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Research paper

Protective lung strategies: A cross sectional survey of nurses knowledge and use in the emergency department

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ABSTRACT

Background: Mechanical ventilation (MV) is commonly used in emergency departments (EDs). Protective lung strategies (PLS), comprising of low tidal volume (6 mL/kg), control of oxygen and plateau pressures, and administration of positive end expiratory pressure (PEEP) has been shown to reduces the risks associated with MV but there is little evidence exists about nurses' knowledge or application of PLS. Our aim was to explore nurses knowledge and application of PLS in Australian EDs.
Methods: Descriptive, exploratory design utilising an online questionnaire. A convenience sample was recruited via the College of Emergency Nursing Australasia mailing list and secondary snowball sampling was used to optimise response rate.
Results: There were 157 participants. PLS are being used in most EDs ($n = 104$, 75%) and clinical practice guidelines (CPG) are often available ($n = 86$, 62%). Most ED ventilators are capable of implementing PLS, but measurement of plateau pressures was infrequent ($n = 46$%). Participants demonstrate appropriate knowledge, but reported varying levels of confidence and perceived autonomy when implementing PLS in the ED.
Conclusion: PLS are being used in Australian EDs, aligning with best available evidence. Nursing staff have good levels of PLS knowledge. Development of an evidence-based CPG may improve confidence when implementing PLS and may pave the way for ED nurses to expand their scope of practice.

Introduction

Mechanical ventilation (MV) is a frequently applied therapeutic intervention in the Emergency Department (ED). Application of MV is not without risk, and there is a range of associated complications including lung trauma and the development of acute respiratory distress syndrome (ARDS). The concept of a protective lung strategy (PLS) (delivery of a low tidal volume (6 mL/kg), aggressive control of positive end expiratory pressure (PEEP), fraction of inspired oxygen and plateau pressures) has developed over the last 15 years as an approach to reduce risks associated with MV. Emerging evidence with a focus on MV in the ED context suggests that measures to prevent the development of ARDS should begin in the ED [1,5]. Despite increasing recognition of the relationship between MV and the development of ARDS, studies show that ED patients are continuing to receive injurious tidal volumes, and implementation of PLS still not routine [1,2].

Implementing PLS poses unique challenges in the ED context, as there are technical aspects that may inhibit ED clinician's ability to implement PLS. Inspiratory plateau pressures are infrequently monitored and are not considered a standard ventilator observation in the ED [2]. ED ventilators are most commonly transport ventilators, and are often unable to measure plateau pressures, which is an integral element of a PLS [3]. Anecdotal evidence suggests major metropolitan centres still regularly use ventilators that do not have the capacity for plateau pressure measurement and have limited capacity for titration and delivery of oxygen. There is also increasing recognition that decisions made early in the resuscitation phase whilst in the ED, such as initial and ongoing ventilator settings may impact on clinical outcomes [1,2]. Underlying pathophysiological processes associated with ventilator associated lung injury from injurious tidal volumes in patients with ARDS can occur within hours, which is particularly relevant to the ED context. The

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Table 1
Comparison of Initial Settings For Clinical Scenarios (n = 119).

	1. Female 70 kg, SAH[a]	Commonly accepted settings	2. Female, 60 kg, asthma	Commonly accepted settings	3. Male, 80 kg, OD[b]	Commonly accepted settings
Tidal volume (mL)	452.8 (SD 66.9) (6.45 mL/kg)	420	381.8 (SD 53.8) (6.35 mL/kg)	360	516.7 (SD 88.7) (6.45 mL/kg)	480
Starting rate	13.6 (SD 2.6)	16–17	14 (Q1 10, Q3 18)	8–10	13.2 (SD 2)	16–17
Theoretical minute volume	6140 mL	Aim for 7000 mL, based on weight	5345	Aim for 6000 mL, but potentially less as lower rates required	6820 mL	Aim for 8000 mL, based on weight
Level of PEEP (cmH20)	5 (Q1 5, Q3 5)	5–10	5 (Q1 0, Q3 5)	0–5	5 (Q1 5, Q3 5)	5–10
FiO2 (%)	75.5 (SD 26.9)	80–100	94 (SD 14.8)	80–100	89 (SD 21.5)	80–100
Plateau pressure	72 (67%)	30 cm H_20 or less	70 (64%)	30 cm H_20 or less	70 (66%)	30 cm H_20 or less
30cmH^20 or less	22 (20%)		29 (26%)		25 (24%)	
Unsure	14 (13%)		11 (10%)		11 (10%)	
Would not use						

[a] SAH-subarachnoid haemorrhage.
[b] OD-overdose.

development of ARDS is associated with increased mortality, duration of mechanical ventilation, non-pulmonary organ failure and increased lengths of stay [4].

In the Australian context, ED nurses play a pivotal role in managing patients who are mechanically ventilated. Clinical decision making (particularly ventilator settings), care and management is shared by medical and nursing staff [3]. This differs somewhat internationally; in North America (United States and Canada) most ventilator management decision making is in the realm of the Respiratory Technician or Therapist, with nurses having a secondary role [6]. This role of the Respiratory Therapist is unique to North America, there is no Australian or European equivalent.

Safe practice for patients receiving this highly complex intervention requires ED nurses to have an in-depth understanding of the technology, and the clinical application including effects on lung physiology [7]. With increasing ED lengths of stay, it is vital that strategies for optimal management of ventilation are implemented [8]. The only published research around Australian ED ventilation practices was in 2007; a contemporary investigation of current ventilation practices was timely. The aim of the study was to identify clinical practice patterns and explore the current knowledge of Australian emergency nurses related to the implementation of PLS in adult mechanically ventilated patients.

Methods

Study design

The study utilised a descriptive, exploratory design utilising a self-reporting cross-sectional survey administered via an online survey platform. A three-part survey was developed that collected demographic information, sought information on clinical practice patterns and explored nursing knowledge using validated clinical scenarios. The survey was reviewed for clinical acceptability, face validity and was pilot tested. The sample was obtained from two sources; the College of Emergency Nursing Australasia mailing list and by secondary snowball sampling. Consent was implied through completion of the on-line survey. Anonymity was maintained as data was non-identifiable.

Sample

The sample population was Australian Registered nurses (Division 1) who work regularly in an ED (at least one shift/month), and who have been credentialed to independently to nurse mechanically ventilated patients by their organisation. The single exclusion criteria was registration as an Enrolled nurse (Division 2). As this was a descriptive study, no sample size based on comparative data could be calculated. The challenge of setting a target sample size was also complicated by the fact that the number of eligible (credentialed) nurses in Australia was unknown. We considered that a sample of 150–200 would give adequate data for analysis. Study recruitment was via two sources; the College of Emergency Nursing (CENA) mailing list and snowball sampling through professional networks.

Data collected

The three-part survey collected the following information. Part one focused on general demographic information including age, state, type of ED and source of sample. Part two had questions on clinical practice patterns, which included questions on modes of ventilation available, availability of ventilator guidelines, ventilator functionality (including plateau pressures), ventilator observations and calculation of tidal volume and ideal body weight. Participant knowledge of PLS was also explored, with participants asked to self-rate levels of confidence and conceptual understanding of PLS. Information was also sought on the participants level of involvement around ventilator decisions. Part three used three validated clinical scenarios that asked participants to choose initial ventilator settings (tidal volume, frequency, fraction of inspired oxygen and PEEP) and plateau pressure aims based on the clinical picture (Table 1).

Outcomes measures

1. Current clinical practice patterns relating to the implementation of PLS
2. Knowledge of ED nurses on the implementation of PLS

Ethics

The study design met the criteria for a Quality Assurance project and adheres to National Statement on the Conduct of Human Research by the Australian National Health and Medical Research Council, and was approved by the Western Health Human Research Ethics Committee.

Analysis

Data was analysed using IBM SPSS Version 22. Categorical data was summarised using frequency counts (*n*) and proportions (%). Continuous data was summarised using measures of central tendency, with mean (*M*) and standard deviation (SD) if normally

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