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An audit of paramedic administration of oxygen therapy to patients with suspected acute coronary syndrome

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Abstract

Introduction
In the past, high flow oxygen was routinely administered to patients with suspected acute myocardial infarction. Recent evidence has suggested there is no benefit from hyperoxaemia, and in these patients it might result in adverse outcomes. The Australian and New Zealand Council of Resuscitation (ANZCOR) guideline previously recommended routine oxygen therapy, but a recent change has occurred. The ANZCOR current guideline recommends selective use of oxygen therapy in patients with suspected acute myocardial infarction, to achieve oxygen saturations ≥94% and <98%. Because the change occurred recently, the South Australian paramedic adherence rate to the ANZCOR guideline was unknown. Therefore, the aim of this study was to determine the South Australian paramedic adherence rate to the ANZCOR oxygen use in acute coronary syndrome recommendations.

Methods
A retrospective audit of patient case notes was conducted, for patients with chest pain presenting via ambulance to a tertiary hospital emergency department, during a 3-month period. Paramedic administration of oxygen therapy was then compared against the ANZCOR recommendations.

Results
Paramedics treated a total of 111/139 (79.9%, CI 72.4–85.7%) in line with the ANZCOR guideline and the treatment of 28/139 (20.1%, CI 14.3–27.6%) fell outside of the recommendations.

Conclusion
Although the results demonstrated a degree of compliance, this could be improved through clinical education, a review of the local chest pain guidelines, an introduction of a drug protocol for oxygen therapy and future research investigating the reasons for non-compliance to the best practice guidelines.

Keywords:
paramedic; emergency medical technicians; ambulances; oxygen inhalation therapy; acute coronary syndrome; guideline adherence

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Introduction

The South Australian Ambulance Service (SAAS) guidelines recommend routine oxygen administration to all patients with suspected acute coronary syndrome (ACS) (1). In comparison, the Australian and New Zealand Council of Resuscitation (ANZCOR) publish national guidelines in Australia and now recommend oxygen titration. The change to the guideline was based on the lack of evidence supporting the use of routine oxygen (2), and randomised control trials (RCTs) that showed oxygen may increase myocardial infarction size (3,4). At present it is unknown whether paramedics in South Australia adhere to state (SAAS) or national (ANZCOR) guidelines.

Clinical practice guidelines (CPGs) are recommendations for health professionals on how to care for specific conditions. They involve advice on information to give patients or the best way to prevent, manage and diagnose a condition (5). The benefits of CPGs are that they assist clinicians to make informed decisions that are standardised and based on evidence (6). Clinical practice guidelines are developed by multi-disciplinary committees comprising specialists in the topic. Best practice CPGs are those that are based on an internationally recognised reporting standard such as the Grading of Recommendations, Assessment, Development and Evaluation (GRADE) performance methods (7). Standardisation of guideline development ensures recommendations have minimal bias and are based on a comprehensive method of assessment (8). ANZCOR guideline development follows these principles.

Oxygen use had for many years been considered to be of benefit to patients with ACS (9). Unfortunately, this assertion was based on outdated laboratory data on animals (10). Until recently there have been no randomised control trials evaluating use of routine oxygen therapy in ACS. In 2012, a RCT called the Air Versus Oxygen in myocarDial infarction (AVOID) trial was performed, showing that suspected ACS patients who were routinely treated with oxygen by paramedics had increased infarct size compared to those managed with air (4). In 2016, a large registry based RCT called the DETermination of the role of OXygen in suspected Acute Myocardial Infarction (DETO2X-AMI) trial evaluated the effect of hyperoxaemia in patients with ACS (11). In this study, 6629 patients who presented via ambulance or directly to an emergency department were randomised to either oxygen therapy or ambient air. Their findings showed that oxygen therapy in patients who did not have hypoxaemia did not reduce all-cause mortality at 1-year after randomisation. A recent meta-analysis in 2018 evaluated eight RCTs including the AVOID and DETO2X-AMI trials with a total of 7998 patients. Their findings were that oxygen therapy has no benefit to mortality or infarction size in patients with suspected ACS, and that a harmful effect cannot be ruled out (12).

Considering the lack of benefit of oxygen in those who do not have hypoxaemia, the potential harm and the cost of oxygen therapy, most guidelines have now changed to integrate these findings. For example, the International Liaison Committee on Resuscitation suggest 'withholding oxygen in comparison to routine oxygenation in normoxic patients with ACS' (13). The American Heart Association guideline recommends withholding oxygen therapy in normoxic (SpO2 >94) patients with a suspected uncomplicated myocardial infarction (13). The ANZCOR guideline states that 'supplemental oxygen should be initiated only if the patient has breathlessness, hypoxaemia (SpO2 <94%), or signs of heart failure or shock' (3). The ANZCOR guideline currently reflects best practice standards for paramedics in Australia.

Carhart and Salzman (2) determined the trends in paramedic administration of oxygen to patients with normoxemia and uncomplicated ACS. The design was a retrospective analysis of United States paramedic student case data over a 2-year period and included 10,552 patient cases. In 2012, they demonstrated that 53.1% of patients with uncomplicated ACS and normoxemia received oxygen. These results could not be used to answer our research question for the following reasons. Firstly, their study defined complicated ACS as patients with hypoxaemia or hemodynamic instability. Contrary to ANZCOR, their study did not consider breathlessness or signs of heart failure, which are also features of complicated ACS. Secondly, their study did not identify the trend in administration of oxygen to complicated ACS, which is important to determine because hypoxaemia reflects poor oxygen delivery to the tissues and needs treatment with oxygen therapy. Thirdly, they used data recorded by paramedic students and it is unknown if having a student present made the attending paramedic treat more conservatively. Fourthly, attitudes to oxygen therapy may have changed significantly since 2012, when this study was performed. Finally, there are issues of external validity because their study population came from a single country (2).

There are currently no studies reviewing South Australian paramedic administration of oxygen to patients with ACS. The current level of adherence to guidelines might inform the need to review current practices. Therefore, the objective of this study was to identify the South Australian paramedic rate of adherence to the ANZCOR oxygen therapy in ACS guidelines.

Methods

Study design

A retrospective observational study of patient case notes was conducted.

Study population

The SAAS is a government-funded organisation in Adelaide, South Australia. The service contains approximately 2,200 operational staff, who provide acute out-of-hospital care in both rural and urban settings (14). The emergency department was located in a level three university affiliated tertiary hospital with approximately 600 beds, located 12 kilometres outside the city centre. The population of South Australia is approximately 1.7 million people (15).

Participants
Patients were included in this study if they presented to the emergency department via the SAAS with a presenting compliant of chest pain. The time-period audited started 1 June 2016 and ended 30 August 2016.

Patients were excluded if they were less than 18 years of age, had a past medical history of chronic obstructive pulmonary disease or carbon monoxide poisoning. Cases that had an incomplete data set, missing records or were attended to by non-paramedic crews were excluded from the study.

Procedures
Patients meeting the inclusion criteria were identified through the medical records patient database. Data were collected manually from case notes and input into an electronic Microsoft Excel spreadsheet. In South Australia, vital signs data is recorded by paramedics in a patient observation chart. Our data were collected at the time-period when the paramedic had first contact with the patient. The data included the respiratory rate, blood pressure, saturation of oxygen level (SpO2), signs of heart failure and administration of oxygen therapy. If they did receive oxygen, the delivery system and flow rate was documented.

Data analysis

Oxygen use was evaluated against the best practice standard, therefore statistical analysis was not performed on guideline compliance. Patients were categorised according to the ANZCOR guideline as either requiring or not requiring oxygen. The rate of adherence was then determined by identifying whether they appropriately gave the intervention or not.

Patients considered to require oxygen therapy were those who had breathlessness, hypoxaemia, signs of heart failure or shock as described by the ANZCOR guideline. The ANZCOR guideline defined hypoxaemia as SpO2 of <94, but the other parameters were open to clinical interpretation. In this study, breathlessness was defined as a respiratory rate of >24 breaths/min, because patients with a respiratory rate of >24 breaths/min are considered likely to be critically ill (16). Shock was defined as a blood pressure of <100 mmHg, which was based on studies on septic shock (17). Signs of heart failure were defined as pulmonary crepitations on auscultation, peripheral oedema or a raised jugular venous pressure.

Ethics

The study was approved by the South Australian Local Health Network Ethics Committee and access to patient notes was approved by the medical records department.

Results

There were 253 patients who presented to ED via ambulance with chest pain during the audited time period. In total, 172 patient case files could be retrieved, nine patients were excluded because they had a history of COPD and 11 patients were treated by non-paramedic crews. There were seven patients who did not have a saturation of oxygen level recorded, four patients who did not have a respiratory rate recorded, and two patients who did not have a blood pressure recorded, resulting in the inclusion of 139 patients.

Oxygen therapy was administered to 29/139 patients (20.9%, CI 14.9–28.4%). The most common method of delivery was via nasal cannula on 20/29 (70%, CI 50.8–82.7%) occasions with a flow rate between 2–4 L/min (Table 1). Hudson masks were used with an oxygen flow rate of 8 L/min in 9/29 (31%, CI 17.3–49.2%) patients (Table 1).

Table 1. Flow rates and delivery systems

Mode of delivery of oxygen	Number of patients
Nasal cannula 2L/min	9
Nasal cannula 3L/min	3
Nasal cannula 4L/min	8
Hudson mask 8L/min	9
Total	29

There were a total of 21/139 (15.1%, CI 10.1–22%) patients who had an indication for oxygen therapy (Table 2). The most common indication was tachypnea (respiratory rate >24 breaths/min), which occurred in 8/139 (57.6%, CI 2.9–11%) patients. There were 7/139 (5%, CI 2.5–10%) patients who were hypoxaemic (SpO2 ≤94) and 4/7 of these patients

Table 2. Reasons of indication for oxygen therapy

Indication	Indication for O2 (number of patients)	Indication for O2 and given O2 (number of patients)	Indication for O2 and not given O2 (number of patients)
SpO2 <94%	7	4	3
Respiratory rate >24 breaths/min	8	5	3
Systolic BP <100 mmHg	4	1	3
Signs of heart failure	2	1	1
Total n patients	21	11	10

Table 3. Frequency of paramedic adherent and non-adherent treatment

	Treated by paramedics (number of patients)
Treatment in line with recommendations	
Indication and O2 given	11
No indication and O2 not given	100
Total	111
Treatment outside of recommendations	
No indication and O2 given	18
Indication and O2 not given	10
Total	28
Overall total	139

received oxygen therapy. No patient had multiple indications for oxygen therapy. In total, 118/139 (84.9%, CI 78–89.9%) patients did not have an indication for oxygen. There were 18/139 (13%, CI 8.35–19.5%) patients who received oxygen despite having a SpO2 ≥94% and uncomplicated ACS. A total of 111/139 (79.9%, CI 72.4–85.7%) were treated in line with the ANZCOR guideline and the treatment of 28/139 (20.1%, CI 14.3–27.6%) fell outside of the recommendations (Table 3).

Discussion

This audit is the first known observational study in South Australia identifying the SAAS paramedic compliance rate to recommend oxygen use as in an ACS guideline. It is also the first study to determine SAAS paramedic adherence to both complicated and uncomplicated ACS recommendations. Our results show most SAAS paramedics in a region of metropolitan South Australia are administering oxygen in accordance with the ANZCOR guideline. This is important because ANZCOR recommendations are based on recent trials that demonstrate no benefit and a potential harm of oxygen therapy in normoxic patients (11,12).

SAAS paramedics consistently collected the information required to show that they followed ANZCOR recommendations. However, the SpO2 and respiratory rate could be recorded more regularly in the future, which is important because breathlessness and a SpO2 of <94 suggest hypoxaemia and are important indications for oxygen (3). A raised respiratory rate is considered a sensitive marker of clinical deterioration, and is therefore important to evaluate (16).

The SAAS paramedics may be giving oxygen in low doses to adhere to the state-based guideline and cause the least amount of harm possible. The state-based ambulance service guideline recommends routine oxygenation for patients with suspected ACS (1). The relationship between myocardial ischaemia and hyperoxaemia is still under investigation and might occur in a dose-dependent relationship (18). Our results demonstrated that South Australian paramedics are giving low levels of oxygen most often between 2–4 L/min. This might suggest they were being judicious with their oxygen use and are trying to avoid hyperoxaemia. Giving low doses of oxygen might be a compromise between the developing evidence base and the ANZCOR guideline and the current service guidelines. For the 20.7% of SAAS paramedics working outside of the ANZCOR guideline it is important to understand what the reasoning behind their practice was, because it could provide solutions to improve guideline compliance in the future. However, it is outside the scope of this study to ascertain the reason for SAAS paramedics working outside of the ANZCOR guideline. Understanding adherence to ACS guidelines is challenging because not all patients with chest pain had ACS. In the pre-hospital setting paramedics have limited resources, which makes provisional diagnosis more difficult. There were many causes of chest pain such as gastroesophageal reflux, peptic ulcer disease, shingles and skeletal muscle injury, and some paramedics may have felt confident in their diagnosis of a non-cardiac cause of pain.

In the future, adherence to ANZCOR recommendations might be improved through education and guideline review. Improvements to education can be made at undergraduate, intern and qualified paramedic levels. Education about the rationale behind changes to the guidelines might improve adherence. Review of the SAAS ischaemic chest pain guideline might improve compliance to ANZCOR recommendations. A drug therapy protocol specifically for supplemental oxygen therapy would provide paramedics with clear advice. Future research into the reasons for paramedics working outside of the ANZCOR guideline could provide methods to improve compliance.

There were multiple limitations associated with the design of this study. First, because our study was a retrospective analysis, there were errors associated with self-reporting and missing data limited our results. Secondly, the ANZCOR guideline have room for interpretation, and to determine compliance we needed to clearly define the parameters for the indications of oxygen use. For example, we identified the ‘signs

of heart failure' as a patient having pulmonary crepitations, peripheral oedema or a raised jugular venous pressure, however these non-specific signs are not exclusive to patients with heart failure. Diagnosis of these patients through a more definitive means would have been logistically difficult. Finally, this study only included data limited to a single hospital over a short 3-month period.

Conclusion

The audit has shown most paramedics in a region of metropolitan South Australia were adhering to the ANZCOR ACS oxygen therapy guideline. Compliance could be improved through clinical education, a review of the SAAS ischaemic chest pain guideline, an introduction of a drug protocol for oxygen therapy and future research to identify reasons for non-compliance to the guideline.

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Conflict of interest

The authors declare they have no competing interests. Each author of this paper has completed the ICMJE conflict of interest statement.

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