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Title : ESOPHAGEAL PRESSURE MONITORING IN INFANTS

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Introduction. Increased pulmonary impedance in spo aneously breathing subjects, due to increased airway resistance and/or pulmonary elastance, is associated with an increase in the negative pleural pressure with inspiration and the widening of pleural pressure oscillation during the respiratory cycle. Such changes in the pleural pressure can be assessed accurately by means of a thin-walled balloon or a fluid filled catheter in the lower third of the esophagus (1). Thus the monitoring of esophageal pressure during the respiratory cycle would provide useful information on the degree of changes in the pulmonary impedance in patients with impending respiratory failure. Review of literature, however, indicates that this concept has not been utilized in infants who are more susceptible to the upper and lower airway obstruction. The purpose of this presentation is to describe such a technique as a simple, non-invasive monitoring device in the neonatal and pediatric intensive care units.

Methods. Studies were made in infants with respiratory dysfunction who were breathing spontaneously in the Pediatric Intensive Care Unit. This project has been approved by the Institutional Review Board for the Protection of Human Subjects. With the patient in the semi-lateral position, saline-filled #5 French feeding catheter was inserted through the nose or mouth, and the distal end was placed in the lower third of the esophagus. The proximal end of the catheter was then connected to an H-P 267B transducer and a direct writing oscillograph. Oscillation of esophageal pressure (Pes) was recorded continuously during respiratory cycle and the average difference in Pes between end-expiration and end-inspiration (ΔPes) was measured. In some patients the study was performed before and after the use of a bronchodilator.

Results. Pes was nomitored in 10 infants below 3 months of age who were admitted to the ICU with respiratory dysfunction due to a variety of etiologic factors. Preliminary studies showed that ΔPes varied between 3 and 13 cmH_2O in infants whose $PaCO_2$ was below 45 torr. On the other hand, those with $PaCO_2$ above 55 torr and with reduced pH showed ΔPes above 30 cmH_2O. There was a significant correlation between ΔPes and $PaCO_2$ ($\Delta Pes = 1.748 \times PaCO_2 - 61.6$, $r = .90$, $p < .01$). By contrast, in 2 infants with $PaCO_2$ above 55 torr but pH above 7.35, ΔPes remained below 20 cmH_2O probably due to the adaptation of the bulbopontine respiratory centers to chronic respiratory acidosis.

Measurement of ΔPes was also useful for the assessment of bronchospasm as a contributing factor to airway obstruction. Figure I showes a tracing of Pes of a 3 months old infant with the clinical diagnosis of acute bronchiolitis. The average ΔPes was 35 cm H_2O while $PaCO_2$ was 60 torr (Table I). After the administration of terbutaline 0.2 mg, there was a dramatic reduction in ΔPes (17 cmH_2O), $PaCO_2$ and respiratory rate (RR). Based on these findings the infant was placed on continuous bronchodilator treatment with success thus avoiding mechanical ventilatory support.

Discussion. The measurement of esophageal pressure is a simple and non-invasive technique. It does not require any specific instrument other than a pressure transducer and monitoring oscilloscope or recorder for blood pressure measurements. Indirectly it allows continuous monitoring of both acute and gradual changes in pulmonary impedance and work of breathing in infants with impending respiratory failure. In addition, determination of ΔPes is useful in documenting the efficacy of bronchodilator or other treatment promptly even without the aid of arterial blood gas determination.

References.

1. Millic-Emili J, Turner J, Glauser EM: Improved technique for estimating pleural pressure from esophageal balloons. J. Appl. Physiol., 19:207-211, 1964.

TABLE I

	Before Bronchodilator	After Bronchodilator
ΔPes (cmH_2O)	35	17
RR (min^{-1})	54	44
F_IO_2	.44	.44
PaO_2	69	60
$PaCO_2$	60	45
pHa	7.26	7.31
BE	-2	-4

FIGURE I