REFLECTIONS ON PREHOSPITAL CARE

EtCO₂: the key to effective prehospital ventilation

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DESCRIPTION

An advanced life support (ALS) unit staffed by two paramedics and two students was dispatched to a road traffic accident in South Africa. On arrival the team noted an adult male who had fallen from a minibus travelling at speed. The patient was noted to be in extremis:

- A. Airway was partially obstructed by blood/vomit, although the patient was lying in a lateral position
- B. Respiration was shallow at 6 breaths min⁻¹ and oxygen saturation via pulse oximetry was 100% on high-flow oxygen
- C. Heart rate was 100 bpm and blood pressure 160/100 mm Hg
- D. Eyes – 1; verbal – 1; motor – 3
- E. Isolated head injury with no other obvious injuries

Treatment priorities were dictated by the need to secure/protect the airway, concerns over hypoventilation,¹ and prolonged hospital transfer time. The decision was made to attempt to reduce secondary hypoxic brain injury through endotracheal intubation.² Due to the presence of trismus, midazolam (5 mg IV) was selected to facilitate intubating conditions. Sedation assisted intubation is common practice in South Africa.

Pre-oxygenation was continued with the patient on his side, a second IV line was secured, and the medication and equipment were prepared. Following a thorough but quick team briefing, the patient was log rolled onto his back and intubated. It was decided to hand ventilate the patient until he was in the ambulance where the mechanical transport ventilator would be used.

THE ISSUE

The authors were aware of the tendency of health care professionals to hyperventilate intubated patients^{3,4} and therefore one paramedic supervised the ventilation of the patient by a student who was specifically instructed to ensure that the ventilation rate did not exceed 10 min⁻¹. Our aim was to maintain optimum EtCO₂, but despite every effort to control hand ventilation, marked variations in the patient's EtCO₂ were noted (range 7–44 mm Hg). These were significantly outside the target range of 32–38 mm Hg that would indicate normocapnia.⁵

Once ventilation was transferred to the mechanical ventilator, which was set at 10 min⁻¹ with a tidal volume of approximately 6 ml/kg,⁵ a steady EtCO₂ was maintained. On reflection, the team challenged the decision to delay mechanical ventilation until the patient was in the ambulance.

REFLECTION

The purpose of reflection is to critically review an action and challenge clinical decisions, thereby confirming or changing practice.⁶ The authors were aware of the deficiencies of hand ventilation compared to the use of mechanical ventilation⁷ but decided to delay use of the ventilator until the patient

was in the ambulance to facilitate patient movement. This decision was based on the belief that careful hand ventilation with EtCO₂ monitoring would allow an acceptable EtCO₂ range to be maintained.

Without reflective practice there is a risk that clinicians will continue to act on “auto-pilot” as was the case in this instance.⁸ It is common practice to hand ventilate a patient until a mechanical ventilator has been configured or during short transfers, and prior to this case the authors had not challenged this mode of ventilation as it had become an accepted standard of care.

It is evident from the literature that hyperventilation occurs during the prehospital management of intubated patients^{3,4} and that this has a negative impact on outcomes.⁴ Our reflection highlighted the inability of hand ventilation to achieve effective ventilation as there is no control of minute volume due to breath-to-breath variability.⁹ However, variations of up to 20% from the pre-set values of the commonly used transport ventilators have been reported,⁹ but this difference will remain constant and therefore can be detected and compensated for.

A key aspect of prehospital ventilation as demonstrated during our reflection is patient specific tidal volumes, thereby challenging the previous approach of 10 ml/kg at 10 min⁻¹.¹⁰ The choice of 6 ml/kg at 10 min⁻¹ facilitated effective ventilation as demonstrated by Helm *et al.*¹¹

The management of this patient inadvertently provided an opportunity to make a qualitative and quantitative comparison of two ventilation strategies. This case highlighted the role of EtCO₂ monitoring in the context of prehospital ventilation and the importance of education in ventilation strategies and not just the psychomotor skill of intubation.

Perhaps most importantly for the authors, it provided stark evidence that patient care can be improved by challenging commonly held beliefs. The reflection that followed this case has resulted in a number of changes to the standard operating procedures of the paramedic unit involved, resulting in the earlier use of mechanical ventilation and mandatory use of EtCO₂ in all intubated patients. This is particularly important, as this ALS unit has been tasked with evaluating the introduction of prehospital rapid sequence intubation within South Africa.

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