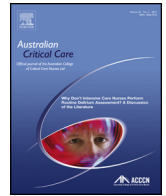




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Intensive care clinicians' opinion of conservative oxygen therapy (SpO₂ 90–92%) for mechanically ventilated patients



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A B S T R A C T

Background: In the ICU, SpO₂ ≥ 96% are regularly targeted implying that more oxygen may be given than desirable. To reduce exposure to hyperoxia a conservative oxygen therapy protocol (targeted SpO₂ 90–92% using lowest FiO₂) for mechanically ventilated patients was introduced in a single tertiary ICU in September 2012.

Objectives: To describe intensive care clinicians' opinion of conservative oxygen therapy for mechanically ventilated adult patients.

Methods: A structured multi-choice questionnaire of intensive care clinicians was conducted between February and March 2013.

Results: Responses were received from 90 staff members: 81 intensive care nurses and 9 medical doctors. A majority of respondents (60.7%) considered oxygen related lung injury as 'a major concern'. Most respondents (81/89; 91.1%) felt conservative oxygen therapy was easy to perform and few respondents (6/88; 8%) considered performing conservative oxygen therapy to be stressful. Most respondents (58%) reported not performing more arterial blood gases to monitor PaO₂ during conservative oxygen therapy and 90% (81/90) of respondents indicated a desire to continue conservative oxygen therapy. Free text comments indicated adoption of this protocol was a paradigm shift yet more education and research to elucidate the benefits/harm of lower oxygen saturation targeting is needed.

Conclusions: Intensive care clinicians readily accepted the introduction of a conservative oxygen therapy protocol into their practice. Most respondents found conservative oxygen therapy easy and not stressful to perform. Further evaluation the administration of oxygen therapy, its management by intensive care clinicians and possible impact on outcome for mechanically ventilated patients appears well accepted by clinical staff.

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Introduction

Oxygen is required for normal cellular function and is vital to sustaining human life. The normal arterial oxygen tension (PaO₂) at atmospheric pressure (760 mm Hg) is 80–100 mm Hg. This equates

with a normal oxygen saturation of greater than or equal to 95% when measured by pulse oximetry (SpO₂).¹ Oxygen therapy is the therapeutic administration of oxygen to patients for the treatment or prevention of hypoxaemia. Hypoxaemia (a state of oxygen deficit) carries significant risk and is typically carefully avoided.^{2,3} Similarly, hyperoxia (a state of oxygen excess) provides a buffer of safety in some high risk ventilated patients, yet may also be injurious.⁴ For example, hyperoxia in the lungs may cause histopathological injury, atelectasis, interstitial fibrosis, alveolar protein leakage and infiltration by neutrophils.^{4–6} Systemically, hyperoxia can generate free radicals in various organs^{7,8} and reduce stroke volume and cardiac output.^{10,11}

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In emergency situations supplemental oxygen is given to achieve a SpO₂ of 100%. For patients admitted to the intensive care unit (ICU) SpO₂ greater than 96% are regularly targeted. In many instances this would mean that more oxygen is given than may be desirable. Mechanical ventilation (MV) is a common intervention provided to critically ill patients.^{12,13} Mechanical ventilation involves the placement of a breathing tube (endotracheal tube) into the patient's airway to mechanically assist or replace spontaneous breathing and support oxygenation. A recent Australian and New Zealand study¹² identified as many as 55% of patients admitted to ICU receive MV. Unfortunately, mechanically ventilated *n* patients are at risk of lung injury associated with this form of life-support. As described above a key threat to lung injury is hyperoxia. At the present time most mechanically ventilated patients receive a higher than normal fraction of inspired oxygen (FiO₂) to maintain a target PaO₂.^{13,14} Indeed, standard clinical management is to titrate FiO₂ to maintain normal or above normal PaO₂ in mechanically ventilated patients as a buffer of safety against hypoxaemia (Table 1).

Concern amongst intensive care clinicians about the risks associated with oxygen therapy have been identified by Mao et al.¹⁵ and Eastwood et al.² Although separated by 10 years, a shared finding of these two studies was clinician's concern over oxygen related lung damage associated with prolonged high FiO₂ exposure for mechanically ventilated patients. Further more Eastwood et al.² also identified that 12.8% of surveyed intensivists working in Australia and New Zealand believed the threat of oxygen related damage to the lungs was greater than barotrauma (damage associated with pressure changes) when commencing patients on MV. A recent retrospective observational study of 5498 ventilated patients to evaluate the response of intensivists to hyperoxia showed that 22% of patients were hyperoxic.¹⁶ Despite hyperoxia being frequent, in most cases there was no adjustment of ventilator settings to reduce FiO₂. Moreover, the optimal SpO₂ target for mechanically ventilated patients remains unknown and the practice of precise control of PaO₂ by FiO₂ titration underexplored.^{17,18}

Following multiple discussions with medical staff, in-service presentations to clinical staff and internal journal club presentations of oxygen therapy related literature,^{17,19–22} the Austin Hospital ICU implemented a conservative oxygen therapy protocol. Conservative oxygen therapy was defined as targeting SpO₂ between 90 and 92% for mechanically ventilated patients by using the lowest achievable FiO₂. The conservative oxygen therapy protocol was commenced in September 2012. Medical and nursing staff members were asked to follow three steps in order to implement conservative oxygen therapy:

1. For adult patients (greater than or equal to 18 years old) that are.
2. Ventilated and expected to be ventilated at least until the day after tomorrow (at least 48 h).
3. Keep oxygen saturation (SpO₂) between 90 and 92% using the lowest FiO₂.

It was recognised that the introduction of a conservative oxygen therapy protocol would challenge clinician's current practices and clinical norms associated with the oxygen therapy management of mechanically ventilated patients. In addition, following the introduction of new protocols that require practice change, it is important to evaluate their impact for staff. In parallel with the before-and-after trial, this survey was performed with the aim to explore intensive care nurses' and doctors' opinion of conservative oxygen therapy at the Austin Hospital ICU. Significantly, the findings of this survey would provide insight into the perceptions, concerns and practice of conservative oxygen therapy. Furthermore, the knowledge generated by this study may inform future

Table 1

Intensive care clinicians' opinion of conservative oxygen therapy (SpO₂ 90–92%) for adult critically ill patients in a tertiary intensive care unit.

Question	Responses ^a
"Which of the following describes your clinical role in the ICU?" (90 responses)	
Nurse	81 (90%)
Doctor	9 (10%)
"I feel that oxygen related lung (such as oxygen toxicity or atelectasis) is a concern for mechanically ventilated patients" (88 responses)	
Yes, a major concern	54 (60.7%)
Yes, but not a major concern	35 (39.3%)
No, its not a concern	0
"I initiated conservative oxygen therapy" (88 responses)	
100% of the time	23 (26.1%)
Between 50 and 100% of the time	55 (62.5%)
<50% of the time	10 (11.4%)
"I found conservative oxygen therapy easy to perform" (89 responses)	
Strongly agree	53 (59.6%)
Agree	28 (31.5%)
Uncertain	5 (5.6%)
Disagree	2 (2.2%)
Strongly disagree	1 (1.1%)
"I found implementing conservative oxygen therapy a stressful experience" (88 responses)	
Strongly agree	1 (1.1%)
Agree	5 (5.7%)
Uncertain	8 (9.1%)
Disagree	39 (44.3%)
Strongly disagree	35 (39.8%)
"I performed more arterial blood gas during conservative oxygen therapy to monitor PaO ₂ " (87 responses)	
Strongly agree	5 (5.7%)
Agree	7 (8%)
Uncertain	17 (19.5%)
Disagree	43 (49.4%)
Strongly disagree	15 (17.2%)
"Implementing conservative oxygen therapy has made me more conscious of how I administer oxygen to mechanically ventilated patients" (89 responses)	
Strongly agree	43 (48.3%)
Agree	40 (44.9%)
Uncertain	1 (1.1%)
Disagree	4 (4.5%)
Strongly disagree	1 (1.1%)
"I feel that we should continue implementing conservative oxygen therapy in our mechanically ventilated patients" (90 responses)	
Strongly agree	49 (54.4%)
Agree	32 (35.6%)
Uncertain	9 (10%)
Disagree	0
Strongly disagree	0

ICU = intensive care unit. PaO₂ = arterial tension of oxygen.

^a Responses = all responses are expressed as a % of the total number of responses for that question.

interventional studies aimed at optimising oxygen therapy in the care of critically ill patients.

The before-and-after trial was conducted by a team of researchers at the Austin Hospital to evaluate the safety and feasibility of conservative oxygen therapy. The aims of this trial were to establish the biochemical, physiological and clinical outcomes for patients following the introduction of the conservative oxygen therapy protocol. The before-and-after trial was conducted between March 2012 and January 2013 (and was performed with the assent of the entire ICU Consultant group).

Methods

Ethics approval

Prospective approval was obtained from Austin Health human research ethics committee for the survey to be conducted (Austin Health Human Research Ethics Committee approval number:

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