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Original Article

Pulmonary function studies in hyperthyroid females with goiter - before & after thyroid surgery

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ABSTRACT

Objective Pulmonary function tests are measurements of Physical characteristics such as volume, compliance and also of performance. The aim of this study is to assess the pulmonary functions of female individuals with goiter having increased thyroxine level and compare the lung function of individuals having goiter before and after thyroid surgery. Experimental Design 50 hyperthyroid female subjects aged between 25 - 40 years with goiter posted for thyroid surgery were selected from department of surgery. After obtaining ethical approval written informed consent was taken from each subject and recordings were done using computerized spirometer. Graphic recording of airflow during maximal inspiration and expiration at different lung volumes were carried out in patients undergoing surgery for goiter. The same was documented one month later to find whether there is any improvement in flow rates after surgery. Observation. On analysis of the data the subjects were categorized into groups. The mean and standard deviation were calculated for all measured parameters. The significance of difference in the values were analysed using students paired 't' test before and after one month of surgery and their probability was estimated. Conclusion Following thyroid surgery denotes the changes in the early and mid airway bronchus and bronchioles making us to conclude that the mechanical compression due to enlarged thyroid were responsible. The decrease in FVC, FEF 75% in subjects with goiter could be due to the effect of excess thyroxine on the smooth muscle of the bronchial tree apart from its general metabolic activity on lung parenchyma.

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1. Introduction

Pulmonary function tests determine the volume of the lungs, the diameter of the airways, the perfusion of alveolar capillaries, the mobility of the lungs, the chest wall and the strength of respiratory muscles. In clinical practice pulmonary function testing is used most commonly to estimate prognosis [1,2], follow the course of the disease or the response to therapy, detect untoward reaction to drugs, and to assess functional impairment

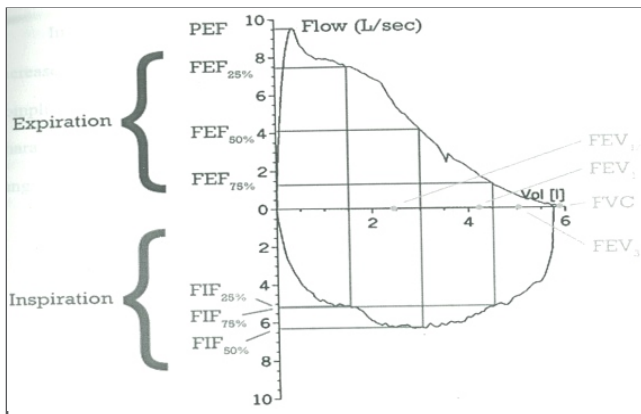
loop curve[3]. Thyroid hormone has dramatic effect on the pulmonary vascular cells resulting in changes in vascular dynamic also this study has proved the interaction between the smooth muscle cells and thyroid hormone. Keeping this in mind the pulmonary function tests were carried out in patients undergoing surgery for goiter. The same was documented one month later to find whether there is improvement in how rates after surgery which serves as a good control on the effect of the operation on the thyroid gland.

2. Materials and Methods

50 Hyperthyroid female subjects with goiter of age between 25 - 40 years posted for surgery were selected. The participants were made to relax and be comfortable prior to the tests. Detailed

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clinical history about Goitre was collected. Physical & General examination. Normal Standard height was measured without foot wear, with the subjects back to a wall. General and systemic examination pertaining to Respiratory and cardiovascular system done and findings were recorded. The Pulse rate, Respiratory rate and Blood Pressure were recorded in each subject under resting condition. The thyroid gland is palpated with the patient's neck slightly flexed. The patient should be seated on a stool and the clinician stands behind the patient. The patient is asked to flex the neck slightly. Venous Blood was withdrawn from the patient and Thyroid function tests were done at the Department of immunology. Clinical data, Duration of goitre in years were reviewed from the patient record. First the procedures for the maneuvers were explained to the subject, as proper understanding and co-operation was essential to obtain optimum values. Demonstration of the maneuver had to be done repeatedly sometimes to get the best result from the subject. The subject was instructed to take a maximal inspiration, the mouth piece was placed firmly in the mouth and he was asked to breathe out maximally and rapidly till he was unable to expire any more and immediately followed by a deep inspiration. Flow volume loop / curve are obtained by plotting expiratory flow rates against lung volume (rather than against time). If inspiratory part is added then it becomes a flow volume loop, otherwise a flow volume curve [4]. The shape of the loop provides useful information regarding obstructive and restrictive patterns and also differentiates between fixed and variable obstruction.



Normal flow volume loop

The shape of the flow - volume loop may indicate the location of airflow limitation such as the large upper airways or smaller distal airways. With common obstructive airflow disorders, the disease generally affects the expiratory limb and may reduce the effort - dependent peak expiratory flow as well as subsequent airflows that are effort independent. The descending limb of the expiratory loop is typically concave. In contrast, several unusual anatomic disorders that narrow the large airway may produce a variety of patterns of truncation or flattening of either one limb of the loop. (Variable upper airway obstruction) or both limbs of the loop (fixed upper airway obstruction). loop curve[3]. Thyroid hormone has dramatic effect on the pulmonary vascular cells resulting in changes in vascular dynamic also this study has proved the interaction between the smooth muscle cells

and thyroid hormone. Keeping this in mind the pulmonary function tests were carried out in patients undergoing surgery for goiter. The same was documented one month later to find whether there is improvement in how rates after surgery which serves as a good control on the effect of the operation on the thyroid gland.

3. Result

The subjects were categorised into three groups based on their height. Mean and standard deviation were calculated for all measured parameters. The significance of difference in the values were analysed.

Parameters	Number of Patients	Percentage (%)	
Age group	31-35	21	42.0%
in years	36-40	11	22.0%
Height in	151-160	25	50.0%
cm	161-170	10	20.0%
Weight in	51-60	30	60.0%
kg	61-70	10	20.0%

All the variables showed very highly significant ($P < 0.001$) lesser values in subjects with goitre in relation to their predicted values. All the variables showed very highly significant ($P < 0.001$) changes after surgery compared to the pre surgical mean values. There was no significant change ($P > 0.05$) in the mean values of FEV1% post surgically. FEV 75% showed highly significant change ($P < 0.01$) post surgically

Parameters (%)	Before Surgery Mean	Before Surgery SD	After Surgery Mean	After Surgery SD	p value
FVC	76.36	6.23	82.36	8.02	<0.001
FEV1	83.40	8.21	90.70	9.52	<.001
FEF ₂₅₋₇₅	77.36	16.76	87.44	11.65	<0.001
PIFR	31.3	7.4	36.0	8.9	< 0.01
PEFR	59.5	15.1	72.2	16.0	< 0.001
FEF ₇₅	85.06	11.57	90.8	12.3	< 0.01
FIVC	69.28	9.08	72.5	8.02	< 0.01
FEF ₅₀	73.2	17.1	83.7	13.0	< 0.001

4. Discussion

There are so much speculation about ventilation parameters and Goitre. Thyroid gland by its anatomical location and its action can alter the airflow dynamics and cellular metabolism at the macro and the micro level in the disease condition. My study was aimed to assess its effect on lung function in hyperthyroid females with goitre before and after thyroid surgery. Plain radiology of the upper airways is the most commonly used investigation to detect upper airway obstruction. But radiology however provides a static

measurement only of the upper respiratory tract and gives no information on airflow dynamics in the upper respiratory tree. Moreover tracheal radiology does not exclude the presence of abnormal upper airway dynamics and that these ventilation parameters using spirometer [3-6] with flow - volume loop curves gives more valuable and sensitive information. In variable extrathoracic obstruction, inspiratory flow is reduced more than expiratory flow, while in variable intrathoracic obstruction expiratory flow is reduced more than the inspiratory flow. Airflow is equally reduced when a fixed airway stenosis is present. Interestingly thyroxine, up - regulates protein methylase - 1 the enzyme responsible for the production of NO inhibitor ADMA. This reduction in NO expression may result in elevated pulmonary vascular resistance as seen in our study where the FEF 50% and FEF 75% were significantly less pre-operatively [7].

5. Conclusion

Computerised spirometer provides a quantitative assessment of airflow dynamics in both inspiratory and expiratory phases of the respiratory cycle [7]. This overall improvement following thyroid surgery is mainly due to the removal of the offending enlarged thyroid gland as visualized in the PEFr, PIFr, FEF 25-75%, FEF 25% and FVC values of post surgical subjects. These variables denote the changes in the early and mid airway bronchus and bronchioles making us to conclude that the mechanical compression due to enlarged thyroid were responsible for the lower values before surgery. It can also be concluded that a decrease in FVC, FIVC, FEF 75% in subjects with goitre could be due to the effect of excess thyroxine on the smooth muscle of the bronchial tree and vasculature apart from its general metabolic activity on lung parenchyma. Thyroid hormones¹ reduces smooth muscle contractility by altering the interaction of myosin light chain kinase with calmodulin. Moreover elevated thyroid hormones will reduce critical surfactant protein expression in human - lung cells by an increase in transforming growth factor - β levels which causes lack of adequate surfactant. This inadequate surfactant production results in reduced pulmonary compliance and reduced gas exchange. Although this study was aimed at studying the lung function of goitre patients before and one month after thyroidectomy, more information could be gathered if this study is pursued for a longer period to actively assess the effect of thyroxine in goitre.

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