_1\%$)percentage in pregnant women[17-21]. Few researches show increase in the (PEFR, FVC) during pregnancy. [22]. However there have been very little literature investigate the changes in lung function test during different trimesters of asthmatic pregnant women.

In 2002 [23] noted improvement of asthma control during pregnancy in 33.6%, worsing in 36.3%, unchanged control in 26.4% therefore this study was carried out to determine the changes in pulmonary function test in second and third trimesters of asthmatic pregnant women in comparison with that of non – asthmatic pregnancy.

The aims of this study is to investigate the changes in Pulmonary Function Test in asthmatic pregnant women at the second and third trimesters of pregnancy in comparison with that of non – asthmatic pregnancy.

Materials and Methods

A convenient sample of 200 pregnant women at age 18 – 45 years was selected from pregnant women attending to Gynecological consultancy department of AL-Zahraa teaching hospital for Gynecology and Pediatrics in Najaf city by special internal medicine and 100 healthy non – asthmatic pregnant were

selected after filling the inclusion and exclusion criteria.

Inclusion criteria: pregnancy, age 18 – 45 years, gestational age more than 1st trimester and asthma.

Exclusion criteria: hypertension diabetes mellitus, renal diseases, congenital heart disease, obstetrical and gynecological complicated, history of blood transfusion and bleeding, previous surgery and drug allergy and anemia, smoking or alcoholic consumption and finally twins pregnancy.

The changes in pulmonary function test parameters (FEV_1 / FVC / FEV_1% and PEFR) were estimated by spirolab III tools.

Body mass index (BMI) was calculated by Uniscale weighing scale for every pregnant women. The gestational age was estimated by Ultrasonography and all data were collected and held in a password protected computer.

Pilot study was done I month before collection of the data on 20 pregnant women (10 asthmatic and 10 non – asthmatic) were excluded from this study.

Statistical Analysis

Independent T – test (t) was used to compare between two means and one way ANOVA analysis used to compare between more than two means level of significance of ≤ 0.05 was considered as significant.

Results

There were no significant differences in age, BMI and FVC means between asthmatic and non – asthmatic pregnant women ($p>0.05$). A significant lower means of FEV1% and PEFR was observed among asthmatic pregnant women than non – asthmatic ($p<0.001$) as shown in table 1.

Table 1: Distribution of age, BMI and spirometry parameters means for all pregnant women according to presence of asthma

Variable	Asthma	Non-asthma	t-test	P
	Mean±SD	Mean±SD		
Age	32.9±9.6	32.2±8.06	0.5	0.5
BMI	32.06±10.2	30.57±6.6	1.2	0.2
FVC L	2.5±1.07	2.5±0.7	0.2	0.8
FEV1 L	1.7±0.6	2.2±0.6	5.0	<0.001
FEV1%	71.02±15.7	86.5±6.6	9.08	<0.001
PEFR L	3.07±1.4	3.7±1.3	3.6	<0.001

There was a statistically significant lower means of BMI and FEV1% of pregnant women in 2nd trimester than 3rd trimester ($p<0.001$). A significant higher means of FVC, FEV1 and PEFR for pregnant women were observed in 2nd trimester than 3rd trimester ($p<0.001$) as shown in table 2.

Table 2: Distribution of BMI and spirometry parameters means for all pregnant women according to gestational age

Variable	2nd trimester	3rd trimesters	t-test	P
	Mean±SD	Mean±SD		
BMI	29±6.6	33.6±9.7	3.9	**<0.001**
FVC L	3.06±0.9	2.09±0.5	8.8	**<0.001**
FEV1 L	2.2±0.7	1.7±0.5	4.4	**<0.001**
FEV1%	71.9±16.1	85.6±7.6	7.6	**<0.001**
PEF R	3.7±1.5	3.1±1.1	3.1	**0.002**

There was a significant association between patients with restrictive and mixed spirometry pattern and 3rd trimester ($p<0.001$) as shown in table 3.

Table 3: Distribution of age, BMI and spirometry parameters means for all pregnant women according to spirometry outcomes

Spirometry outcome	Age	BMI	FVC (L)	FEV1(L)	FEV1%	PEFR(L)
	Mean±SD	Mean±SD	Mean±SD	Mean±SD	Mean±SD	Mean±SD
Normal	30.8±7.2	30.4±7.4	3.09±0.4	2.5±0.3	83.5±3.9	4.3±0.8
Obstructive	31.7±10.06	31.3±9.7	2.6±1.1	1.7±0.7	68.06±15.7	2.9±1.5
Restrictive	33.6±8.4	30.4±5.7	2.1±0.6	1.8±0.6	89.5±7.4	3.1±1.3
Mixed	39.3±2.6	37.3±11.9	2.08±0.4	1.7±0.3	85.8±2.2	3.7±0.1
ANOVA (P value)	**0.006**	**0.03**	**<0.001**	**<0.001**	**<0.001**	**<0.001**

Discussion

Effect of asthma on pregnancy

Asthma in pregnancy is associated with high risk factor for pregnant women and their fetuses. Many literatures have shown a significantly increased risk of complications in pregnant women with asthma, especially in those with poorly controlled asthma. These complications include: prematurity, low birth weight, preeclampsia, higher proportion of cesarean section delivery and higher perinatal morbidity. Some hypotheses were raised to explain such complications, namely: 1) common etiology for uterine and bronchial hyperactivity, 2) hypoxia secondary to maternal asthma, 3) bioactive mediators released during an asthma attack, 4) finally caused by treatment of asthma through pregnancy by medications [24].

In present study, many factors affecting respiration in pregnant women were studied:

Effect of age on respiration at pregnant women

Mean age of all pregnant women in present study was 33±9 years with predominance of age group 30-39 years (40.5%). Other study in India reported mean age of selected 200 pregnant women as 32±9.2 years with prevalent age group 30-39 years [25]. Mean age of asthmatic pregnant women in our study was 33±10 with predominance of age group 30-39 years. This finding is consistent with results of previous study in Thailand which reported mean age of asthmatic pregnant women as (33 years) with prevalent middle age groups [26]. Mean age of non-asthmatic pregnant women in this study was 32±8 years with

predominance of age group 30-39 years. No significant differences were observed between asthmatic and non-asthmatic pregnant women regarding their age (p=0.05). This finding is consistent with results of the study in Hungary which found no significant difference in age between asthmatic and non-asthmatic pregnant women [27]. ANOVA analysis in this study revealed that mixed spirometry outcome was associated significantly with elderly age women (p=0.006). This finding is similar to results of other study in Italy [28] which found that restrictive ventilatory pattern was associated with elderly age and mortality..

Effect of body mass index (BMI) on respiration at pregnant women

Mean BMI of asthmatic pregnant women was 32.07±10.27Kg/m^2 with predominance of obese pregnant women (41%). This finding agreed with study in USA [29] that reported obesity prevalence among asthmatic pregnant women as 43.5%. Mean BMI of non-asthmatic pregnant women was 30.57±6.6 Kg/m^2, 44% of them were obese. There was no significant difference between asthmatic and non-asthmatic pregnant women regarding their BMI (p=0.2). This finding is similar to results of the study in Hungary [27], Pregnant women with mixed spirometry pattern in this study were associated significantly with obesity (p=0.03). This finding is consistent with reports of other study in USA [30] that found BMI of pregnant women as main risk factor of mixed (restrictive and obstructive) spirometry pattern. The rate of overweight and obesity among women in reproductive age had elevated in last decades and maternal obesity is related with high risk of pregnancy co-morbidities [31].

Previous study in USA [32] have revealed that obesity and overweight were significantly associated with high risk of asthma complication during pregnancy. These result derived from data of study on 906 women having mild asthma, 906 having moderate-severe asthma, and 928women were controls. The prevalence of pregnant women with obesity was higher among women with asthma as compared to controls (30.7% and 25.5%, respectively, P = 0.006). In same study,32% of women having moderate-severe asthma and 29.2% of the women having mild asthma (P = 0.19) were obese, compared to 25.5% in the control group (P = 0.002).

Effect of asthmatic pregnant women on spirometric parameters at 2nd and 3rd trimester of pregnancy

FVC

Mean forced vital capacity (FVC) of asthmatic pregnant women in this study was not significantly different from FVC of non-asthmatic pregnant women. This finding is similar to results of other study in India [33] that found no significant difference between asthmatic and non-asthmatic pregnant women regarding FVC. Although, there was a clear significant decrease in FVC of pregnant women (all and asthmatic) in 3rd trimester (p<0.001)which is consistent with other study in Nigeria [34]. FVC of pregnant women in our study was affected physiologically by pregnancy but not affected by asthma. As pregnancy progresses, the uterus expands and causes elevation of the diaphragm by 5-7 centimeters, resulting in a decrease in lung functional residual capacity (FRC) of 10%-25% [4].

FEV1

Mean forced expiratory volume in 1 second (FEV1) was decreased significantly among asthmatic pregnant women (p<0.001). This finding agreed with results of other studies in Denmark [35] and Brazil [24]. Pregnancy does not decrease forced expiratory volume in 1 second or peak expiratory flow rate [36]. Similar to non-pregnant women with asthma, the FEV1 and PEFR might be used for monitoring of asthma control throughout pregnancy [37].

There was a marked significant decrease in FEV1 of pregnant women at 3rd trimester (p<0.001). This finding is consistent with results of other study in

Bangladesh [38] and the study in Iraq [39] which concluded that FEV1 of pregnant women was significantly lower in 3rd trimester.

The reduction in these values of FVC and FEV1 in 3rd trimester may be due to a comparative decrease in the negativity of the intrapleural pressure occasioned by an upward displacement of the diaphragm by the enlarging uterus. Another likely reason is the reduction in alveolar PCO_2, caused by pregnancy associated hyperventilation, causing some degree of broncho-constriction. Furthermore, poor nutrition especially micronutrients in pregnancy in our environment as earlier reported may be a contributory factor [40].FVC and FEV1 of asthmatic pregnant women were decreased significantly with elderly age pregnant women [41].

FEV1%

Mean forced expiratory volume in 1 second/forced vital capacity (FEV1%) of asthmatic pregnant women was significantly lower than FEV1% of non-asthmatic pregnant women. This finding agreed with results of previous studies in UK [10] and in USA [42] which found the decrease in FEV1% among asthmatic pregnant women as an obstructive pattern. Many literatures reported that asthma exacerbation rate raised with increasing asthma severity, and severe asthma might be a major risk factor for exacerbations throughout pregnancy [10].[43] found that acute exacerbations of asthma through pregnancy occurred in 12.6% of pregnant women were classified with mild asthma, 25.7% of pregnant women were classified with moderate asthma, and 51.9% of pregnant women were classified with severe asthma [43].

There was a significant increase in FEV1% among pregnant women (all and asthmatic) in 3rd trimester ($p<0.001$). This finding is consistent with results of other studies in India [25] and in Nigeria [34], Previous study in Iraq [39] reported that FEV1% was increased in pregnancy especially in 3rd trimester. In a study in northern India, this variable also increased, but not significantly [44]. FEV1did not decrease as much as FVC hence a rise in the FEV1/FVC ratio. FEV1/FVC ratio also increased as gestational age increased. Again, this may be due to a comparative decrease in the negativity of the intrapleural pressure occasioned by an upward displacement of the diaphragm by the enlarging uterus. The reduced, but normal values for FVC and FEV_1 with higher, but normal values for FEV1/FVC is a clear indication that physiological restriction occurs during pregnancy [45]. Under-treatment, represented a big problem throughout pregnancy causing drop down in asthma control. The concerns from harmful effect of treatment on infant leads to low adherence to medication, high risk of asthma exacerbation, and negative effect on fetal health [35].FEV_1% mean of asthmatic pregnant women was significantly increased with obesity ($p=0.01$). This finding agreed with results of previous study in Hungary [27]. Obesity was prevalent among asthmatic patients due to steroids use.

PEFR

Peak expiratory flow rate (PEFR) of asthmatic pregnant women was significantly lower than non-asthmatic pregnant women. This finding agreed with results of previous study in USA [42].

The PEFR and FEV1are both decreased in asthma and during an acute asthma exacerbation as result of increased airway resistance [46]. The PEFR variation greater than 20% during the day suggests airway hyper-responsiveness' and poorly controlled asthma. PEFR and FEV1withless than 50% of predicted value (or personal best value) are signs of respiratory distress and severe asthma exacerbation [47].

PEFR of pregnant women was significantly decreased in 3rd trimester ($p=0.02$). This finding is similar to results of previous study in India [33]. The values obtained by the spirometry, including forced vital capacity (FVC), forced expiratory volume in 1 second

(FEV1), and peak expiratory flow rate (PEFR) have largely been found to remain unchanged throughout pregnancy. In other studies, PEFR is found to drop down with progressing of gestational age and to be affected by maternal positioning and by living at high altitude.

Low PEFR of asthmatic pregnant women in present study was associated significantly with obesity. This finding agreed with results of previous study in Hungary [27].

Spirometry patterns

Mixed spirometry pattern of pregnant women in this study was associated significantly with lower FVC, FEV1, PEFR and increased FEV1% ($p<0.001$). These findings agreed with results of previous study in Iraq [39]. Restrictive pattern was increased in 3rd trimester that exacerbated by obstructive pattern of asthma which led to prevalent mixed pattern in 3rd trimester as reported by many authors [35,42].

There was a significant association between pregnant women with mixed pattern in present study and 3rd trimester ($p<0.001$). This finding is similar to results of previous study in India [33].

Despite the efforts used to keep asthma controlled, exacerbations may occur. There are several factors that may trigger it, such as: discontinuation of medication, exposure to allergens, stress, and respiratory tract infection. While prevention is the most suitable conduct to avoid exacerbations, a study evidenced that 52% of the patients with severe asthma showed exacerbation of the disease during pregnancy, and many of them needed hospitalization [43].

Limitations of the study

1. As other observational studies, temporal relationship cannot be assessed.
2. Selection bias.
3. No group of healthy non – pregnant women to compare with it in this study.

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