



## ORIGINAL ARTICLE

## Chest trauma epidemiology and emergency department management in a tertiary teaching hospital in Kigali, Rwanda



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## ABSTRACT

**Introduction:** Chest trauma is a major contributor to injury morbidity and mortality, and understanding trends is a crucial part of addressing this burden in low- and middle-income countries. This study reports the characteristics and emergency department (ED) management of chest trauma patients presenting to Rwanda's national teaching hospital in Kigali.

**Methods:** This descriptive analysis included a convenience sample of patients presenting to a single tertiary hospital ED with chest trauma from June to December 2017. Demographic data were collected as well as injury mechanism, thoracic and associated injuries, types of imaging obtained, and treatments performed. Chart review was conducted seven days post-admission to follow up on outcomes and additional diagnoses and interventions. Incidences were calculated with Microsoft Excel.

**Results:** Among the 62 patients included in this study, 74% were male, and mean age was 35 years. Most patients were injured in road traffic crashes (RTCs) (68%). Common chest injuries included lung contusions (79% of cases), rib fractures (44%), and pneumothoraces (37%). Head trauma was a frequent concurrent extra-thoracic injury (61%). Diagnostic imaging primarily included E-FAST ultrasound (92%) and chest x-ray (98%). The most common therapies included painkillers (100%), intravenous fluids (89%), and non-invasive oxygen (63%), while 29% underwent invasive intervention in the form of thoracostomy. The majority of patients were admitted (81%). Pneumonia was the most common complication to occur in the first seven days (32% of admitted patients). Ultimately, 40% of patients were discharged home within seven days of presentation, 50% remained hospitalized, and 5% died.

**Conclusion:** This study on the epidemiology of chest trauma in Rwanda can guide injury prevention and medical training priorities. Efforts should target prevention in young males and those involved in RTCs. ED physicians in Rwanda need to be prepared to diagnose and treat a variety of chest injuries with invasive and noninvasive means.

## Introduction

While some countries have made progress decreasing deaths from traumatic injuries, they still cause significant morbidity and mortality globally [1]. Thoracic trauma is a major contributor to this burden, causing or contributing to over a quarter of trauma-related deaths [2].

Thoracic trauma studies in African countries identified that young males are disproportionately affected and road traffic crashes (RTCs) are a common cause. Frequent injuries include rib fractures and hemo- and

pneumo-thoraces, often with polytrauma. Thoracostomies are among common interventions performed, and mortality greatly varies, sometimes over 15% [3–5].

Understanding thoracic trauma epidemiology is important in order to tailor medical treatments and prevention efforts. Rwanda is an East African country where thoracic trauma has been minimally studied. Injuries are the leading cause of mortality outside communicable diseases there, causing 22% of deaths and 11% of hospital admissions [6]. Thoracic trauma occurs in nearly one-tenth of RTCs in Rwanda, and over

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15% of injured patients transported by Rwandan emergency medical services suffer from thoracic trauma [7].

This purpose of this study is to describe mechanisms, specific thoracic and associated injuries, radiology studies, clinical interventions, and outcomes of chest trauma patients presenting to the University Teaching Hospital-Kigali (CHUK) Emergency Department (ED).

## Methods

### Study design and setting

This descriptive analysis of thoracic trauma presenting to the ED was conducted at CHUK, Rwanda's primary public referral teaching hospital in its capital city, Kigali. CHUK has a dedicated 40-bed ED and hosts the country's sole emergency medicine (EM) training program. CHUK has 24/7 ED, operating room, and specialist capabilities. The Institutional Review Board of the University of Rwanda College of Medicine and Health Sciences (Approval No. 287, 2017) and the CHUK Ethics Committee approved the study contingent upon consent of subjects or their families.

### Study population

Patients presenting with thoracic trauma from any mechanism were eligible for inclusion. A convenience sample was enrolled by a Rwandan EM resident who enrolled eligible patients after reviewing charts from trauma cases every morning during the study period; this resident was also available during the entire study period to be summoned to the ED by colleagues treating patients with chest trauma. Written consent was obtained in the local language, Kinyarwanda, and a family member could consent for a patient. Patients were excluded if consent could not be obtained.

We collected demographic factors (sex, age, home province, occupation), injury mechanism, specific thoracic injuries, other associated injuries, radiology obtained, and treatments performed. Chart review was again performed on hospital day seven to include other subsequently discovered injuries or performed therapies missed during initial enrollment and to assess outcome.

### Statistical analysis

Data were entered into an EpiData database (version 4.0.2.101, EpiData Association, Denmark), then exported to Microsoft Excel (Excel 2016, Microsoft Corporation, USA) for chart and table creation.

## Results

### Demographic data

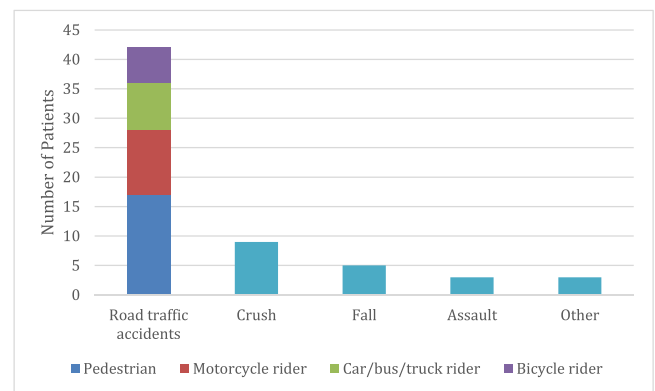
From June to December 2017, 78 cases of thoracic trauma presenting to the CHUK ED were reviewed. Signed consents were obtained from 62 patients (13 patients were too injured to consent and had no family member present). Sixteen patients in total were excluded: 13 who could not consent and three whose charts had large amounts of missing data.

Among the 62 included patients, 46 (74%) were male and 16 (26%) were female. Median age was 35 years (IQR 27-51 years). Most were from Kigali (23, 37%) or the South Province of Rwanda (20, 32%).

### Injury types and mechanisms

The most common mechanism of thoracic trauma was RTC (42 cases, 68%). Many of these (17) were pedestrians; eight were struck by vehicles, seven by motorcycles, and two by bicycles.

Nine subjects sustained crush injuries (five mine collapses, one working under a car, one on a construction site, one under a falling tree, and one while attempting carrying a heavy cable roll), five fell, and three



**Fig. 1.** Mechanisms of Injury (n = 62).

Different sub-categories of RTC are in reference to the injured patient's role in RTC.

**Table 1**

Frequency of Specific Thoracic Injuries (n = 62).

Thoracic Injury Types	Cases (n = 62)	Percent of total
Lung contusion	49	79
Rib fracture	27	44
Flail chest	3	5
Pneumothorax (all)	23	37
Tension pneumothorax	8	13
Hemopneumothorax	13	21
Contralateral hemothorax	3	5
Clavicle fracture	17	27
Hemothorax (without pneumothorax)	8	13
Subcutaneous emphysema	8	13
Thoracic spine injury	7	11
Scapula fracture	3	5
Chest wall soft tissue injury	2	3
Diaphragmatic injury	1	2
Esophageal injury	1	2
Hemopericardium	1	2
Sternal fracture	1	2
Great vessel injury	0	0
Tracheal injury	0	0

"Pneumothorax (all)" includes simple pneumothoraces in addition to tension pneumothoraces, hemopneumothoraces (hemothorax and pneumothorax on the same side), and contralateral hemothorax (hemothorax and pneumothorax on opposite sides)

were assaulted. Three suffered thoracic injuries by other mechanisms, including a sports injury, an encounter with a cow, and one patient trampled in a crowd. See Fig. 1. Only two subjects sustained penetrating trauma: a patient who was assaulted with a screwdriver, and one who fell and was impaled by a steel bar.

Frequent thoracic injuries included clavicle (27%) and rib (44%) fractures. Twenty-three total patients (37%) had pneumothoraces, including eight tension pneumothoraces and 13 hemopneumothoraces. Eight patients had hemothoraces without pneumothorax. One patient had a hemopericardium but was not in tamponade. The impaled patient had the sole diaphragmatic and esophageal injuries in this study. A large number (49, 79%) were diagnosed radiologically with lung contusions. See Table 1.

Extra-thoracic injuries included 38 (61%) head injuries, 17 (27%) leg injuries, nine (15%) arm injuries, seven (11%) abdominal injuries, six (10%) neck injuries, one pelvic injury, and one lumbar injury resulting in paraplegia.

### Diagnosis, treatment, and outcomes

Most patients received an extended focused assessment with sonography for trauma (E-FAST) and chest x-ray (CXR), while only few un-

**Table 2**  
Diagnostic imaging modalities and therapeutic interventions.

Diagnostic Imaging	Cases (n = 62)	Percent of total
CXR	61	98
E-FAST	57	92
Chest CT	6	10
<b>Therapeutic Interventions</b>		
Painkillers	62	100
IV Fluids	55	89
Non-invasive oxygen	39	63
Antibiotics	35	57
Tetanus antitoxin	20	32
Thoracostomy	18	29
Wound care	5	8
Intubation	4	7
Blood transfusion	3	5
Thoracic corset placement	2	3
Abdominal ex-lap	1	2
Clavicle ORIF	1	2
Needle decompression	1	2

CXR= chest x-ray. E-FAST= extended focused assessment with sonography for trauma (point-of-care ultrasound exam). CT=computed tomography. ORIF=open reduction internal fixation.

derwent a chest computed-tomography (CT) scan. Among common basic therapies, most were placed on supplemental non-invasive oxygen, almost 90% received intravenous fluids, and all patients received pain medication. Invasive emergency interventions included 18 receiving chest tubes and one needle decompression. Four patients (6%) were intubated. No open thoracotomies were performed. See [Table 2](#).

Fifty cases (81%) were admitted while 12 (19%) were discharged from the ED. For those admitted, complications which developed in the first seven days included 16 cases of pneumonia, and one case each of sepsis, iatrogenic pneumothorax, iatrogenic hemothorax, episode of delirium, and malaria. Seven days after presentation to the ED, 31 patients (50%) remained hospitalized. Twenty-five (40%) recovered and were discharged home, three were discharged with a disability to another facility, and three died. Of those who died, two were 59 years old (one was a farmer who sustained a fall, the other a pedestrian involved in an RTC, both with concurrent head injuries) and the third was a two-year old child struck by a motorcycle with a pneumohemothorax and concurrent head injury.

## Discussion

Like neighboring African LMICs, thoracic trauma in Rwanda most commonly affects young males and those involved in RTCs [3–5]. These populations are targets of ongoing interventions and should continue to be. In response to a World Bank report critical of Rwandan road safety, broad regulations began to be enforced in 2001, and a collaboration with the World Health Organization several years later helped increase public awareness [8].

Thoracic injury mechanisms may indicate underlying societal trends. Only one patient sustained a non-accidental penetrating injury suggesting a lower rate of interpersonal violence in Rwanda, while the high incidence of RTCs may reflect Rwanda's modernization efforts.

Lung contusions were the most common injury in this study. Few other studies have shown such a high rate of contusions [9]; providers need to maintain a high index of suspicion to avoid missing this injury since it may have high associated mortality [2]. Rarity of certain injuries, such as great vessel or tracheal injuries, may be attributable to their severity leading to mortality before ED arrival.

Head trauma was often associated with thoracic trauma in Rwanda; this is similar to nearby Tanzania [5]. Interestingly, Uganda, Rwanda's other neighbor, had more associated abdominal trauma [4]. The frequent co-occurrence of significant associated injuries in thoracic trauma

should lead providers to suspect other serious injuries when evaluating patients.

E-FAST ultrasound exams were frequently performed. Point-of-care ultrasound (POCUS) is a cost-efficient improvement to patient care and is increasingly important to developing world EDs [10]. Timely availability and low cost of POCUS in the Rwandan ED setting likely contributed to heavier use. Meanwhile, rare utilization of CT scans was likely because of cost considerations.

Most patients received non-invasive care in the form of oxygenation, intravenous fluids, painkillers, and antibiotics, similar to Tanzania where patients are also managed nonoperatively [5]. Less than a third of patients received tube thoracostomy despite about half having pneumo- or hemothoraces; this may reflect either a local preference, or a conscious decision to manage injuries conservatively.

The most common admission complication was pneumonia. Pneumonia and other infection-related complications occur frequently in other East African studies revealing an important area for in-hospital prevention efforts [4,5]. Mortality was low but likely underestimated due to out-of-hospital deaths and exclusion of some sick patients without capacity to consent.

## Limitations

The data collection was performed by a single investigator during the study period, and certain cases may have been missed. In particular, minor thoracic trauma may have been missed in review of major polytrauma cases, or in patients who were well enough to be discharged before the investigator could arrive and enroll them. Some critically ill patients also were lost because they could not be consented for enrollment; this may also affect reported surgical intervention rates, as more severely injured patients were taken to the operating suite.

We felt that in-depth descriptions of non-thoracic trauma would be more appropriately addressed in other studies. However, our specific focus only on a detailed description of chest trauma meant that injury scores (such as Injury Severity Score) could not be calculated, which could have been useful in correlating to patient outcome. Finally, this study does not incorporate prehospital data including time to presentation or pre-hospital mortality.

## Conclusion

This small epidemiologic thoracic trauma study in Rwanda reports preliminary data; there is need for further investigation. Further research should target pedestrian trauma in young males, with a focus on reducing the burden of injury from RTCs. Clinical education should include optimizing treatment for common thoracic injuries, including pulmonary contusions, fractures, and hemo- and pneumothoraces. Heavy POCUS use to complement CXR reflects global trends in emergent imaging [10]. Improving trauma prevention, associated injury recognition, and proper treatment knowledge can improve mortality of thoracic trauma patients.

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## Dissemination of results

Results from this study was shared with the Anesthesia and Emergency Medicine faculty and residents at CHUK via a research presentation by Dr. Nsengiyumva.

### Authors' contribution

Authors contributed as follows to the conception or design of the work; the acquisition, analysis, or interpretation of data for the work; and drafting the work or revising it critically for important intellectual content: BN and MBH contributed 30% each; MG contributed 20%; HMK 10%; and MKE and MMR 5% each. All authors approved the version to be published and agreed to be accountable for all aspects of the work.

### Declaration of Competing Interest

The authors declare no conflicts of interest.

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