MEASUREMENT OF FORCED VITAL CAPACITY AND FORCED EXPIRATORY VOLUME IN HEALTHY CHILDREN USING VITALOGRAPH

THESIS

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ABBREVIATIONS

A.D.: Alveolar duct
A.P.C.: Apneustic center
A.S.: Alveolar sac
A.T.: Atrium
B.T.P.S.: Body temperature pressure saturation
C.L.: Lung compliance
E.R.V.: Expiratory reserve volume
F.E.VT.: Timmed forced expiratory volume
$F.E.V_1$.: Forced expiratory volume in one second
$F.E.V_{0.50}$.: Forced expiratory volume in 0.50 second
F.R.C.: Functional residual capacity
F.V.C.: Forced vital capacity
G.C.: Gasping center
I.C.: Inspiratory capacity
I.R.V.: Inspiratory reserve volume
M.B.C.: Maximal breathing capacity
M.M.E.F.R.: Maximal mid expiratory flow rate
M.V.V.: Maximal voluntary ventilation
N.T.S.: Nucleus tracus solitarius
N.A.: Nucleus ambigaus
$P.CO_2$: Partial pressure of CO_2
$P.O_2$: Partial pressure of O_2
P.E.F.R.: Peak expiratory flow rate
Raw: Airway resistance
R.B.: Respiratory bronchioles
R.pulm.: Pulmonary resistance
R.resp.: Total respiratory resistance
R.V.: Residual volume
S.: Saccule
T.B.: Terminal bronchioles
T.L.C.: Total lung capacity
T.S.: Terminal saccule
T.V.: Tidal volume
V.C.: Vital capacity

CONTENTS

INTRODUCTION

INTRODUCTION

In children, the respiratory tract is probably more often affected by diseases than the other systems of the body (Dugdale and Moeri, 1968).

The ventilatory functions of the lung are usually assessed either by measuring lung volumes and capacities or by measuring flow rates (Cotes, 1979). Various instruments including the dry spirometer can be taken to bed side, and can be used efficiently without special training (Dugdale and Moeri, 1968).

However, the most common use of spirometery should be, by the practicing physician, in the diagnosis of lung disease, in determining the extent of impairment of lung function, and in evaluating the response of patients with lung disease to specific treatment (Zamel et al., 1983). Using such spirometer, the dynamic and static lung function studies have been performed on healthy children of both sexes (Bjure, 1963).

AIM OF WORK

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The aim of this work is to evaluate the normal forced vital capacity and the forced expiratory volume in healthy Egyptian children. The normal values can be used as predicted normal values in different ages, weights and heights.

This will enable us to evaluate the condition of the lung in different respiratory diseases as well as the course of the disease.

REVIEW

OF

LITERATURE

REVIEW OF LITERATURE

1. Embryology of the lung
2. Postnatal lung growth
3. Anatomy of the respiratoery system
4. Control of breathing
5. Mechanics of breathing
6. Lung volumes and capacities
7. Pulmonary function tests

REVIEW OF LITERATURE

1. EMBRYOLOGY OF THE LUNG

Four stages of human fetal lung development have been identified:

1- Embryonic period: occuring between conception and the fifth week in-utero.

2- Pseudoglandular period: lasting from the fifth week to the sixteenth week in-utero.

3- Canalicular period: lasting from the sixteenth week to the twenty fourth week in-utero.

4- Terminal sac period: lasting from the twenty fourth week until term.

There is an overlap from one stage to the next, and the transition between stages occurs gradually (Hislop and Reid, 1974).

The lung arises as a ventral diverticulum from the foregut during the fourth week of gestation and is lined with endodermally-derived epithelium. During the next few weeks, through dichotomous branching of the diverticulum, the major airways develop, and a tree of narrow tubules formed of thick epithelial wall composed of columnar or cuboidal epithelium. This imports to the lung the appearance of glands, hence the name pseudoglandular stage. Budding and branching of the tree occur only in the presence of the surrounding mesenchyme, indicating that the stimulus for this growth arises from the mesoderm (Spooner and Wessells, 1970).

At the sixteenth week of gestation, all of the branches of the conducting portion of the tracheo-bronchial tree, from the trachea up to the terminal bronchioles and including them, are established (Hislop and Reid, 1974).

During this stage (pseudoglandular stage), the mesenchyme surrounding the lung bud diverticulum differentiates to form the early rudiments of cartilage, connective tissue, muscles, blood vessels and lymphatics (Inselman and Mellins, 1981).

During the canalicular stage, differentiation of the airways begins with widening of the lumina and gradual thinning of the epithelium, giving the lung the appearance of canals. Also proliferation of a rich vascular supply occurs, and a relative decrease in mesenchyme brings the capillaries closer to the airway epithelium, in anticipation of future gas exchange. In addition, primitive respiratory bronchioles begin to form (Boyden and Tompsett, 1965).

The terminal sac stage is characterized by further differentiation of the respiratory portion of the lung, with transformation of some terminal bronchioles into respiratory bronchioles, thereby decreasing the number of pre-acinar airways; and by the appearance distally of terminal clusters of airways called saccules (Hislop and Reid, 1974). At this stage, the saccules presumbly could function for gas exchange, since the thickness of blood-gas barrier is similar to that of adult alveoli. Also, the alveolar epithelium type II cells appear and surfactant production begins. However, the saccules are not true alveoli because they are larger and lack the smooth outline of the true alveoli (Thurlbeck, 1977).

During the terminal sac stage, the saccules enlarge and form additional generation, the last generation being the terminal saccules (Hislop and Reid, 1974).

Throughout generation the epithelial thickness decreases, and it does so to a greater extent distally, so that at birth the proximal airways are lined by pseudostralified columnar epithelium while the intermediately located airways are lined by cuboidal epithelium and the more distal airways by flattened epithelium (Jeffery and Reid, 1977). At birth the epithelial lining of the saccule is thin and continuous