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A study of pulmonary function tests in different stages of pregnancy

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ABSTRACT

Pulmonary status of women during pregnancy is of great importance. Their efficacy should be assessed for both maternal & fetal well being. In this study, the respiratory functions in various stages of pregnancy & in postnatal period are monitored & compared. Mini Wright Peak Flow Meter (PFM), which is highly effective in assessing the lung functions of a person, has been selected as a means of assessing pulmonary functions of a pregnant woman. Graphs or tables are available of predicted normal values based on person's gender, age & height. We have tested the PEFR throughout pregnancy from 6 weeks onwards till puerperium and effect of mode of delivery and puerperium on it. We have taken study sample size of 300. It is divided as 60 subjects in 5 groups like Non pregnant, First trimester, Second trimester, Third trimester, Postnatal period till 30 days after delivery in medical teaching institute. Predicted PEFR which depends on age & height of patient is calculated by referring to Wright's scale.

In 1st & 2nd trimester the lung functions are relatively normal, while in 3rd trimester the pulmonary function gets compromised with decrease in PEFR, PEFR is not affected by parity and in all modes of delivery it is significantly low, more after caesarean section (post operative pain might be responsible) and by the end of one month after delivery, the lung functions return back to normal.

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1. Introduction

Giving birth to a child is a very precious event in the life of every woman. It is a time of celebrations in the family to welcome a new member. The pregnant woman goes through various physical, mental, psychological & social changes.

The physiological changes occurring in a pregnant woman are vast & widespread. These include changes in genital organs, breasts, weight gain, Cutaneous changes, systemic changes (respiratory, cardiovascular, etc.), body water metabolism, hematological & metabolic changes. In first trimester, there is a feeling of nausea and vomiting while in later months, women mostly complain of dyspnoea and palpitations due to mechanical discomfort caused by enlarged gravid uterus.

We used Mini Wright Peak Flow Meter to assess the peak flow rate. It measures how fast a person can breathe out (exhale) air i.e.

Peak Expiratory Flow Rate (PEFR). It provides an indirect assessment of airway hyper responsiveness which correlates closely with degree of airway inflammation. It is also used for monitoring of severity of asthma.

PEFR varies with age, height & sex of patient. Depending on these parameters, Predicted PEFR is calculated. Observed PEFR is obtained with peak flow meter. Normally, observed PEFR should be >80% predicted PEFR. If the PEFR is <80% it indicates pulmonary functions are compromised. Likewise, the respiratory functions in various stages of pregnancy as well as in postnatal period are monitored and compared.

Aims & objectives:

1. To determine the pulmonary function test (PEFR) in different stages of antenatal (1st, 2nd, 3rd trimester) & postnatal period up to 6 weeks.
2. To determine the effect of age, parity & gestational age on the pulmonary functions of pregnant women.

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3. To evaluate the effect of mode of termination of pregnancy (MOTP) on respiratory functions of pregnant women.
4. To compare the pulmonary functions of non-pregnant & pregnant women.

Mini Wright peak flow meter

A peak flow meter is a medical device which measures and scales the peak expiratory flow rate (PEFR).

PEFR is the maximum rate of airflow which can be achieved during a sudden forced expiration from a position of full inspiration.

The Peak Flow Meter provides a convenient, accurate & inexpensive method for monitoring lung function changes.

Indications:

- ❖ Estimation of airway caliber
- ❖ Diagnosis, treatment, monitoring severity of asthma
- ❖ To know asymptomatic airway obstruction,
- ❖ Evaluation of dyspnoea and peak flow monitoring at home
- ❖ Clinical & epidemiological research studies
- ❖ Establishment of baseline personal best

Contraindications: If patient is unable to hold the mouth piece due to paresis or weakness.

2. Results:

Table 1: Comparison of % of subjects in non-pregnant, pregnant & postnatal period.

Subject	No. of cases examined (300)	No subjects with PEFR significantly low (93)	PEFR range & Mean
Non-pregnant	60	6(10.00%)	268-396(332)
First trimester	60	14(23.33%)	256-366(311)
Second trimester	60	28(46.66%)	224-308(266)
Third trimester	60	36(60.00%)	142-266(205)
Postnatal (immediate)	60	9(15.00%)	266-406(336)

$\chi^2 = 26.4, d.f = 4, p < 0.001, \text{highly significant.}$

Interpretation: The above table shows with increase in gestational age the Peak Expiratory Flow Rate is decreased and their in increase in PEFR immediately after delivery, also there is statistical significance.

Table 2: Effect of advancing gestation on % of subjects with significantly lowered PEFR:

Gestational age (in weeks)	(78) No of subjects with PEFR significantly less
6-10	3%
11-15	6%
16-20	6%
21-25	8%
26-30	12%
31-35	18%
36-40	25%

Interpretation: The above table shows percentage of subjects affected with increase in gestational age hence total percentage of subjects increases with low PEFR as the gestational age increases.

Table 3: Effect of AGE on PEFR:

Age group (in yrs.)	No. of patients (N) (300)	Mean PEFR %	No of pts. with significantly low PEFR (n= 93)
15-20	36	76	15(16.12%)
21-25	148	86	29(31.02%)
26-30	86	75	23(24.73%)
31-35	30	75	26(27.95%)

$\chi^2 = 22.6, d.f = 3, p < 0.001, \text{highly significant}$

Interpretation: The above table shows that number of percentage of subjects with significantly low PEFR were maximum in age group 21 to 25 years i.e. 31.02%, and the association was found to be statically significant.

Table 4: Effect of parity (P) on PEFR

Parity	No of cases (180)	PEFR Range	Mean PEFR (%)
G1	45	234-312	81
G2P1	45	204-278	78
G3P2	45	178-260	80
G4P3 & more	45	148-174	71

$(p = 0.96, NS)$

Interpretation: The above table shows no association between parity with PEFR.

Table 5: Effect of mode of termination of pregnancy (MOTP) on PEFR:

Mode of termination of pregnancy	No of cases	PEFR range	PEFR Mean (%)	S/NS
Pre term delivery with episiotomy	7	168-248	76	S
Full term normal delivery with episiotomy	38	142-214	70	S
LSCS	15	126-170	66	S

Interpretation: In all modes of termination of pregnancy PEFR is significantly low, more after caesarean section probably pain factor (post operative pain) may be responsible.

Table 6: PEFR in Post natal period:

PNC DAY	PEFR RANGE	PEFR MEAN (%)	S/NS
1-4	146-186	68	S
5-8	180-226	70	S
30th day	240-356	82	NS

PEFR returned to normal after 30 days.

5. Discussion:

The enlarged full term uterus, in later months of pregnancy, causes elevation of diaphragm by 4cm. The lower ribs flare out resulting in increase in sub costal angle and there is also increase in transverse diameter of the chest.[1,2,3]

Peak expiratory flow rate and their percentage of predicted values were significantly lower during third trimester of pregnancy compared to controls and it progressively decreased from first to third trimester. Similar results were seen in a study conducted by Memon et al, (2012).[4] The enlarged full term uterus, in later months of pregnancy, causes elevation of diaphragm (4cm). The lower ribs flare out resulting in increase in sub costal angle and there is also increase in transverse diameter of the chest. The cardio-respiratory embarrassment is relieved during lightening, when a sense of relief of pressure symptoms is obtained due to engagement of the presenting part. It occurs 3 weeks before the expected date of delivery in primigravida. In multiparous women, the same occurs in late first stage of labour with rupture of membranes. The pulmonary changes are more marked in the presence of over distention of gravid uterus like hydramnios & multiple pregnancy. We have excluded such cases from our study to maintain uniformity in the results.

There is marginal increase in respiratory rate. The 'Tidal volume' and 'Minute ventilation' increases by 30-40%. The 'Functional Reserve Capacity' and 'Inspiratory Reserve Volume' may diminish by 20%. A study conducted by Neeraj et al (2010) states that the

decrease in pulmonary function may be due to a decline in alveolar Pco₂ (caused by hyperventilation) which acts as bronchoconstrictor.[6]

There is increase predisposition of upper respiratory tract to hyperemia & congestion.[5] Alteration in blood gases is common. Po₂ increases above 100mmHg, Pco₂ decreases to 27-32mmHg, pH remains normal with increased renal bicarbonate excretion.[7] Dyspnoea & hyperventilation during pregnancy are common. Fetal well being and birth weight depend on a number of maternal and placental factors which includes maternal nutrition (height and weight), diet, rest, supplementation of Iron, calcium, proteins and the lung status of a woman.

PEFR varies with age, height & sex of patient.[9,10,11]. The anaemic pregnant women showed lower PEFR when compared with PEFR of non anaemic pregnant women.[10]

Lung status of women during pregnancy is of great importance. Their efficacy should be assessed for maternal as well as fetal well being.

6. Conclusion:

1. In 1st & 2nd trimester the lung functions are relatively normal, while in 3rd trimester the pulmonary function gets compromised with decrease in PEFR.
2. Mean PEFR at all reproductive age groups is more or less the same (75%).
3. No Effect of parity till 3 pregnancies but Para 4 onwards the lung functions start getting slightly compromised.
4. Pregnancies terminated by caesarean section have more compromised airways (PEFR 66%).
5. By the end of one month after delivery, the lung functions return back to normal in our study

The respiratory distress experienced during pregnancy is purely physiological & completely reversible once the pregnancy is over.

Pulmonary breathing exercises like deep inhalation and exhalation done during second trimester till delivery and postnatal period to improve patient's Spo₂ and oxygen carrying capacity of mother during labour, minimize fetal hypoxic events in Antepartum and Intrapartum period, helps the patient to bear down during labour. Well oxygenated uterus will involute earlier

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