RESISTANCES TO BREATHING

Part I. A review of the literature.

Part II. An experimental study of the compliance of the total respiratory system and its components in health and obesity.

by

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Part I

A review of the current literature on the resistance to breathing indicates that the total respiratory resistance is made up of component resistances offered by the lung and the chest wall. Lung resistance itself has been shown to comprise elastic and non-elastic components - the latter being due to airway and tissue viscous resistance. While present techniques fall short of the ideal, considerable progress in the understanding of lung resistance has been made. Technical difficulties, however, have hindered study of the mechanical properties of the chest wall to a greater extent and although some information has been obtained concerning the elastic properties of the chest wall, little is known regarding non-elastic resistance.

Part II

A modification of a recently described technique for measurement of the compliance of the total respiratory system and its components was used to study normal and obese subjects. Measurements of lung compliance in normal individuals yielded values which agreed closely with those reported previously. Chest wall compliance was approximately equal to lung compliance

in normal subjects. Lung compliance was normal in the obese but chest wall compliance and consequently total compliance were significantly reduced. Obese individuals demonstrated a further reduction in chest wall compliance during recumbency. The decrease in total compliance in obese subjects was proportional to the reduction in vital capacity noted in these individuals. It was concluded that the increase in mechanical work of breathing in obesity is, in part, due to the increased elastic resistance offered by the chest wall in this condition.

PART I. A REVIEW OF THE LITERATURE

A. Introduction

Until recently, the study of the mechanics of breathing has been approached only superficially although it is apparent that knowledge of the energy requirements and the mechanical work involved in breathing, and the factors which determine them, are of great importance to both the physiologist and the clinician.

The mechanical work performed by the respiratory apparatus during breathing is expended in overcoming various resistances. Knowledge concerning the nature and magnitude of these resistances has permitted quantitative estimates of the mechanical work of breathing to be made.

The present thesis is concerned with the development of the current concepts concerning the resistances to respiration in the human subject and the presentation of results of investigations which seek to extend this knowledge.

B. A Mechanical Analogue of the Respiratory System

The respiratory apparatus is analogous to a two plate piston within a barrel (Figure 1), (1). The opposing surfaces of the two plates are attached to a rubber balloon, the interior of which represents the pleural "space". The retractile force of the lungs is represented by the springs attached to the plate on the left, while that of the chest wall is represented by the springs attached to the plate on the right. The total capacity of the container represents the total lung capacity. An air inlet represents the tracheobronchial tree and the piston represents the respiratory musculature.

It can be seen from this model that in order to create air movement, certain resistances must be overcome. These include inertia due to the continuous acceleration and deceleration of air, that caused by the movement of air through narrow and branching tubes, and that due to the friction of the parts sliding over one another. These resistances are encountered only when air is moving and hence they are called "kinetic" resistances. The resistance due to inertia is small and generally considered to be negligible compared to the other kinetic resistances (2).

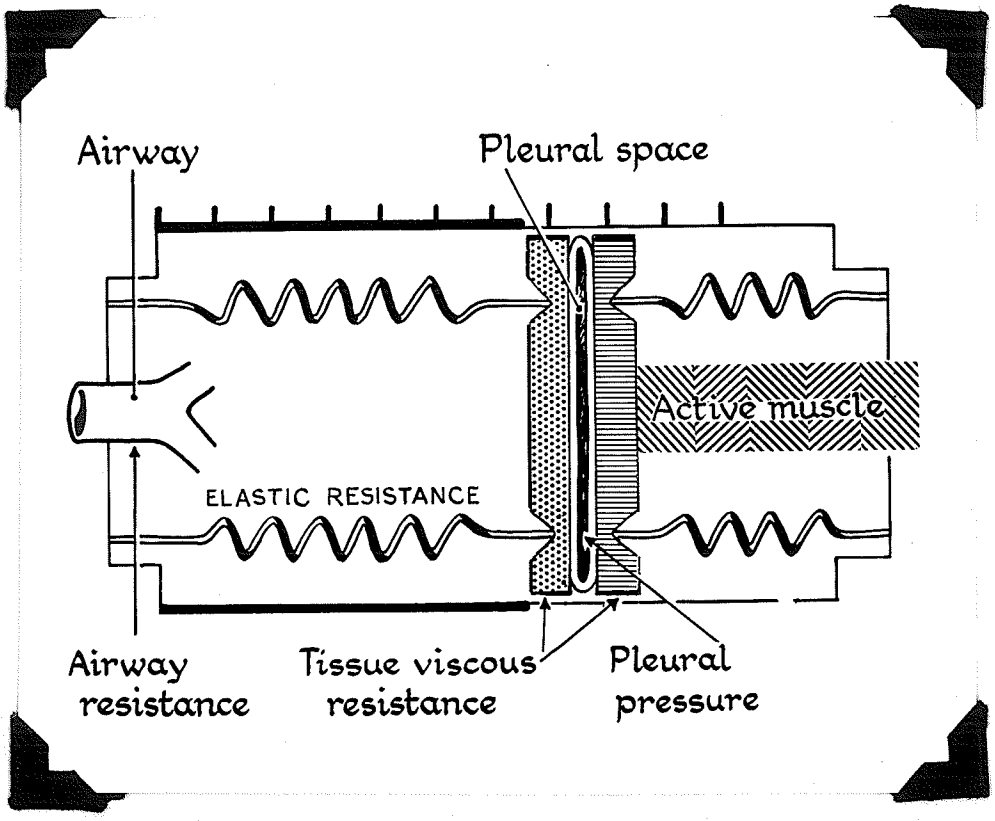

Figure 1. A Mechanical Analogue of the Respiratory System. For explanation see text.