

**RESEARCH ASSIGNMENT TOWARDS MASTERS DEGREE IN FAMILY MEDICINE (MFam  
Med) 2013**

**TITLE**

**PREDICTORS OF PNEUMOTHORAX IN MOTOR VEHICLE ACCIDENT (MVA) SURVIVORS  
WHO SUSTAIN CHEST TRAUMA**

**INSTITUTION**

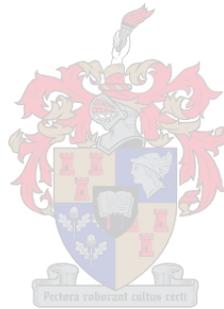
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## DECLARATION

I the undersigned hereby declare that the work contained in this assignment is my original work and that I have not previously submitted it, in its entirety or in part, at any university for a degree. I also declare that ethical approval for the study was obtained from the Health Research Ethics Committee of the University of Stellenbosch (Reference number S11/11/020) and also the Human Research Ethics committee of Queensland Health Australia (Reference number HREC/12/QPCH/139)

Signature.....

Date 23 /02 / 2014

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## ABSTRACT

Pneumothorax is a relatively common<sup>1</sup> and potentially fatal complication of MVA.<sup>2</sup> The incidence of pneumothorax in MVA was found to be 38% in Cape Town<sup>1</sup> and 54.6% in India.<sup>3</sup> Pneumothorax may be missed during clinical assessment. An audit of paramedic records from 2000-2001 in Melbourne, Australia found that a significant number of tension pneumothoraces were missed prior to assessment at the hospital<sup>4</sup>. This led to a change in the clinical guideline for paramedics resulting in a 60% decrease in undiagnosed tension pneumothorax within the next 12months<sup>4</sup>. There has been no Australian study to establish the incidence of pneumothorax or its specific clinical predictors in MVA survivors. This could be a useful tool for doctors during assessment of chest injured MVA patients therefore the need for this study

## OBJECTIVES

Pneumothorax (PTX) is a treatable yet potentially fatal surgical condition. Clinical diagnosis of this condition can be very unreliable. A review of medical records over a 5 year period was done with the aim of identifying common predictors of pneumothorax as well as defining the common forms of chest injuries associated with it in motor vehicle accident (MVA) survivors by embarking on a critical analysis of data collected from the study.

## MATERIALS AND METHODS

A retrospective chart review was carried out on a total of 63 male and female patients of all age groups with chest injuries specifically resulting from motor vehicle accidents. A comparative analysis of data was carried out on these patients after categorising them based on age, sex, position of the victim at the time of occurrence of MVA, nature of the injury (blunt/penetrating), association with subcutaneous emphysema, rib fractures and intrathoracic organs

## RESULTS

In this study, out of the 63 cases reviewed, there was a total of 18 cases of pneumothorax: 14 males (77.78%) and 4 females (22.22%) with an age range between 7 to 70years, a median age of 38.5years and average age of 41.44years.

7 of these patients were motorcyclists, 6 drivers, 2 bicycle riders, 2 pedestrians, 1 motorcycle passenger and all patients survived with no case fatality recorded. 88.89% resulted from blunt chest injuries while 11.11% resulted from penetrating chest injuries. All the penetrating chest injuries were associated with pneumothorax.

50% of pneumothoraces had an associated fracture of multiple ribs, 27.78% had an associated fracture of a single rib and 38.89% were associated with subcutaneous emphysema,

66.67% of pneumothorax had tube thoracostomy while 33.33% were conservatively managed by hospital admission and observation.

## CONCLUSION

Pneumothorax occurs in 28% of MVA survivors with chest injuries with about three quarters of these cases (72.2%) accounted for by motorcyclists and vehicle drivers. Other strong predictors for pneumothorax are the presence of penetrating chest injury and fracture of one or more ribs. When diagnosed and appropriately managed, 100% survival from pneumothorax is achievable. Evidence was found in support of routine imaging investigation of MVA victims with chest injuries as clinical diagnosis of pneumothorax was insensitive. Also, either surgical intervention with tube thoracostomy or hospital admission for clinical monitoring should be routinely carried out on these patients.

## INTRODUCTION

Pneumothorax is defined as the presence of air in the pleural space between the parietal and visceral pleurae resulting in partial or complete collapse of the lungs.<sup>5</sup> It may result from blunt or penetrating trauma (primary pneumothorax). It can also arise spontaneously in a patient with an underlying lung disease or as a complication of positive pressure ventilation (secondary pneumothorax).<sup>5</sup> Motor vehicle injuries are injuries sustained to any body parts by drivers or passengers of any motor vehicle, motorcycle, pedestrians or bicycle. Road traffic accidents have been claimed to have become the scourge of modern civilization.<sup>6</sup> Data from the Australian Ministry of Infrastructure and Transport showed that 1,368 people died from motor vehicle accidents in 2010 across Australia with about 30,000 cases of hospitalization.<sup>7</sup> Two hundred and forty seven (18%) of the national case fatalities occurred in Queensland<sup>7</sup>. The Victoria State Department of Health has also been quoted in 2011 to have attributed the greatest single cause of accidental death in Australia to motor vehicle accident.<sup>8</sup>

Chest trauma from MVA can either be blunt or penetrating in nature and the most predisposed occupant in a vehicle is the driver due to a blunt injury from the steering wheel.<sup>6</sup> Overall, the risk of chest trauma is higher in unbelted drivers and passengers as compared to those using their seat belts.<sup>9</sup>

Pneumothorax after trauma is a preventable cause of death.<sup>2</sup> and delayed pneumothorax has been found to occur mostly during the first 2 days of admission with the presence of Subcutaneous Emphysema being a major risk factor identified to be associated with pneumothorax.<sup>2</sup>

At presentation, pneumothorax may be overt (detected on X-ray) or occult (detected only by thoracic ultrasound or computed tomography scan).<sup>10,11</sup> In a previous study carried out on the management of chest injuries, Adebonojo.<sup>6</sup> argued that despite improvement in ambulance service and rapid mobilization of victims, about 10% of chest injured patients die on the spot, and another 5% die within 1 hour of reaching

the hospital. Of the remaining 85%, 80% will respond to resuscitative measures and tube thoracostomy drainage alone, while the remaining 5% will require emergency thoracotomy.<sup>6</sup> A study conducted in Kuwait showed that MVA accounted for 93% of blunt chest trauma and 39% of the patients ultimately required tube thoracostomy.<sup>12</sup> A similar study conducted in India on blunt chest trauma showed that 64% of blunt chest trauma among all age groups resulted from MVA and 54.6% of these chest injured patients developed pneumothorax.<sup>3</sup>

Pneumothorax is a relatively common<sup>1</sup> and potentially fatal complication of motor vehicle accidents.<sup>2</sup>

In a study conducted at University of Cape Town paediatric trauma unit over a five and a half year period (April 1984 to September 1989) by Roux and Fisher,<sup>1</sup> 38% of MVA-related chest injuries had pneumothorax which ranked as the 4<sup>th</sup> commonest injury (after pulmonary contusion, rib fracture and post traumatic effusion) associated with chest injuries sustained in motor vehicle accidents.<sup>1</sup>

In the analysis of data collected from a study at Rhode Island between 1979 and 1980, it was found that the annual incidence of pneumothorax / hemothorax was 8.6 per 100,000 population and 40% of this was as a result of motor vehicle accidents.<sup>13</sup>

Every single day, there is an enormous global and local population exposed to the potential risk of a motor vehicle accident either as a pedestrian, a driver or a passenger. Conservative estimates suggest that the annual cost of motor vehicle accidents in Australia (including costs such as medical treatment, workplace absence and vehicle replacement or repair) is about \$17 billion.<sup>8</sup> Thus the outcome of management of MVA survivors (with or without chest injuries) has a gross impact on public health issues.<sup>8</sup>

There has been no Australian study aimed at establishing the predictors of pneumothorax specifically in MVA survivors. Therefore this study focused solely on MVA victims with chest injuries (blunt and penetrating) in view of establishing the incidence of pneumothorax following chest injuries resulting from MVA. This research could contribute to improving the management of MVA victims by establishing which clinical signs are predictors of pneumothorax in motor vehicle accident survivors who sustain chest trauma.

## MATERIALS AND METHODS

This study was approved by the health research ethics committee of the University of Stellenbosch South Africa and Queensland Health Australia Human research ethics committee. Also, an approval was obtained with respect to the Queensland Public Health ACT 2005 which protects health information and regulates access to medical records for the purpose of research.

A retrospective medical record review of patients with chest injuries resulting from motor vehicle accidents was carried out at Harvey Bay Hospital, Queensland Australia over a 5year period (January 2006 - December 2010)

For the proposed 5year period of study, a database search was carried out on EDIS software (emergency department information system) using ICD-10 codes of diagnoses suggestive of chest injuries regardless of whether these occurred from MVA or not. A total of 179 patients was initially identified and their medical records retrieved using their Hospital numbers. The researcher did a quick review aimed at specifically identifying injuries resulting from MVA and 63 patients were identified to have had their injuries during an MVA. The remaining 116 patients whose injuries resulted from other mechanisms different from MVA were excluded. The identified 63 records were further scrutinized for information relevant to the study including age, sex, position of the victim, presence / absence of pneumothorax, subcutaneous emphysema and other associated injuries. Data retrieved were recorded on a data collection sheet which had an allocation of a study specific code for each patient for the purpose of de-identification of data.

A comparative analysis was carried out using T-tests for the difference in a continuous variable between 2 independent groups. Chi square tests was used for association and Fisher's exact tests for association of two nominal variables. The results were considered to be significant if the P value was < 0.05. Statistical analysis was carried out using Statistica version 11 (2012)

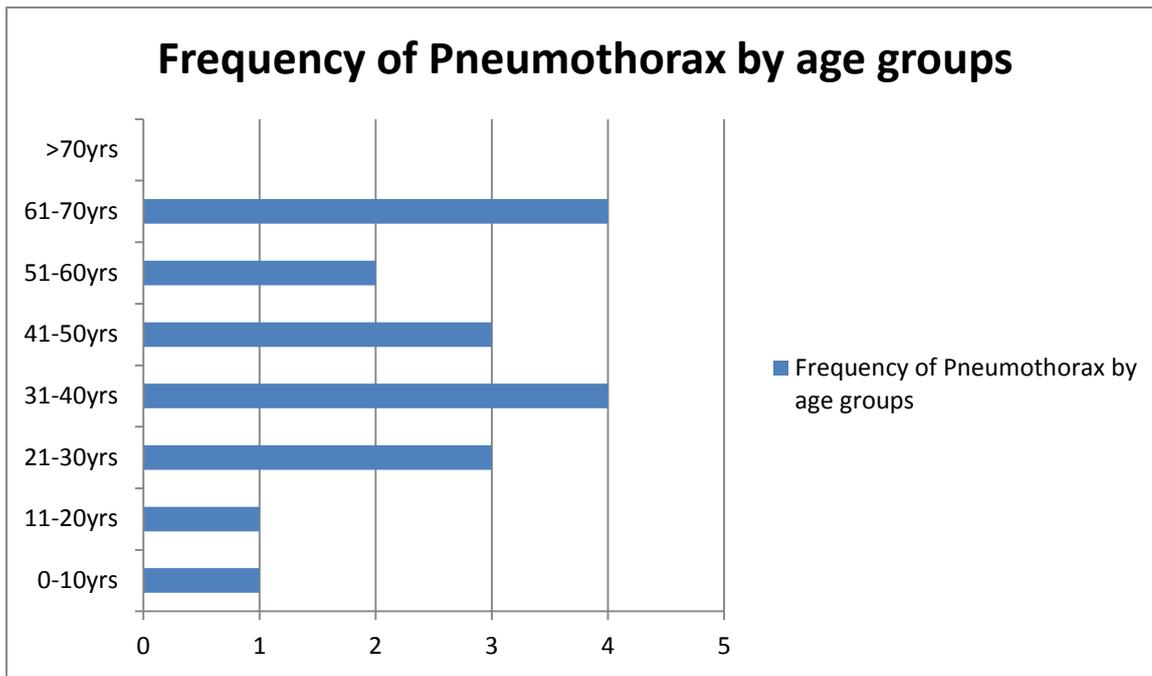
## RESULTS

The study group included 63 patients with chest injuries resulting from motor vehicle accident (MVA). Based on data analysis from this study, pneumothorax and other serious intrathoracic chest injuries were found including myocardial contusion, pericardial effusion, aortic laceration, mediastinal hematoma and oesophageal laceration. Pneumothorax occurred in 28.57% (n=18) of MVA victims with chest injury with males accounting for 77.78% (n=14) of cases of pneumothorax while females accounted for 22.22% (n=4) of the diagnoses of pneumothorax.

The age range of victims was between 7 to 70years, a median age of 38.5years and average age of 41.44years

The frequency of occurrence of pneumothorax among different age groups is as outlined below being commonest in the 31-40yrs and the 61-70yrs age groups (each accounting for 22.22%), next were age groups between 21-30, 41-50, (16.67% accounted for by each), then age group 51-60yrs (11.11%) and much less common (5.56%) in the 0-10 and 11-20yrs and no pneumothorax was recorded in any in any victim above 70yrs of age

Observed frequency of pneumothorax by age groups



Using a T-test comparison, there was no difference between the average ages of the patients with/without the diagnosis of pneumo/haemopneumothorax as evidenced by a P value >0.05

The occurrence of pneumothorax in relation to the physical position/location of the victim at the time of the accident is as outlined in the frequency table below:

Summary Table of Observed Frequencies for position

<b>Position</b>	<b>Pneumothorax/Haemopneumothorax</b>	<b>%</b>
<b>Driver</b>	6	33.33%
<b>Motorcyclist</b>	7	38.89%
<b>Pedestrian</b>	2	11.11%
<b>Push bike (bicycle) rider</b>	2	11.11%
<b>Motorcycle passenger</b>	1	5.56%
<b>Car Passenger</b>	0	0.00%
<b>Total</b>	18	100%

Of the 63 charts reviewed, 96.83% (n=61) resulted from blunt chest injuries while only 3.18% (n=2) was a result of penetrating injuries to the chest.

Prior to patients being investigated, 6 cases of pneumothorax were clinically diagnosed and there was no case of haemopneumothorax diagnosed on clinical grounds as compared to a total of 14 pneumothoraces and 4 haemopneumothoraces diagnosed after imaging investigations were carried out. This means that without appropriate investigations, 66.67% of pneumothoraces (12 of the total 18 cases) would have been missed. This therefore suggests that clinical assessment alone without imaging investigation is insensitive in diagnosing pneumothorax in chest injured MVA survivors

Summary Table for mode of diagnosis

	Pneumothorax/Haemopneumothorax	Rate of occurrence
Total cases diagnosed clinically (before imaging)	6	9.52%
Total cases diagnosed on imaging	18	28.57%
Total cases missed without imaging	12	66.67%

100% of clinically diagnosed pneumothoraces were diagnosed in males with no clinical diagnosis of pneumothorax in any female victim prior to imaging.

50% (2 of the 4 cases) of the confirmed haemopneumothorax were clinically diagnosed as pneumothorax while the remaining 50% cases of haemopneumothorax were missed completely, based on clinical diagnosis.

In this study, 38.89% (n=7) of pneumothorax were associated with subcutaneous emphysema. However, 100% (all 7cases) of patients with subcutaneous emphysema had associated pneumothorax with 85.71% (n=6) being associated with pneumothorax and 14.29% (n=1) were associated with haemopneumothorax

16.67% (n=3) of pneumothorax were associated with a haemothorax (haemopneumothorax).

27.78% (n=5) of pneumothorax had an associated fracture of a single rib while 50% (n=9) cases of pneumothorax had an associated fracture of >1 rib

88.89% (16 out of 18cases) pneumothorax resulted from blunt chest injuries while 11.11% (n=2) were accounted for by penetrating chest injuries. 100% (both cases) of penetrating chest injuries developed pneumothorax

44.44% (n=8) of pneumothorax had other associated injuries to the lungs like contusion and another 27.78% (n=5) of pneumothorax had associated injuries to other intrathoracic structures including the heart, aorta and oesophagus

Summary Table of clinical correlates to the presence of pneumothorax

<b>Clinical signs</b>	<b>Total Frequency count</b>	<b>% associated with pneumothorax (on imaging)</b>
<b>Subcutaneous Emphysema</b>	7	100%
<b>Penetrating chest injury</b>	2	100%
<b>Haemothorax</b>	4	75%
<b>Fracture of &gt;1 rib</b>	23	39.13%
<b>Fracture of a single rib</b>	17	29.41%
<b>History of blunt chest injury</b>	61	26.23%

12 out of 18cases (66.67%) of pneumo/haemopneumothorax had tube thoracostomy while 6 out of 18cases (33.33%) were conservatively managed. However, all 3(100%) haemopneumothoraces had chest tube drainage.

Regardless of whether chest tube thoracostomy was performed or not, 100% (n=18) of patients with pneumothorax following MVA ended up as in-patient hospital admissions.

**DISCUSSION**

Pneumothorax was diagnosed radiologically in 28% of patients with chest injury resulting from an MVA. Of these, only a third were diagnosed clinically, the rest only diagnosed after Chest Xray or CT scans were done. Clinical features that most commonly resulted in pre-radiological diagnosis were subcutaneous emphysema and rib fracture(s).

The rate of occurrence of pneumothorax in this Queensland study (28%) was lower compared to 38% found in a similar study conducted at University of Cape Town paediatric trauma unit.<sup>1</sup> while another study done in India found pneumothorax in 54.6% of MVA chest injured patients.<sup>13</sup>

In this study, strong predictors of pneumothorax included being a motorcyclist, the driver a motor vehicle, the presence of penetrating chest injuries, subcutaneous emphysema and fracture of one or more ribs.

The rate of occurrence of subcutaneous emphysema in this study was comparable to what was described by an earlier study in Taiwan which found subcutaneous emphysema as a major risk factor for predicting the occurrence of pneumothorax.<sup>2</sup>

Routine utilisation of imaging investigations increased (tripled) the rate of diagnosis of pneumothorax when compared to reliance on clinical diagnosis. Early diagnosis of pneumothorax is crucial considering the outcome of Adebonojo's review.<sup>6</sup> which found that despite improvement in ambulance service and rapid mobilization of victims, 5% of patients with pneumothorax die within 1 hour of reaching the hospital. In this study, about half (58.33%) of pneumothorax that required surgical intervention were not diagnosed clinically. Therefore, early routine imaging investigation of chest injured MVA victims is recommended.

All patients with pneumothorax in this study were admitted as hospital in-patients with 66.66% of them requiring surgical intervention while 33.33% were admitted for observation. The survival rate after pneumothorax was 100% which is comparable to the finding in a Taiwan hospital where case fatality was found to be only 2%.<sup>2</sup>

## CONCLUSION

Pneumothorax occurs in 28% of MVA survivors with chest injury with about three quarters of these cases (72.2%) accounted for by motorcyclists and vehicle drivers. Other strong predictors for pneumothorax are the presence of penetrating chest injury and fracture of one or more ribs. When diagnosed and appropriately managed, 100% survival rate from pneumothorax is achievable.

From this study, 66.67% of pneumothoraces (12 out of 18 cases) would have been missed without appropriate investigations.

It would probably be effective to institute a policy that all motorcycle or car drivers presenting with a history of chest injury after involvement in an MVA have a chest Xray to exclude pneumo/haemothorax even in the absence of clinical signs because clinical diagnosis of pneumothorax is insensitive. Routine hospital admission of all diagnosed pneumothorax for surgical intervention or clinical monitoring is also highly recommended

## LIMITATIONS OF THE STUDY

The initial diagnoses search on EDIS software using ICD 10 codes was for chest injuries then a subsequent sorting was done to identify chest injuries that resulted from MVA. An initial search for all MVA then sorting out which cases had associated chest injuries could potentially have yielded a higher sample size and a potentially more representative data. This means that it is not possible to make an algorithm for which MVA survivors should have chest Xrays done in order not to miss pneumo- and/or haemothoraces.

The study was also completely reliant on data collated from patient medical records with the possibility that the outcome could have been influenced by any incomplete or incorrect documentation by clinicians.

To prevent duplication of data, only patients that presented to Harvey Bay hospital were ultimately used for the study as all diagnoses of pneumothorax at Maryborough hospital (a much smaller hospital) were transferred to Harvey Bay hospital (the referral centre) with different hospital numbers. Utilising data from two hospitals could potentially have given a different result.

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