RT35 - 1.3

PATHOLOGICAL CHANGES IN RESPIRATORY TISSUE MECHANICS

Walter A. Zin
Instituto de Biofísica Carlos Chagas Filho
Federal University of Rio de Janeiro, Rio de Janeiro, 21941-900, Brazil

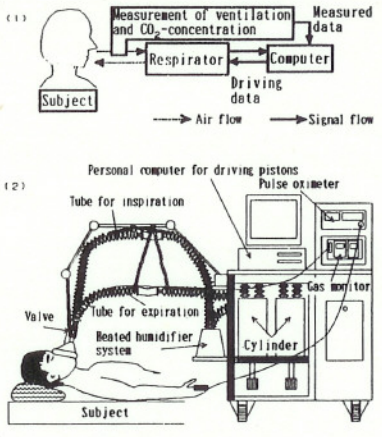
Nowadays it is possible to determine respiratory system (and its lung and chest wall components) elastic, resistive, and viscoelastic mechanical properties by means of a sudden airway occlusion followed by a 5-s pause. The resistive component is related to purely viscous phenomena, whereas mechanical inhomogeneities are added to the viscoelastic element. In the lung, the resistive component pertains to the airways, and the viscoelastic properties are related to the tissues, *i.e.*, to the lung periphery. The respiratory mechanical properties depend on the airflow and tidal volume used during ventilation: for instance, high inspiratory volumes and low airflows will determine the highest viscoelasticity. Looking at the respiratory system under the aforementioned three mechanical components approach it becomes immediately apparent that some concepts have to be reconsidered. For instance, methacholine has been widely used as a brochoconstrictor agent; however, some authors have recently demonstrated that the effects of the drug are predominant at the lung periphery. The same has been found when capsaicin was the test agent. In the adult respiratory distress syndrome the resistive and viscoelastic pressure losses were, qualitatively, similarly affected by airflow and tidal volume in normal subjects and in patients. Quantitatively, however, the viscoelastic losses were greater in the latter group, thus confirming that the syndrome affects mostly the lung periphery. After antero-lateral thoracotomy and sternotomy, the lung pressure losses due to elastic and viscoelastic components increased significantly, pointing towards a change in lung tissue properties. The viscoelastic behaviour returned to control value when physiological PEEP was used. During xiphopubic laparotomy an increase in chest wall viscoelastic pressure loss has been detected; in this situation, the wall imposes the extra mechanical burden onto the system. Nevertheless, after abdominal wall closure the mechanical properties returned to control values. Hence, the relatively unknown tissue mechanical properties still hide a great deal of secrets waiting to be unveiled.

OS35 - 1.1

FUZZY CONTROL OF HUMAN ARTIFICIAL RESPIRATION USING PROGRAMMABLE RESPIRATOR

Hidetoshi Wakamatsu*, Seiichiro Kaguei** and Mitsuo Kamoto**
*Department of Allied Health Sciences, Faculty of Medicine,
Tokyo Medical and Dental University, Tokyo, JAPAN
**Division of Electrical and Computer Engineering,
Faculty of Engineering, Yokohama National University, Yokohama, JAPAN

The present paper describes a control of alveolar CO_2-concentration using a recently developed respirator which can be controlled not only by a manual operation but also by signals from a computer. It has two independent pumping cylinders for inspiration and expiration, which ensure an appropriate ventilation according to a respiratory pattern of a patient. The intermixture of inspiratory and expiratory air is avoided by a valve mounted on an air mask which moves with synchronization o: an respiration so that alveolar CO_2-concentration can be accurately measured in every respiratory cycle. A respiratory system is treated as a system of time-varying nonlinear characteristics depending on the difference of individuals and chronic change of their parameters and physiological state. Its dynamics is characterized by a single input-output system whose input and output are ventilation and alveolar CO_2-concentration, respectively. For the realization of a desirable range of alveolar CO_2-concentration, a ventilation is given by a control system synthesized according to an fuzzy choice of control laws. Healthy young students with various types of physiques are subjected to control experiments of artificial respiration to clarify the feature of the proposed method, resulting in good control performance of alveolar CO_2-concentration for subjects both at rest and at light exercise, even when air mask is not tight enough during its control process.



Outline of control of artificial respiration and its experimental equipments.