CLINICAL PRACTICE

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Investigating the Benefits of Out-of-Hospital External Chest Compression

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Abstract

Objective

1. To review and analyse the literature regarding out-of-hospital external chest compressions (ECC) in severe asthma and status asthmaticus.
2. To compare which ambulance services in Australia and New Zealand actively use ECC in their clinical practice guidelines for severe asthma.

Method

Literature review using a variety of medical databases including, Medline, AMED, ProQuest, EMBASE, CINAHL, Scopus and Cochrane Library from 1950 to present. The following keywords were used in the search strategy, ambulance, asthma, emergency medical technicians, external chest compression, external chest pressure, lateral chest compression, lateral chest pressure, out-of-hospital, paramedic, prehospital, status asthmaticus and thoracic compression. A review of Australian and New Zealand ambulance service clinical practice guidelines was also undertaken comparing the current out-of-hospital guidelines use of ECC.

Results

A total of nine papers were located with low levels of evidence supporting the use of ECC. Only two papers directly discussed ECC in the context of out-of-hospital care. Three of the eight Australian ambulance services actively use ECC in their clinical practice guidelines.

Conclusions

High level evidence was not found supporting the use of ECC in severe asthma or status asthmaticus. Anecdotal opinions and case reports generally have supported its use in dynamic hyperinflation settings. Further research is required before recommendations can be made.

Introduction

External chest compression (ECC) which is also referred to as lateral chest pressure or lateral chest pressure is a technique used by health professionals in clinical situations such as severe asthma and status asthmaticus. This manual technique has been suggested to assist the corresponding gas trapping and increased intrathoracic pressures caused by obstructive airway disease such as acute asthma. Modest anecdotal evidence does exist amongst medical and out-of-hospital practitioners in Australia. However, its use is generally considered controversial since it is not supported by empirical evidence despite brief descriptions of its use dating twenty years.¹

This paper builds upon the work by Fisher, Whaley and Pye (2001)² who suggested the technique could have the greatest impact in the out-of-hospital setting. This paper has two aims, firstly, to undertake a literature review and report the findings from an Australian and New Zealand context. And secondly, to compare which ambulance services use ECC in their clinical practice. This may reveal a capacity for further research or discourse in this area and if this practice is supported by scientific evidence it could allow this technique to be accepted in out-of-hospital clinical practice guidelines/protocols throughout Australia.

External Chest Compression (ECC) – How is it performed?

The procedure is performed by a health care professional who position their hands in a lateral arrangement around the patient's thoracic cage applying gentle, but firm pressure during the commencement of the patient's expiratory phase. The health provider can undertake this procedure from two positions,³ depending on the conscious level of the patient. There are two approaches:

1. A posterior approach – bracing the patient from behind, either standing or sitting (Figures 1 & 2).
2. An anterior approach – generally done whilst the patient is supine (Figure 3).

Figure 1: Posterior Approach

Figure 2: Posterior Approach 2

Figure 3: Anterior Approach

Gentle pressure is applied³ by the health provider in sequence with the patient's respiratory cycle with the aim of potentially reducing hyperinflation or gas trapping. Care should be undertaken not to exert too much force. Anecdotal reports emphasise that audible expiratory wheeze can be heard and increased compliance of bag-valve mask ventilation when this force is applied in some patients.

Methods

The purpose of this review was to critically evaluate the available literature on ECC for acute asthma. A literature review was undertaken using several electronic databases which included:

- Medline
- AMED (Allied & Complementary Medicine)
- ProQuest

- EMBASE
- CINAHL (Cumulative Index to Nursing & Allied Health Literature)
- Scopus
- Cochrane Library

The following MeSH terms were used in the search: ambulance, asthma, emergency medical services, emergency medical technicians, external chest compression, external chest pressure, first aid, lateral chest compression, lateral chest pressure, military, out-of-hospital, paramedic, status asthmaticus and thoracic compression.

All databases were searched from 1950 to present. The search strategy included the following keywords using truncation:

Ambulance	Asthma
Emergency Medical Technicians	External Chest Compression
External Chest Pressure	Lateral Chest Compression
Lateral Chest Pressure	Out-of-hospital
Paramedic	Prehospital
Status Asthmaticus	Thoracic Compression

Other articles were also sourced from references in the retrieved papers to identify relevant articles that may have been missed during the initial search process. They were included in the literature review if the title and abstract indicated that the content addressed the use of ECC for asthma in either hospital or out-of-hospital settings. Given the limited literature surrounding ECC, no exclusion criteria were applied.

A review of current Australian and New Zealand ambulance service clinical practice guidelines relating to ECC was also undertaken. This review simply identified which ambulance services currently used ECC in their clinical management of severe asthma and/or status asthmaticus.⁴⁻¹²

Results

The vast majority of papers located in the literature addressed the use of ECC in case studies with generally good outcomes. Several clinical prospective studies were located emphasising the use of reduced ventilatory rates in ventilated asthmatic patients. No out-of-hospital ECC studies have been undertaken since 2001. A total of nine papers were located and are presented in table 1.

Table 1: Located literature

Author, date and country	Patient group	Study type	Level of Evidence (NHRMC)	Findings	Location
Adachi Y., et al., 2001 Japan ¹⁴	Case report of 2 year old boy	Case report	4	2 year old survived following ECC	Hospital
Eason J., et al., 1991 United Kingdom ¹⁶	Case report of 11 year old girl	Case report	4	11 year old survived following ECC	Hospital
Fisher M, Bowey J, Ladd-Hudson K. 1989 Australia ³	Out-of-hospital study of bronchial asthmatic patients	Retrospective study (n=50)	4	No complications were reported following ECC.	Out-of-hospital
Fisher M, Whaley A, Pye R. 2001 Australia ²	Out-of-hospital case report of 27 year old female	Case report	4	27 year old survived following ECC	Out-of-hospital
Darioli R, Perret C. 1984 Switzerland ¹⁸	Status asthmaticus patients admitted to Intensive Respiratory Unit requiring mechanical ventilation	Retrospective study (n=159)	4	All patients survived. In severe cases – low ventilatory rates provided	Hospital
Tuxon D, Lane S. 1984 Australia ¹⁹	Patients admitted to Intensive Care Unit with severe airflow disease requiring mechanical ventilation	Prospective study (n=9)	4	Support low ventilatory rates	Hospital
Narimatsu E., et al., 2001 Japan ²⁰	Case report of 7 year old boy	Case report	4	7 year old suffered cardiovascular collapse following ECC	Hospital
Van der Touw T., Mudaliar Y., V. N. 1998 Australia ²¹	Mechanically ventilated patients recovering from severe asthmatic episodes	Prospective study (n=4)	4	ECC would be ineffective in hyperinflation situations	Hospital
Smolnikoff, V.P. 1960, Russia ¹	Case report of direct lung massage on male patient	Case report	4	Description of direct lung massage in patient with total bronchospasm	Hospital

Table 2: CPG Review of ECC⁴⁻¹²

	QLD	NSW	VIC	NT	SA	WA	TAS	ACT	NZ
Was an ECC CPG/Protocol located in service protocols?	No	Yes	Yes	No	No	No	No	Yes	No

Discussion

Few articles^{2,3,14-18} discuss the notion of ECC in severe asthma or status asthmaticus. However, indirect examination of ECC has been examined for ventilation of severe asthmatic patients. These studies first examined intentional hypoventilation in acute asthma in the mid 1980's by Darioli & Perret¹⁸ and Tuxen & Lane.¹⁹ Both studies were prospective and located in Intensive Care Units using mechanically ventilated patients. These authors hypothesised and found that reducing hyperinflation via hypoventilation (including apnoea) techniques could inturn reduce barotrauma, hypoperfusion, circulatory collapse and death. Whilst ECC was not discussed in these articles, they did emphasise the same physiological principles including a low frequency ventilation rate, high tidal volumes and hypoventilatory techniques. These same principles are currently being used in the clinical practice guidelines of the Ambulance Services of Victoria, Ambulance Service New South Wales and Australian Capital Territory Ambulance Service.

The first publication found directly discussing ECC was undertaken by Watts (1984)¹⁷ in an editorial correspondence that highlighted the clinical advantages of this relatively simple technique. He emphasised simple physics, physiology and pathophysiology in contrasting thoracic compression and acute severe asthma.¹⁷ Despite only being an editorial correspondence letter, three other articles were located^{2,3,15,16} who all positively emphasised the clinical use of ECC.

Adachi et al¹⁴ and Eason et al¹⁶ both discussed cases involving two paediatric patients suffering with status asthmaticus who received ECC during their standard medical management.^{14,16} Both case studies revealed clinical improvement following standard sympathomimetic treatment and ECC. Interestingly, Eason et al instructed that ECC should be abandoned after 15 minutes¹⁶ however, this is not reported in any other articles.

Fisher, Bowey & Ladd-Hudson³ performed the first out-of-hospital study in 1989 involving New South Wales paramedics. They also investigated their perceptions of ECC success⁽³⁾. Paramedics were asked to complete a questionnaire following the transportation of severe asthmatic patients (n=50) and comment on whether ECC had any effect on patient presentation during out-of-hospital treatment. Paramedics suggested that ECC was lifesaving in approximately 30% of patients and effective in up to 50% of the sample group. Fisher, Bowey & Ladd-Hudson³ also found that 17 of 18 patients who were breathing spontaneously also benefited from ECC.

Fisher, Whaley & Pye⁽²⁾ reviewed the literature of ECC who also highlighted the sparsity of published trials⁽²⁾. The article provides historical origins of ECC, whilst outlining the logical basis and technique when performing ECC. Fisher, Whaley & Pye draw attention to the fact that despite the positive documentation of anecdotal cases involving ECC, it is still not included in Resuscitation Policy Guidelines.² The authors emphasise the need to incorporate ECC in general care of the asthmatic patient in extremis, especially in the out-of-hospital settings.²

Of the nine articles found only two papers^{19,20} challenged the safety and efficacy of ECC in acute asthma. Narimatsu et al²⁰ described negative clinical manifestations following ECC in a paediatric patient. Their paper exemplifies the serious circulatory deficiency in a 7-year-old boy following admission to an emergency department.¹⁹

The patient presented in status asthmaticus with a reduced conscious state (GCS 7) and a cardiovascular state of (BP 92/66mmHg) and (HR 144 bpm). Initial intravenous therapies were commenced along with endotracheal intubation.¹⁹ A short time later the patient's

condition deteriorated prompting initiation of ECC with immediate improvement. However two minutes later the patient suffered a cardiac arrest presumably caused by the ECC. The patient was successfully resuscitated. The patient suffered another cardiac arrest a short time later following a second attempt at ECC. The authors attributed the secondary cardiac arrest to be caused by increased intrathoracic pressure, thereby increasing systematic vascular resistance and reducing circulating blood volume.¹⁹

The other article located that did not support ECC was the prospective clinical study undertaken by Van der Touw et al.²¹ Four intubated and mechanically ventilated patients were studied before, during and after brief (2-3 min) intervals of manual chest compressions. This study attempted to determine what cardiorespiratory effects ECC had on severe asthmatic patients. They concluded that ECC only produced small decreases in lung volume and the ECC technique would produce very little clinical benefits, particularly when air-flow was significant.²¹

The review of current Australian and New Zealand ambulance service CPGs and protocols revealed that less than half of Australian ambulance services currently use ECC in the clinical management of severe asthma or status asthmaticus. These findings are important and further examination of why this national and international clinical dichotomy is occurring is warranted, particularly with the national implementation of asthma plans and current era of standardising paramedic clinical practice.

Where does ECC stand with International Resuscitation Councils?

A review of the 2005 American Heart Association Guidelines for Cardiopulmonary Resuscitation and Emergency Cardiovascular Care 2005²² discusses near-fatal asthma. No recommendation is made to reducing ventilation rates or altering ventilation cycles. However, they emphasise that there is insufficient evidence to recommend ECC of the thoracic wall to relieve dynamic hyperinflation.²²

The Australian Resuscitation Council²³ also makes no mention of ECC in the context of acute asthma, however, they state ventilation rates should be lowered to as low as six breaths a minute.²³ No other ECC, severe asthma or status asthmaticus expert guidelines were located.

Conclusion:

High level evidence was not located supporting the use of ECC in the acute asthmatic setting. Despite the low level evidence, the literature review has shown that modest anecdotal evidence exists supporting ECC as an effective technique in the management of the severe asthmatic patient. For this technique to gain further validity and credibility amongst health professionals, it would seem that higher levels of evidence will need to be achieved through randomised methodologies or expert consensus. Further research is also warranted examining the clinical practice implications of ECC among Australian and New Zealand ambulance services.

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