New method to evaluate the practice of positive pressure ventilation in intensive care units

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Background. There is good evidence to support the use of a ‘protective’ ventilation strategy, using small tidal volumes and inspiratory pressures, in patients with acute respiratory distress syndrome. Many general intensive care units in the UK are being slow to adopt this approach and we therefore set out to devise a method to audit ventilation and possibly influence practice in these units.

Methods. Using variables that are routinely documented by intensive care nurses, we assessed the relationship between ventilator settings and arterial blood gas values on 30 consecutive ventilated patients admitted to intensive care units at both a teaching and a district hospital. Data were recorded twice daily and the proportions of data points where there was unnecessary hyperventilation were recorded at each centre.

Results. The initial audit results showed clear differences in practice between the teaching hospital and the district hospital. After an intensive education programme, during which an active role for nursing staff in ventilator management was encouraged, supported by simple protocols, practice in the district hospital was re-audited and found to closely mirror that in the teaching centre.

Conclusions. To assist progress towards the use of a ‘protective’ ventilation strategy in intensive care units in the UK, we devised a simple, robust audit method. We have shown how this method can give a more uniform practice of ventilation in critical care units, with the introduction of nurse-run protocols.

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Simple measures were chosen to estimate the proportion of time that patients were ventilated at inappropriately high pressures or tidal volumes, exposing patients to an unnecessary risk of barotrauma (Fig. 1).

Methods and results

We studied ventilation practice on the intensive care units of a teaching (university) and a district general hospital. We studied 30 consecutive admissions to each unit who were ventilated for more than 24 h. A record was made for each patient at 8 a.m. and at 8 p.m. each day of ventilatory pressures, volumes and arterial blood gas results. The study team made no interventions. For the assessment, `unnecessary hyperventilation' was defined as any record in which arterial pH was greater than 7.35 and either tidal volume was greater than 11 ml kg⁻¹ or peak inflation pressure was greater than 35 cm H₂O. The proportion of these records was calculated for each centre. Ninety-five per cent confidence intervals were calculated for the proportions, assuming a binomial distribution.

The initial results revealed a high proportion of non-ideal ventilatory settings in the district hospital (Fig. 1). In the light of these findings, an education programme was undertaken at the district hospital. In addition, a simple protocol was written to support increased involvement of nursing staff in the set-up and adjustment of mechanical ventilators. In outline, this protocol suggested lower (8 ml kg⁻¹) initial or default tidal volume settings than were previously being used, and limitation of peak inflation pressure to 32 cm H₂O if the arterial pH was greater than 7.32. In addition, a strategy for increased use of positive end-expiratory pressure to improve oxygenation was outlined, and it was suggested that the initial treatment of respiratory acidosis with a ventilator rate below 20 min⁻¹ should be to increase the ventilator rate rather than the inflation pressure. Six months after this process was completed, ventilation at the district hospital was re-evaluated (Fig. 1), and this showed a significant improvement in ventilation practice at the district hospital.

Comment

In the light of recent evidence supporting the use of ‘protective’ ventilation strategies, we devised and tested a simple and objective method of quantifying inappropriate ventilation practice on intensive care units. We found a clear difference in practice between two hospitals. Feedback of the results to the hospital with the more traditional ventilation strategy and the subsequent involvement of nurses in intensive care clinical pathways after an education programme resulted in uniformity of practice between the hospitals.

The process of audit in intensive care is evolving as best practice is determined in specific treatment areas. For effective audit, simple robust tests are required which do not involve significant extra clerical work and can therefore be undertaken with minimal extra resources. The audit test described here only gives an approximation to ventilation practice on intensive care units and then only to certain aspects of this practice. Because of its simplicity, however, it can be used easily and quickly to address this specific issue. The specific cut-off values we used represent a pragmatic application of currently available data from patients with ARDS and may need adjustment to suit local needs and targets. The tests could then lead to uniform best practice in critical care networks; it is likely that in many instances district units will be found to be performing better than teaching/hub hospitals.

It is particularly notable that an education programme aimed at nursing staff as well as medical staff, with protocols that were subsequently used by the whole team, improved ventilation practice in a small intensive care unit in a district hospital. This success shows the value of involving a multidisciplinary team in intensive care to facilitate progress towards modern practice.

References


Fig 1 Proportions (95% confidence intervals) of ventilation records in `undesirable’ clinical sectors. VT=tidal volume (ml kg⁻¹); PIP=peak inflation pressure (cm H₂O).