THE EFFECT OF POSTURE ON THE MEASUREMENT OF OESOPHAGEAL PRESSURE IN THE CURARIZED SUBJECT

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SUMMARY

The effect of posture on the measurement of oesophageal pressure has been studied in six paralysed, artificially ventilated patients. It is considered that oesophageal pressure is not a reliable indicator of intrapleural pressure in such patients when measured in the supine position.

In studies of pulmonary mechanics oesophageal pressure is often accepted as representing the mean intrapleural pressure. Milic-Emili and his colleagues (1964) have described the optimum characteristics of a balloon-catheter system for measuring oesophageal pressure and recommended that the balloon should be placed in the middle third of the oesophagus. They found that posture had a small effect on the recorded pressure. In the supine position the pressure was approximately 2 cm H₂O greater than that in the upright position in conscious spontaneously breathing subjects although pressure-volume plots had the same slope except at very low lung volumes (Milic-Emili, Mead and Turner, 1964).

On the basis of these findings, studies of pulmonary mechanics in supine anaesthetized subjects have employed measurements of oesophageal pressure to represent mean intrapleural pressure. At the start of such a study in paralysed, artificially ventilated patients, it became evident that the oesophageal pressures recorded were higher than expected and that the changes occurring with ventilation were less. Therefore the effect of posture on the measurement of oesophageal pressure in paralysed patients has been investigated.

METHODS

Six patients (age range 19–49 years) with severe head injury have been studied. All had been paralysed with either tubocurarine or pancuronium to permit intermittent positive pressure ventilation. In all patients chest radiographs were reported as normal and none had any known history of chest disease or injury, or evidence of aspiration pneumonitis.

A rubber balloon 10 cm in length and 3.5 cm in circumference, containing 0.2 ml of air was connected to a Bell and Howell 4327-L.221 pressure transducer by a catheter 100 cm in length and 1 mm internal diameter. With the patient in the supine position the balloon was passed through the mouth until the tip was 50 cm from the incisor teeth. The pressure was recorded at 5-cm intervals as the catheter was withdrawn. The balloon was returned to the point at which the lowest pressure had been recorded and the lungs were then inflated with gas from a calibrated syringe. Airway pressure was recorded with an Elmed PT8 transducer. Recordings were made on Devices M2 or M4 hot pen recorders. The procedure was repeated with the patient in the left lateral position.

Static compliance was calculated as follows:

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\text{Total static compliance} = \frac{\text{Change in lung volume}}{\text{Change in airway pressure}} (\text{ml/cm H}_2\text{O})
\]

\[
\text{Static pulmonary compliance} = \frac{\text{Change in lung volume}}{\text{Change in transpulmonary pressure}} (\text{ml/cm H}_2\text{O})
\]

All volumes were reduced to BTPS. Statistical comparison was made with a \( t \)-test for paired differences.

RESULTS

Oesophageal pressure profiles (fig. 1). The average oesophageal pressure of the six subjects was lower at each point in the lateral position than in the supine, and this difference was statistically significant in the middle of the oesophagus. In every patient the lowest pressure found was at one particular point, rather than as a zone of pressure extending some distance along the oesophagus.

Static compliance. Measured total and pulmonary static compliances are shown in figure 2. Total compliance was greater in the supine than in the
MEASUREMENT OF OESOPHAGEAL PRESSURE

The differences in oesophageal pressure between the left lateral and supine positions found in this study were greater than those reported previously in conscious spontaneously breathing subjects (Milic-Emili, Mead and Turner, 1964). This suggests that changes in pressure might not be accurately recorded in the supine position. The measurements of static compliance were used to test this suggestion since the differences in pressure might also be caused by the increase in functional residual capacity which occurs on moving from the supine to the lateral position (Wood-Smith, Horne and Nunn, 1961). It was assumed that the greatest negative pressure found was nearest to the pleural pressure.

That total static compliance is lower in the lateral position has been reported previously (Potgeiter, 1959) and is due to limitation of expansion of the lower chest wall. This should not affect pulmonary compliance and it is suggested that the inconsistent differences found between the two positions resulted from inaccurate estimation of pleural pressure in the supine position, presumably an effect of the weight of the mediastinum.

These findings appear to contradict those of Milic-Emili, Mead and Turner (1964) until it is remembered that they found that pressure-volume plots made in the supine position differed from those made in the upright position at low lung volumes. Lung volume is reduced in the paralysed subject (Laws, 1968), possibly due to the removal of the inspiratory tone present at the end of a normal expiration (Nunn, 1969).

For this reason, it is recommended that, to represent intrapleural pressure, measurements of oesophageal pressure should not be made in the supine position in the paralysed subject, nor in any other
situation where there may have been a decrease in lung volume. In addition, since the lowest pressure was found at only one point in the oesophagus, it is suggested that this point be sought out before any measurements are made.

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REFERENCES


BRITISH JOURNAL OF ANAESTHESIA

EFFETS DE LA POSTURE SUR LA MESURE DE LA PRESSION INTRA-OESOPHAGIENNE CHEZ UN SUJET CURARISE

SOMMAIRE
Les effets exercés par la posture sur la mesure de la pression intra-oesophagienne, ont été étudiés chez six malades paralysés et soumis à une ventilation artificielle. On considère que la pression intra-oesophagienne ne constitue pas un indice valable de la pression intrapleural chez de tels malades, lorsque la mesure est effectuée en position de décubitus dorsal.

ÜBER DEN EINFLUSS DER LAGERUNG AUF DIE MESSUNG DES OESOPHAGEALDRUCKES BEIM CURARISIERTEN PATIENTEN

ZUSAMMENFASSUNG
Der Einfluss der Lagerung auf die Messung des oesophagealen Druckes wurde bei 6 paralysierten künstlich beatmeten Patienten gemessen. Es zeigt sich, daß der Oesophagealdruck kein zuverlässiger Indikator für den intrapleuralen Druck bei solchen Patienten darstellt, wenn die Messung in Supinationslagerung erfolgt.

EL EFECTO DE LA POSTURA EN LA DETERMINACION DE LA PRESION ESOFAGICA EN EL INDIVIDUO CURARIZADO

RESUMEN
Se ha estudiado el efecto de la postura sobre la determinación de la presión esofágica en seis enfermos paralizados y ventilados artificialmente. Se considera que la presión esofágica no es un indicador real de la presión intrapleural en tales pacientes, cuando se mide en decúbito supino.

DEPARTMENT OF ANAESTHESIA: THE UNIVERSITY OF LEEDS

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A course of practical instruction and tutorials designed to help trainee anaesthetists will be held in the Department of Anaesthesia during the week March 25–29, 1974. Numbers will be limited in order to allow those accepted to gain first-hand experience in operating the equipment.

The course will consist of practical exercises illustrating the use of selected types of measuring equipment of interest in the specialty of anaesthesia. Topics will include: basic electronics; statistics; gas flows and volumes; gas analysis; blood flow, pressure and temperature measurements; gas chromatography; recorders and the use of radio-isotopes.

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