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Predictors of the selective use of chestcomputed tomography in road traffic accident patients with none clinically evident chest trauma

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ABSTRACT

The purpose of this study is to identify predictors that select road traffic accident patients with no clinical evidence of chest trauma who will need to do Chest CT. This prospective study was conducted to include one hundred patients with Road traffic accident injuries admitted to the Emergency Department of Alexandria main university hospital. Primary survey and secondary survey, radiological investigations including CT chest and other radiological investigations were done to all patients. This also includes laboratory tests to asses' arterial blood gases and hemoglobin level. In our study 74% of patients had positive CT chest finding despite normal initial chest examination and six predictors were identified to have a significant relation to CT chest positivity and they are age≥55yrs old (with p value =0.024), abnormal arterial blood gases result (p =0.003), hemoglobin <9gm/dl (p =0.010), disturbed level of consciousness (p=0.002), presence of fracture dorsal spine (p = 0.019) and presence of abdominal collection associated with pelvic fracture with a p value = 0.033).

Key words: blunt chest trauma, chest imaging, chest computed tomography

INTRODUCTION

Road traffic injuries (RTIs) are a major cause of global mortality and morbidity, killing approximately 1.3 million people and injuring 20 to 50 million each year. Current estimates for Egypt show a road traffic fatality rate of 42 deaths per 100,000 population-one of the highest in the Eastern Mediterranean Region.

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RTIs are also responsible for 1.8 percent of all deaths and 2.4 percent of all disability-adjusted life years (DALYs) lost in the country (Puvanachandra P et al 2012).

Thoracic injury directly accounts for 20 to 25% of deaths resulting from trauma. Early deaths (within the first 30 minutes to 3 hours) resulting from thoracic trauma are often preventable Because these problems are often reversible or may be temporized nonoperatively and Approximately 75% of patients with thoracic trauma can usually be managed with simple tube thoracotomy and volume resuscitation. The advancement of newer imaging modalities, minimally invasive approaches, and pharmacologic therapy contribute to decreasing the morbidity and mortality of these injured patients (Khandhar SJ et al 2007).

Due to lack of sensitivity of chest radiograph to identify significant injuries, computed tomography

(CT) scan of the chest is frequently performed in the hemodynamically stable patient (Salim A et al 2006). Computed tomogram is the modality of choice for rapid assessment of emergency chest trauma patients where associated abdominal injuries can be scanned in one sitting with high sensitivity and specificity, though chest radiograph remains the initial screening modality (Omert L et al 2001).

The role of computed tomography (CT) scanning in the evaluation of chest trauma patients continues to expand. Although CT scans provide much greater diagnostic sensitivity than plain radiography (Traub M et al 2007), the routine use was not recommended by some studies (Brenner DJ et al 2007 and Tillou A et al 2009).

Although many studies addressed the value of CT in trauma patients, few evidence-based indications for trauma CT of the chest exist (Brink M et al 2010 and ACR Appropriateness Criteria 2012)

PATIENTS AND METHODS

Patients:

The study was conducted on 100 patients with RTA admitted to Emergency Department of Alexandria Main University Hospital. This study includes all adult patients admitted within 24 hours of trauma. Patients with clinical evidence of chest trauma and patients unable to do CT chest (i.e. pregnant, shocked, and dead after arrival within 15 minute and patient need immediate surgical intervention) were excluded from the study.

Methods:

Data as regard age, sex, date of admission, mechanism of trauma were collected. Primary survey, secondary survey and CT chest were done to all patients in addition to other radiological investigations. This also the following laboratory tests (CBC, Urea, Creatinine, PT, PTT, INR, arterial blood gases analysis).

Statistical analysis:

Data were fed to the computer and analyzed using IBM SPSS software package version 20.0. Qualitative data were described using number and percent. Quantitative data were described using range (minimum and maximum), mean, standard deviation and median. Comparison between different groups regarding categorical variables was tested using Chi-square test. When more than 20% of the cells have expected count less than 5, correction for chi-square was conducted using Fisher's Exact test. The distributions of quantitative variables were tested for normality. If it reveals normal data distribution, parametric tests was applied. If the data were abnormally distributed, non-parametric tests were used. For normally distributed data, comparison between two independent population were done using independent t-test. For abnormally distributed data, comparison between two independent population were done using Mann Whitney test. Significance test results are quoted as two-tailed probabilities. Significance of the obtained results was judged at the 5% level.

RESULTS AND DISCUSSION

The present study was a prospective one that was performed on one hundred patients admitted to the Emergency Department of the Alexandria Main University Hospital suffered from RTA injuries. Our aim was to identify predictors that select road traffic accident patients with no clinical evidence of chest trauma who will need to do Chest CT.

Regarding age and gender distribution there were found that the average age of patients were thirty eight and half years (38.5 years) ranging from (16-75) years. Males dominate with 71% of patients and female patients equal 29% where males outnumbered females in a ratio of 2.5:1 this was agreement with (Meera Th et al 2005). This male predominance explained that they are more exposed to the hazards of road traffic accidents and violence.

Table-1. Demographic data of the studied group

	Total no. of cases	Percentage%
Sex		
Male	71	71.0
Female	29	29.0
Age		
16 – 24	32	32.0
25 – 45	32	32.0
>45	36	36.0
Min. – Max.	16.0 – 75.0	
Mean ± SD.	38.52 ± 18.28	

In this current study we found that the majority of RTA victims were vehicle occupant accounting for 49% (divided into four wheeler drivers 17% and other vehicle occupants 32%) followed by pedestrian equal 43%.This was agreement with (M.R.Gudadinni 2007) who found that the occupants comprised the largest group accounting for 375, followed by pedestrians accounting for 165.

In our study 74% of patients have positive CT chest finding despite normal initial chest examination done in primary survey and 26% of patients were negative for CT chest finding, this result has agreement with what The authors of a prospective comparative study (Omert L et al 2001) found that chest CT revealed an acute injury in 39% of patients with no thoracic symptoms or signs, a negative Chest

Figure-1. Different mode of trauma in studied group

radiograph, and recent high-energy mechanism blunt trauma and 66% had injuries noted with chest CT but not in chest radiography. Another study also done by (Barrios C et al 2010)of 374 patients with blunt trauma, approximately half of all pneumothoraces, rib fractures, and pulmonary contusions were not apparent on AP chest radiography. Nearly three-fourths of all hemothoraces were also not identified on AP chest radiography. The authors focused on the ability of combined chest radiography and abdominal CT without chest CT to detect most chest injuries. Even with the combined AP radiograph and abdominal CT, one-fifth of all pneumothoraces, rib fractures, and pulmonary contusions were still missed. Moreover, all 5 cases of aortic injury were not evident on chest radiograph or CT abdomen, which argues against over-reliance on chest radiography in the setting of high-energy mechanism blunt trauma.

Although AP chest radiographs seem to be essential to the care of critically ill blunt trauma patients, they are often of low quality. If patients are in severe pain or are unconscious, full inspiration is usually not possible. Overlying material is the rule rather than the exception, and motion artifact is common. The mediastinum may appear falsely enlarged due to AP projection (ACR Appropriateness Criteria 2012).

In our study we found that most common lesion identified in CT chest is pulmonary contusion accounting for 39.7% (46 cases) followed by occult pneumothorax (identified on CT but not on AP chest radiography) accounting for 13.8% (16 cases) this also agree with what (Omert L et al 2001) found that most common identified lesions were pulmonary contusion followed by pneumothorax.

Table-2. Distribution of patients according to CT chest result.

CT chest	Total no. of cases	Percentage %
Lung contusion	46	39.7
Unremarkable	26	22.4
Pnemo-thorax	16	13.8
Hemo-thorax	12	10.3
Rib fracture	8	6.9
Rupture diaphragm	4	3.4
Pnemo-mediastinum	2	1.7
Pericardial effusion	2	1.7
Positive	74	74.0
Negative	26	26.0

In the present study six predictors were identified (age≥55yrs old, abnormal arterial blood gases result, hemoglobin <9gm/dl, disturbed level of consciousness, presence of fracture dorsal spine and presence of abdominal collection associated with pelvic fracture).those predictors shows significant relation to CT chest positivity in absence of any clinical finding during initial chest examination and in presence of unremarkable chest x-ray. Similar findings were reported by workers like (Brink M et al 2010) as they identified nine criteria of selective use of chest computed tomography in blunt trauma patients (age ≥55 years, abnormal chest physical

Figure-1. Distribution of patients according to CT chest result.

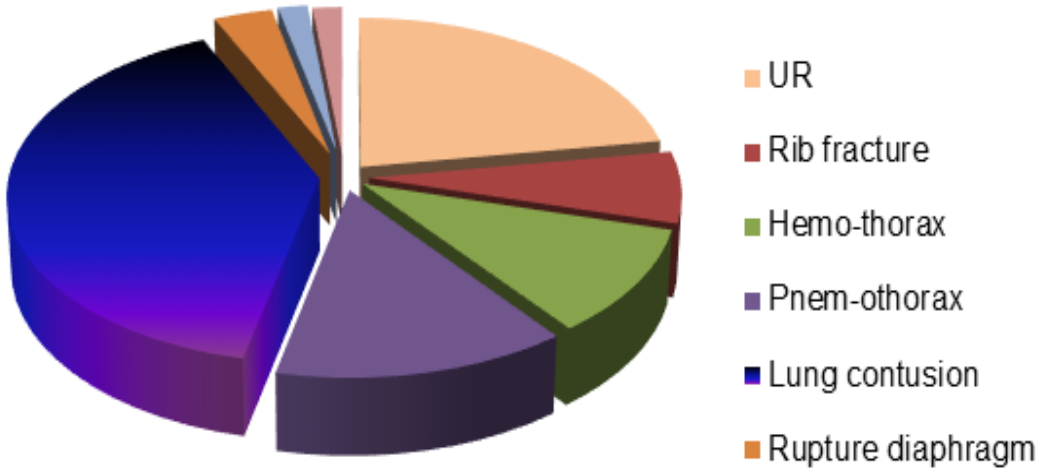

Table-3. Distribution of the studied cases according to positive predictors founded

	CT chest result				χ^2	^{FE}p
	negative (n = 26)		positive (n = 74)			
	No.	%	No.	%		
Age <55 yrs	24	92.3	52	70.3	5.123*	0.024*
Age ≥ 55 yrs	2	7.7	22	29.7		
Glasgow coma score 15	24	92.3	44	59.5	9.540*	0.002*
Glasgow coma score< 15	2	7.7	30	40.5		
normal arterial blood gases	26	100.0	54	73.0	8.784*	0.003*
Abnormal arterial blood gases	0	0.0	20	27.0		
Hemoglobin level ≥9 gm/dl	26	100.0	58	78.4	6.692*	0.010*
Hemoglobin level < 9 gm/dl	0	0.0	16	21.6		
Normal dorsal spine	26	100.0	61	82.4	5.250*	0.019*
Fracture dorsal spine	0	0.0	13	17.5		
Normal abdomen and pelvis	26	100.0	62	83.7	4.791*	0.033*
Abdominal collection and pelvic fracture	0	0.0	12	16.2		

examination, altered sensorium, abnormal thoracic spine physical examination, abnormal chest x-ray, abnormal thoracic spine x-ray, abnormal pelvic x-ray or abdominal ultrasound, base excess <−3 mmol/l and haemoglobin<6 mmol/l).

Some studies had identified one or more of these predictor to had a significant relation to CT chest result like study done by (Kaiser ML et al 2011) found that age older than 30 yrs has significant p value=0.004 in predicting lesions on CT basis and studies done by (Traub M et al 2007, Holmes JF et al 2002) had identified disturbed level of consciousness as indication of CT chest imaging also study done by (Plurad D et al 2007 and D. Radhakrishna et al, 2015) found that pelvic fracture alone had strong relation to CT chest positivity.

CONCLUSION

In some studies including ours CT chest were found to be highly effective in detecting occult chest lesions in pt with high risk factors including

- age ≥ 55yrs old
- abnormal arterial blood gases result

- hemoglobin <9gm/dl
- Disturbed level of consciousness(GCS<15)
- Presence of fracture dorsal spine
- Presence of abdominal collection and pelvic fracture

Some of these predictors agreed by American College of Radiology (ACR Appropriateness Criteria) such as altered mental status, so considering CT imaging in such cases may be beneficial in predicting chest injuries.

Conflict of Interests:

The authors declare that there is no conflict of interests regarding the publication of this paper.

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