

Intensive Care Clinicians' Attitudes and Self-Reported Practice of Conservative Oxygen Therapy

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Abstract

Background: Conservative oxygen therapy (COT) targets a SpO₂ of 90 - 92% using the lowest possible FiO₂ for mechanically ventilated (MV) adult patients. Conservative oxygen therapy aims to maintain adequate oxygenation while avoiding the harmful effects of hyperoxaemia. However, a lower SpO₂ target during MV is recognised as challenging in current clinical norms.

Objectives: We sought to describe intensive care clinicians' opinion and self-reported practice of conservative oxygen therapy.

Methods: The research tool was a multi-choice questionnaire of intensive care clinicians working at 10 affiliated metropolitan tertiary hospitals from January-April, 2014.

Results: Four hundred and twelve (84%) staff members responded to the survey. Of these, 91% (375) were intensive care nurses and 9% (37) were medical doctors. A majority of respondents (86%, 356/412) considered oxygen-related lung injury as "Yes, a major concern". Most respondents, 85% (351/412), felt COT was easy to perform and a few respondents, 6% (23/412), considered performing COT to be stressful. More than 90% of the respondents reported not performing more arterial blood gases to monitor PaO₂ during COT and essentially all (98%) indicated a desire to perform COT. Free text comments indicated COT as a challenge to current practice and expressed a strong desire to avoid inadvertent hypoxaemia.

Conclusions: Intensive care clinicians varied in their opinion and self-reported practice of conservative oxygen therapy and were genuinely concerned about unintended physiological consequences related to targeting low SpO₂ values. We recommend conservative oxygen therapy to be implemented cautiously in conjunction with further evaluation of its impact on outcomes for patients and the perceptions of clinicians.

Keywords: Conservative Oxygen Therapy, Hypoxemia, Hyperoxaemia, Intensive Care Unit

1. Background

Oxygen therapy may be a life-saving intervention and is an intervention applied essentially to all intensive care unit (ICU) patients (1). Intensive care clinicians play a vital role in the administration and management of oxygen therapy for patients admitted to the intensive care unit (ICU) (1, 2). Evidence from animal (3, 4) and human stud-

ies (5, 6) has continued to identify the injurious effects of prolonged hyperoxaemia. Mechanically-ventilated ICU patients are at high risk of prolonged hyperoxaemia due to higher than normal fraction of inspired oxygen (FiO₂). Maintaining higher than normal oxygen levels may be exposing these patients to avoidable harm (2, 7).

Recently, a team of investigators implemented a conservative oxygen therapy (COT) protocol for mechanically-

ventilated ICU patients (8). In their before-and-after clinical trial, Suzuki et al. (2014) evaluated the physiological impact of targeting pulse oximetry-derived oxygen saturations (SpO₂) of 90 - 92% using the lowest possible FiO₂ for mechanically ventilated adult patients. The sample included 101 mechanically ventilated patients admitted to a tertiary medical-surgical ICU. The findings of their study demonstrated that COT decreased the median time weight SpO₂ from 98.4% to 95.5%, median arterial oxygen tension decreased from 107 mmHg to 83 mmHg and median FiO₂ from 0.40 to 0.27. Importantly, after assessing the number of secondary outcomes, these investigators concluded that COT was free of adverse biochemical, physiological or clinical outcomes, such as changes in serum lactate, serum creatinine, new non-respiratory organ failure and episodes of severe hypoxaemia (PaO₂ < 55 mmHg). Furthermore, these investigators recognised that introduction of the COT would be a challenge to the current practices and clinical norms of their ICU clinicians. As such, these investigators performed a questionnaire survey to ascertain the opinion regarding COT of their intensive care doctors and nurses (9). Survey findings identified that staff were concerned about oxygen-related lung injury; that COT was easy and not stressful to perform; COT did not result in more arterial blood gas (ABG) samples being taken; and, COT was to continue so long as further research evaluating the clinical impact of this approach was performed.

In response, we implemented our own pilot study of conservative oxygen therapy for mechanically ventilated patients admitted to the ICU. Importantly, along with evaluating the physiological implications of implementation of this new approach, we too sought to evaluate the attitudes and opinions of COT from our intensive care doctors and nurses. Accordingly, we conducted a survey of intensive care clinicians' to describe their attitudes and self-reported practices in relation to COT.

2. Objectives

The aim of this study was to describe intensive care clinicians' opinion and self-reported practice of conservative oxygen therapy.

3. Methods

Prospective institutional ethics approval was obtained from the deans of each participating hospital for the survey to be conducted. The survey was deemed low-risk, and completion of the survey implied consent. To maintain anonymity, each respondent was allocated a unique identifier and the final data set for analysis was re-identified.

3.1. Questionnaire

We used an anonymous structured multi-choice questionnaire to survey intensive care clinicians. The questionnaire consisted of nine questions. There were seven practice-oriented questions followed by one free-text question and one employment status question. The questionnaire was the conservative oxygen therapy questionnaire survey of Australian ICU clinicians by Eastwood et al. (9). The survey was translated from English to Persian and pilot tested to ensure face and content validity. There was no need to change the translated questions and the questionnaire was distributed to the intensive care clinicians.

3.2. Target Population and Questionnaire Administration

Intensive care nurses and doctors employed in ten tertiary affiliated metropolitan ICUs in Tehran, Iran, during the study period were eligible to participate in this study. All clinicians were informed of the study via an introductory cover letter that accompanied the questionnaire. Furthermore, respondents could seek clarification from a member of the research team if they had any questions. All responses were obtained during a 16-week period from 10th of January to 25th of April, 2014.

3.3. Data Management and Analysis

Questionnaire responses were collated to facilitate data management and analysis. All responses are expressed as a percentage (%) of the total number of responses for that question. No imputation was made, as there were no missing responses. The response rate of this survey was 84%. Because the concept of COT was recognized necessary for clinical registered nurses and doctors, the researchers clearly explained the purposes, and for collecting completed questionnaires, there was no time pressure and the participants could fill and deliver the questionnaires in their own free time. Data collected by this questionnaire were analysed using simple descriptive statistical procedures to calculate means and percentages (Microsoft Office Excel 2007, U.S.A). Free text comments were analysed sentence by sentence to identify common themes expressed by the respondents (10). To achieve reliability in coding, one researcher and two other experienced researchers performed the thematic analysis. Thematic analysis was uncomplicated and there was no disagreement between the researchers during the analysis process.

4. Results

4.1. Characteristics of Cohort

A total of 412 from 489 (84%) available staff members responded to our survey invitation. Full responses were received to the multi-choice questions from all respondents.

Overall, 91% (375) of the respondents identified themselves as intensive care nurses and the remaining 9% (37) as medical doctors (Table 1).

Clinicians reported opinion and practice of conservative oxygen therapy.

In response to the question of concern about oxygen-related lung injury, 86% (356/412) of the respondents reported 'Yes, a major concern' and 14% (56/412) of the respondents reported 'Yes, but not a concern'; while no respondent reported 'No, it is not a concern'.

It was desirable to initiate conservative oxygen therapy at the beginning of and then sustain through the duration of mechanical ventilation. A third of the respondents (34%, 141/412) reported initiating conservative oxygen therapy '100% of the time' while most respondents, 59% (242/412), reported initiating conservative oxygen therapy between 50 - 100% of the time. Fewer respondents (7%) reported initiating conservative oxygen therapy '< 50% of the time' (Table 1).

In response to the question related to how easy conservative oxygen therapy was to perform, most respondents, 85% (351/412), 'strongly agreed' and 10% (42/412) 'agreed', while fewer respondents (4%) reported being 'uncertain', 'disagree' or 'strongly disagree'. When questioned as to whether or not the clinician found implementing conservative oxygen therapy to be a stressful experience, 63% (257/412) 'strongly disagreed' and 6% (23/412) 'strongly agreed'.

Clinicians were asked whether they felt they performed more arterial blood gases during conservative oxygen therapy to monitor PaO₂: 60% (247/412) of the respondents 'strongly disagreed' and a further 31% (130/412) of the respondents 'disagreed', while fewer respondents, 4% (14/412), were uncertain. Most respondents indicated that implementing COT had made them more conscious of how they administer oxygen to mechanically ventilated patients: 66% (272/412) of the respondents 'strongly agreed' and 33% (137/412) of the respondents 'agreed' (Table 1).

Clinicians were asked if they felt that the conservative oxygen therapy protocol should be continued. The majority of the respondents (80%, 331/412) reported they 'strongly agreed' and 18% (75/412) of the respondents 'agreed', the remaining 1% (6/412) of the respondents were 'uncertain' (Table 1).

In the final question of the survey, respondents were invited to raise concerns that they had in relation to performing conservative oxygen therapy in mechanically ventilated patients. All respondents provided comments. There were two common themes: 'challenge to current practice' and 'protocol for the prevention of hypoxia'. Theme one, 'Challenge to current practice', was raised by all respondents. Many respondents considered the intervention to

be a positive step in evaluating current practice:

"Application of a new method can help our patients, because manipulation in unknown areas like oxygen therapy is in the majority of times helpful" (Intensive care nurse, 19 years of clinical experience).

In contrast, some respondents were concerned about departure from traditional norms:

"This kind of intervention must be confirmed by our physicians and nurses cannot make a decision independently" (Intensive care nurse, 29 years of clinical experience).

The second theme "Protocol for the prevention of hypoxia" was made evident from the comments submitted. Some nurses believed that conservative oxygen therapy required a rigorous protocol for application at ICUs, because there are different situations that affect oxygen therapy for hospitalized patients at the ICU and all of these situations must be rigorously described for a panel of experts. In this regard, one nurse declared:

"We have no codified protocol for oxygen therapy, even for simple usage of oxygen devices, other than conservative oxygen therapy" (Senior intensive care nurse, 18 years of clinical experience).

Similarly, there was an identified need for further education. Education was viewed as the link between knowledge and practice.

"For better understanding of conservative oxygen therapy, education in form of workshops, seminars, and on the bed of patients is very important and critical" (ICU lecturer, 11 years of clinical experience).

Moreover, one respondent felt education was paramount for improving medical understanding of COT:

"Education for this new concept is the backbone and is the foundation of practice" (Head of ICU physicians, 27 years of clinical experience).

5. Discussion

5.1. Summary of Major Findings

Our survey of intensive care clinicians' attitudes and practices regarding conservative oxygen therapy had four key findings. First, intensive care clinicians were concerned about oxygen-related lung injury. Second, performing COT was reported to be easy to perform and not stressful. In addition, they did not report performing more ABGs as a means to monitor the management of COT. Finally, while the participants expressed a strong desire to continue COT, they did feel that this approach was a challenge to current clinical norms and that COT warranted further investigations.

Table 1. Intensive Care Clinicians' Opinion About Conservative Oxygen Therapy for Mechanically Ventilated Adult Patients at a Tertiary Intensive Care Unit

Question	Responses ^a
"Which of the following describes your clinical role at the ICU?"	
Nurse	375 (91%)
Doctor	37 (9%)
"I feel that oxygen-related lung complications (such as oxygen toxicity or atelectasis) is a concern for mechanically ventilated patients"	
Yes, a major concern	356 (86%)
Yes, but not a major concern	56 (14%)
No, it's not a concern	0
"I initiated conservative oxygen therapy"	
100% of the time	141 (34%)
Between 50-100% of the time	242 (59%)
< 50% of the time	29 (7%)
"I found conservative oxygen therapy easy to perform"	
Strongly agree	351 (85%)
Agree	42 (10%)
Uncertain	8 (2%)
Disagree	7 (1%)
Strongly disagree	4 (1%)
"I found implementing conservative oxygen therapy a stressful experience"	
Strongly agree	23 (6%)
Agree	6 (1%)
Uncertain	14 (3%)
Disagree	112 (27%)
Strongly disagree	257 (63%)
"I performed more arterial blood gas during conservative oxygen therapy to monitor PaO₂"	
Strongly agree	15 (4%)
Agree	6 (1%)
Uncertain	14 (4%)
Disagree	130 (31%)
Strongly disagree	247 (60%)
"Implementing conservative oxygen therapy has made me more conscious of how I administer oxygen to mechanically ventilated patients"	
Strongly agree	272 (66%)
Agree	137 (33%)
Uncertain	2 (1%)
Disagree	1 (<1%)
Strongly disagree	0
"I feel that we should continue implementing conservative oxygen therapy in our mechanically ventilated patients"	
Strongly agree	331 (80%)
Agree	75 (18%)
Uncertain	6 (1%)
Disagree	0
Strongly disagree	0

Abbreviations: ICU, intensive care unit; PaO₂, arterial tension of oxygen.^aAll responses are expressed as a percentage of the total number of responses for that question.

5.2. Comparison with Previous Studies

One previous study directly described intensive care clinician's attitudes to the introduction of COT for mechanically ventilated adult patients. In 2013, Eastwood et al., in their survey questionnaire of 90 intensive care clinicians in an Australian ICU, identified considerable consistency

in the attitudes and stated practices in relation to COT. The key findings of this Australian study were that clinicians were strongly concerned about oxygen-related lung injury, and reported that COT was easy to perform, and that further research should be conducted to show no harm was being caused as a result of COT (9). Our study iden-

tified similar homogeneity in attitudes and practice towards COT. For example, each cohort consisted of a significant proportion of respondents that identified oxygen related lung injury as 'a major concern'; 60.7% of Australian respondents and 86% of Iranian respondents. Likewise, there were a similar proportion of respondents, who found implementing COT made them more conscious of how they administered oxygen to mechanically ventilated patients, with 93.2% Australian respondents and 99% Iranian respondents. However, a lower proportion of Australian respondents (54.4%) reported that they 'strongly agreed' with continuing COT compared with 80% of the Iranian respondents. The concordant views expressed by these Australian and Iranian respondents demonstrate that change in oxygen therapy-related practice is possible. However, evidence supporting the benefit of targeting lower oxygen saturations in mechanically ventilated patients has yet to be sufficiently demonstrated.

Oxygen therapy-related practice variability and perceived concerns related to oxygen administration have been shown in other studies (11-13). Such practice variability may be in part due to contextual differences in clinical settings and this may have implications for guideline implementation. For example in the Iranian context, critically ill are typically nursed in a 1:2 or 1:3 nurse-patient ratio and it is uncommon for intensive care nurses to make oxygen therapy management decisions, such as when to adjust the FiO₂ settings. By comparison, critically ill patients are nursed on a 1:1 nurse-patient ratio and the majority of intensive care nurses have a critical care qualification (14). Thus, while the findings of our study and the study by Eastwood et al. (2013) provide encouraging bi-national practice data, their findings are likely to vary significantly from other international settings with differing levels of nursing expertise and critical care resource utilisation (9). As such, we urge a greater evaluation of nursing and critical care service provision regarding the administration of oxygen for mechanically ventilated patients.

5.3. Clinical Implications

Recently, randomized controlled trials have commenced to clarify the safety, feasibility and efficacy of targeting different oxygenation targets for mechanically ventilated ICU patients (Australian New Zealand clinical trials registry; ACTRN 12613000505707), patients following cardiac surgery (ACTRN 12613001322729), patients with traumatic brain injury (NCT01201291), patients with acute myocardial infarction (15), and stroke (6). While it is premature to change practice until the trial results are known, it has been of value to evaluate the impact of practice change on our clinicians. In addition, given the large number of intensive care patients treated each

year with mechanical ventilation worldwide, there is the potential for practices of intensive care clinicians to affect a large number of patients. Furthermore, the presence of differences in responses of clinicians justifies further investigations of oxygen therapy-related practice change. Such investigations should seek to ascertain the intensive and critical care clinicians from different clinical settings and geographic locations.

5.4. Strengths and Limitations

Our study has several strengths. To date, this is the largest sample of intensive care clinicians surveyed in relation to their attitudes and self-reported practice of conservative oxygen therapy practice. This study included intensive care nurses and doctors from ten ICUs within an affiliated network, thereby provides insight into the breadth of opinions of clinicians most acutely charged with making oxygen-related clinical decisions for intensive care patients. Our questionnaire was based on a previously used study that had been pilot tested and our response rate was high. There were also some limitations associated with the conduct of this study. Firstly, responses were self-reported data and, as such, may not reflect actual practice. Secondly, the survey was tailored toward ICUs that had been practicing COT and, as a consequence, the attitudes of clinicians in ICUs toward the possibility of performing COT is unknown. However, oxygen therapy is a ubiquitous therapy administered to ICU patients and the concerns of intensive care clinicians are likely to be shared by others.

5.5. Conclusion

In summary, intensive care clinicians reported being concerned over oxygen-related lung injury for mechanically ventilated patients. When a conservative oxygen therapy approach, in which the SpO₂ target for ventilated patients was set at 90 - 92% using the lowest FiO₂, was used the intensive care clinicians found it to be easy to perform and non-stressful. Further, while practice change was readily adopted, there was a strong desire to ensure appropriate education to staff members and to ensure that unwarranted hypoxaemia is avoided. Practice variation is based on differing levels of nursing and expertise and critical care resource utilisation. As such, to verify or refute our findings, it is prudent to explore the safety and feasibility of COT practices through the experience of intensive care nurses and doctors in other settings and locations.

Opinions of clinicians were very positive about conservative oxygen therapy (SPO₂ 90 - 92% for mechanically ventilated patients) protocol in their practice. Moreover, this new concept was easy and it did not result a greater number of arterial blood gases being taken. Whether or not

conservative oxygen therapy benefit (lower SpO₂ targets) outweighs the harm requires an independent evaluation.

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Footnotes

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