



Improvement in the prehospital recognition of tension pneumothorax: The effect of a change to paramedic guidelines and education



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ABSTRACT

Introduction: An audit of ambulance service clinical records from 2001 to 2002 in Melbourne, Australia revealed 10 patients with tension pneumothorax on arrival at hospital which had been undetected or untreated by paramedics. The clinical practice guideline for paramedic recognition of tension pneumothorax was subsequently changed to emphasise heightened clinical suspicion of a tension pneumothorax in the setting of chest trauma, especially when patients were managed with positive pressure ventilation.

This study was undertaken to determine whether the number of undetected or untreated tension pneumothoraces had decreased after the new clinical practice guideline and associated education program; if there were unintended consequences arising from earlier paramedic intervention; and what effect, if any, this change had on subsequent hospital treatment.

Methods: Retrospective case note review of all patients requiring intercostal catheter (ICC) insertion at The Alfred Hospital, Melbourne, Australia, using records from Ambulance Victoria, the Alfred Trauma Registry and the National Coronial Information System.

Results: In 2001–2002 paramedics treated 22 patients with suspected tension pneumothorax before transport to the Alfred Hospital. In 2006–2007 this number had increased to 81. There was a decrease from ten to four in the number of unrecognised or untreated tension pneumothoraces between the two time periods. No unintended or adverse consequences of prehospital needle decompression could be found. However, there was an increase in the number of patients who had prehospital needle decompression that needed further treatment for tension pneumothorax on arrival at hospital. This need for further treatment was associated with use of shorter cannulas and unilateral needle decompression by paramedics.

Conclusion: A small change in clinical practice guidelines, supported by an education and audit program, led to a reduction in unrecognised untreated tension pneumothoraces by paramedics without an increase in complications. Paramedics should be aware that a shorter cannula may fail to reach the pleural space and that both sides of the chest may require decompression.

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Introduction

The management of tension pneumothorax in the prehospital environment is controversial. Tension pneumothorax is a relatively

uncommon condition; however, it can lead to death if untreated and is responsible for a significant number of preventable deaths.¹ The condition is usually encountered by paramedics, and hospital staff in the Emergency Department, Operating Theatre and Intensive Care Unit.²

In 2004 Heng et al. published a study examining intercostal catheter (ICC) insertion in trauma patients admitted to The Alfred Trauma Centre in Melbourne, Australia.³ That study reported that 10 patients transported by paramedics over the 12-month study

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period had an untreated tension pneumothorax on arrival at hospital.³

In 2005, the Medical Standards Committee of Ambulance Victoria (AV) approved minor changes to the Clinical Practice Guidelines (CPGs) as a result of these findings, and understanding that the “classic” clinical signs of a tension pneumothorax may not always be present or readily detected in the field.² These CPGs are used by Mobile Intensive Care (MICA) Paramedics to guide their practice in the management of a patient presenting with suspected tension pneumothorax. These changes were supported by a clinical education program and audit process.

After these CPG changes more patients underwent needle decompression whilst in the care of MICA Paramedics. However, it was not clear how safe and effective this revised guideline was.

The aims of this study were to:

1. Compare the number of needle decompressions by MICA Paramedics in 2006–2007 to 2001–2002 and the number of unrecognised/untreated patients admitted to The Alfred Trauma Centre and;
2. Identify any unintended adverse consequences arising from the revised CPG and the clinical practice of MICA Paramedics in 2006–2007.

Methods

Setting

Victoria is in the south east region of Australia with a population of 5.5 million people; the capital and major city is Melbourne with a population of 4 million people. The Alfred Hospital is one of Melbourne's two adult trauma centres. The Alfred Hospital receives approximately half of Victoria's adult major trauma patients (>1000 major trauma patients per year). AV is the single, publicly funded, state-wide emergency ambulance service which is the primary provider of prehospital emergency care for the state of Victoria.

At the time the study was undertaken, ambulance services in Victoria were provided by two separate services: Metropolitan Ambulance Service (including Air Ambulance Victoria), and Rural Ambulance Victoria. These services have since amalgamated to form AV. This study examined only Metropolitan Ambulance Service and Air Ambulance Victoria (AAV) cases. Rural cases were not examined as the case records for the study period were not readily available.

MICA paramedics and Flight MICA paramedics are experienced emergency paramedics who have completed a postgraduate diploma in intensive care paramedic practice.

Clinical intervention

MICA paramedics use a standardised technique for needle decompression. The insertion site is the second intercostal space, mid-clavicular line. This site is marked and cleaned and a needle decompression is performed. During this study two types of cannula were used in clinical practice: the preferred device was a proprietary brand needle decompression kit (Emergency Pneumothorax Set Cook™ 10.2Fr × 105 mm), the alternative device was a 75 mm or 45 mm 14 gauge intravenous cannula.

If the patient had a recent history of chest trauma and had a low or decreasing conscious state and had poor perfusion, then immediate needle decompression was performed. Signs of successful decompression, if witnessed, such as air escaping from the cannula and a change in perfusion status, respiratory status and/or conscious state were documented on the Patient Care Record (PCR).

If tension pneumothorax was suspected, but diagnosis was uncertain, then a 23 gauge needle attached to a 10 ml syringe containing normal saline was inserted at the second intercostal space, mid-clavicular line, and the plunger drawn. If air bubbles were seen in the saline, the needle was removed and a needle decompression was performed at the same site.

Clinical practice change

The 2001–2002 paramedic diagnosis of tension pneumothorax relied heavily on the presence of certain physical signs such as tracheal shift, sub-cutaneous emphysema and increasing distension of neck veins. It was recognised that these physical signs might not be present or readily detected in the field, especially in trauma patients.² In 2005 this led to a change in AV CPGs and MICA paramedic training.

MICA Paramedics were taught to have a heightened suspicion of a tension pneumothorax in patients with chest trauma. In the setting of positive pressure ventilation auscultation of air entry alone is an unreliable exclusion for pneumothorax.^{4,5} The revised CPG and associated teaching emphasised the pre-emptive use of needle decompression, especially in intubated trauma patients. Table 1 summarises these changes.

There was another contemporaneous change to the MICA paramedic CPGs. In 2001–2002 only Flight MICA Paramedics administered neuromuscular blocking agents prior to endotracheal intubation and positive pressure ventilation, whereas road based MICA Paramedics used sedation alone to facilitate intubation where airway reflexes prevented intubation. Sedated patients usually maintained spontaneous ventilations. By 2006–2007 all MICA Paramedics performed Rapid Sequence Intubation (RSI) for the management of the patient with traumatic brain injury which lead to an increase in the number of patients receiving neuromuscular blocking agents and subsequent positive pressure ventilation.

There was no change to the Alfred Hospital guidelines for management of pneumothorax over the two study periods.

Population

The population for the study was comprised of patients who were transported by AV MICA paramedics or AAV Flight MICA paramedics to the Alfred Trauma Centre with an injury classified as major trauma (Injury Severity Score (ISS) >15) and who received a prehospital needle decompression or an ICC within 15 min of arrival at the Alfred Trauma Centre.

Case definition of untreated tension pneumothorax on arrival at hospital

There are no reliable published data on the incidence of tension pneumothorax in the setting of chest trauma. Definitions of tension pneumothorax across jurisdictions are likely to vary as the presence of the condition is a clinical diagnosis.

For the purposes of the study, any pneumothorax which was treated with ICC insertion within 15 min of arrival at hospital was considered a potential case. ICC insertion within 15 min of arrival at hospital was chosen as the cut off for cases as early intervention was likely to be based primarily on presenting clinical signs, is consistent with the need for urgent decompression; and is therefore clinically meaningful and useful.

From this pool of potential cases, actual cases were identified. The case notes were independently reviewed by four of the investigators to identify cases where patients arrived at the Alfred Trauma Centre and their clinical presentation was consistent with

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