Management of Thoracic Trauma in Intensive Care Unit in Togo: A Particular Reference to Sylvanus Olympio University Hospital of Lome

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Abstract

Background: The Management of thoracic trauma (TT) requires important resources, especially for intensive cares. In developing countries, intensive care units (ICUs) are often the first facilities providing life-saving care to severe trauma patients. This study aimed to analyze the management of TT in a Togolese ICU.

Methods: A retrospective and descriptive study was carried out in the ICU of the Sylvanus

Olympio University Hospital (SO UH) of Lomé, over a six-year period. The records of TT inpatients were analyzed from registers. Statistical tests were performed using Epi-info 7.2.4 software.

Results: Of the inpatients for resuscitation, one hundred and ninety-five patients (195) were admitted with TT (5.1% of ICU admission), with 187 selected for the research. Their mean age was 38.1 ± 13 years and sex-ratio = 6.8. Road Traffic Accidents (RTA) were the most frequent causes (87.2%). Patients had respiratory distress (62.6%), hemorrhagic shock (4.8%) and severe coma (24.6%). It was polytrauma in 92.5% of the cases with 75.9% of cranio-encephalic injuries. Fifty patients underwent surgery. Resuscitation included oxygen therapy (65.8%), mechanical ventilation (15%), decompression needle thoracostomy (11.2%), chest drainage (10.7%), analgesia, sedation (54%), vascular filling (21.9%), administration of vasopressors (14.4%) and blood transfusion (49.7%). The mean length for ICU stay was 12.7 ± 6 days. At least one complication occurred in 55.8% of patients: sepsis in 43.3%, bronchopulmonary infection in 32.1%, acute respiratory distress syndrome (ARDS) in 25.7%, hemorrhagic shock in 16.6% and septic shock in 15%.

Eighty-four patients (44.9%) died of septic shock (30.9%), hemorrhagic shock (14.3%), brain injuries (36.9%), and ARDS (9.5%). The management faced shortcomings such as inadequate aseptic conditions, unavailability of arterial blood gas test, insufficiency of surveillance monitors and ventilators.

Conclusion: TTs were common in ICU. Most of the patients presented associated injuries. ICU management was successful in most cases, but faced challenges. It is necessary to improve equipment and management protocols.

Background

Thoracic trauma (TT) includes traumatic injuries involving the chest wall as well as intrathoracic organs. It often occurs in polytrauma circumstances, which generate vital distress requiring treatment in intensive care units [1]. Road traffic accidents (RTAs) are the commonest cause of polytrauma and TT [2–9]. The increase in automobile traffic, and especially motorcycles in Togo and some sub-Saharan countries in recent decades, has led to the rise of road traffic accidents, which have become a public health problem [2, 7].

Management of TT requires a multidisciplinary collaboration: anesthesia, intensive care, emergency medicine, surgery, and interventional radiology often within large trauma centers [1, 4, 10]. In developing countries such as Togo, the lack of pre-hospital medical care and the poor organization and equipment of emergency departments oblige intensive care units (ICUs) to be the first facilities to provide suitable care to patients with life-threatening injuries. This study aimed at analyzing the diagnosis and the management of TT in an ICU, identifying any limitation, and making recommendations.

Methods

We conducted a retrospective and descriptive study in the ICU of the Sylvanus

Olympio University Hospital (SO UH) of Lomé, which was the largest public ICU in Togo. We sent a request along with research protocol to the hospital's Research Board, whose ethical committee confirmed the compliance with the Helsinki Committee recommendations, and agreement was granted. We reviewed the ICU register, analyzed grounds for ICU admissions and diagnoses, between November 1, 2012, and October 31, 2018 (over a six-year period). The ICU was a new facility that had been set up and equipped in October 2012. We extracted data of patients who were admitted for trauma, then analyzed their records and selected those with thoracic trauma. The diagnosis of TT was based on the occurrence of respiratory disorders and/or thoracic injuries on imaging. Subsequently, the records were reviewed for the collection of epidemiological and diagnostic data, thoracic and extra-thoracic injuries, surgical and resuscitation cares, and evolvement. Patients whose data were not found at all or for whom critical information (clinical presentation or type of injury) was missing were excluded from the study. Continuous variables were presented as averages with standard deviation, while categorical variables were presented as frequencies with percentages. Statistical evaluation was performed using Epi-info 7.2.4 software (Epi Info™, Center for Disease Control and Prevention; USA).

Results

During the study period, three thousand eight hundred and twenty-eight (3,828) patients were hospitalized in the ICU of the SO UH. Among them, one thousand and forty-six (1,046) were trauma patients (18.6%), including 195 with TT (5.1% of ICU hospitalizations and 18.6% of trauma patients). Eight patients whose records could not be found (2 patients) or missed critical information (6 patients) were missing, and the remaining 187 were included in the research.

The mean age was 38.1±13 years (range: 2-76 years), and the sex ratio was 6.8. One hundred and eighty-four patients (98.4%) were evacuated from the accident scene to the emergency department (primary transfer) and then transferred to ICU, while 3 (1.6%) were transferred from another hospital (secondary transfer). Epidemiological data are presented in Table 1.

On admission to the ICU, patients presented some vital distress. One hundred and seventeen patients (62.6%) had respiratory distress, 9 (4.8%) hemorrhagic shock, and 46 (24.6%) severe coma (Glasgow

coma scale ≤ 8). The mean SPO_2 was 87.1±55.9% (range: 25-99%). Respiratory disorders are displayed in Table 2.

Diagnostic imaging included chest X-ray, head CT scan, limbs X-ray, thoraco-abdominal CT scan and chest CT scan in respectively 185 patients (98.9%), 142 (75.9%), 68 (36.4%), 67 (35.8%) and 12 patients (6.4%). Blood group and D rhesus, blood count, uremia, serum creatinine and blood glucose tests were performed in all patients. C-reactive protein (CRP) and blood ionogram were performed in 180 (96.2%) and 174 patients (93.0%) respectively. The median hemoglobin concentration was 8.8 ± 3, 7 g. dl^{-1} (range: 3.3 to 12 $g.dl^{-1}$).

Table 1
Epidemiological data of TT patients

	Frequency (n)	Percentage (%)
Comorbidity		
Hypertension	12	6.4
Diabetes	3	1.6
Asthma	2	1.1
Causes and mechanisms of TT		
Road Traffic Accident (RTA)	163	87.2
Motorcycles colliding	63	33.7
Automobile-motorcycle colliding	51	27.3%
Automobile-obstacle colliding	20	10.7%
Motorcycle-obstacle colliding	20	10.7%
Automobile-pedestrian colliding	9	4.8
Assault	15	8.0
Struck by walls and heavy loads	5	2.7
Fall from a height	3	1.6
Impalement by an ox	1	0.5
Admission time* (hours)		
[1 to 2]	115	61.5
]2 to 24]	69	36.9
>24 hours	3	1,6
Means of transport		
National fire service's vehicles	87	46.5
Motorcycles	77	41.2
Private vehicles	20	10.7
Ambulance	3	1.6
Total	**187**	**100**
***Duration from accident time to ICU admission**		

Table 2
Respiratory disorders in TT patients

Characteristics	Frequency (n)	Percentage (%)
Middle hypoxia (SPO_2 = 90-94%)	42	22.5
Moderate hypoxia (SPO_2 = 85-89%)	78	41.7
Severe hypoxia ((SPO_2 ⩽ 85%)	28	15
Tachypnoea	108	57.8
Cyanosis	89	47.6
Chest indrawing	40	21.4
Emphysema	24	18.8
Thoracic asymmetry	16	8.6
Bradypnea	9	4.8
Paradoxical breathing	7	3.7

It was about isolated TT in 14 patients (7.5%) and polytrauma in 173 patients (92.5%). Closed TT accounted for 90.4% and penetrating TT for 9.6%. Associated injuries included: cranioencephalic injuries in 75.9%, abdominal contusion (50.8%), pelvic limb trauma (19.2%), thoracic limb trauma (17.1%), cervical spine trauma (7.0%), thoracic spine trauma (2.1%), and lumbosacral spine trauma (0.5%). The distribution of chest injuries is displayed in Table 3.

Table 3
Distribution of thoracic injuries

	Frequency (n)	Percentage (%)
Lung contusion	67	35.8
Hemothorax	45	24.1
One rib fracture	25	13.4
Pneumothorax	21	11.2
Chest penetrating wound	18	9.6
Fracture of more than 1 rib	14	7.5
Flail chest	7	3.7

The ICU management varied according to injuries, vital distresses, resuscitation physician and the recommendations of the various specialists. The essential components of the treatment were: vascular filling (normal saline or ringer's lactate, for moderate hypotension and Gelofusine for severe hypotension or moderate blood loss), intravenous administration of vasopressors in case of shock (ephedrine,

norepinephrine or rarely epinephrine), blood transfusion, and analgesia. The mean volume of vascular filling during the first 24 hours was 3500±790.6 ml (range: 1500 to 5500 ml). Patients were transfused 1 to 5 units of units of packed red cells (mean: 2.1± 0.8), and 1 to 3 units of fresh frozen plasma (mean: 1.2 ± 0.6). Pleural effusion was managed by decompression needle thoracostomy and/or pleural drainage. All patients received analgesic treatment, using various associations of paracetamol (1 g per 6 to 8 hours), nefopam (20 mg per 6 to 8 hours), tramadol (50 to 100 mg per 6 to 12 hours), ketoprofen (100 mg per 12 hours), and subcutaneous morphine-based analgesia or IV morphine titration. In children, the dosage of drugs was adjusted to weight. IV sedation with propofol, fentanyl, and diazepam was applied to ventilated patients. Non-ventilated patients could also be sedated with diazepam and IV or subcutaneous morphine. The means of resuscitation are presented in Table 4.

Table 4
ICU management and therapeutic interventions

	Frequency (n)	Percentage (%)
Sedation	101	54
Hemodynamic resuscitation		
Fluid resuscitation	41	21.9
Vasopressors	27	14.4
Blood transfusion	93	49.7
Respiratory resuscitation		
Airway release	165	88.2
Oxygen delivery by mask	123	65.8
Tracheal intubation + mechanical ventilation	26	13.9
Tracheal intubation + Oxygen	13	6.9
Decompression needle thoracostomy	21	11.2
Pleural drainage	20	10.7
Respiratory physiotherapy	7	3.7
Tracheotomy + mechanical ventilation	2	1.1

Patients were receiving prophylactic (100%) or curative antibiotics (75.4%), and glucose serum when the oral route was not possible (92.5%). Nine patients (4.8%) were urgently operated for thoracic injuries before admission to the ICU, out of whom 4 cases of firearm chest wounds, 4 cases of thoracoabdominal stabbing wound, and a case of blowing wound of the thorax with costal flap. Forty-one patients (21.9%) underwent urgent surgery for concurrent injuries: 27 cases of open limbs fractures, 7 cases of extradural hematoma, 2 cases of cerebral-meningeal hemorrhage, 1 case of cervical disc herniation, 1 case of

cervical vertebral dislocation fracture, 1 case of traumatic rupture of the spleen, 1 case of open fracture of facial bones and 1 case of the scrotal wound.

Evolvements

The average length of ICU stay was 12.7±6 days (range: 1-28 days). One hundred and three patients (55.8%) manifested at least one complication: wound infection and sepsis in 81 patients (43.3%), bronchopulmonary infection in 60 (32.1%), acute respiratory distress syndrome (ARDS) in 48 (25.7%), hemorrhagic shock in 31 (16.6%), septic shock in 28 (15%), and pulmonary embolism in 3 patients (1.6%). Fifteen patients (8.0%) sustained prolonged ventilation and could not be weaned from the ventilator, until they died. Overall, 84 patients (44.9%) died in the ICU, while 103 patients (55.1%) were transferred to the wards. The recorded causes of death were: septic shock in 26 cases (30.9%), hemorrhagic shock in 12 (14.3%), brain injuries in 31 (36.9%), and ARDS in 8 cases (9.5%). The causes could not be identified in 7 cases (8.3%).

Discussion

Epidemiological characteristics

Mostly in our study, patients were young males and TT was induced by RTAs involving motorcycles as they were the most active and mobile people, and were more exposed to accidents. In ICU at Dakar, Niang EHM et al reported a predominance of young male patients, and RTAs were the most frequent causes [11]. These data were in line with those reported in emergency, trauma and surgical departments [3, 7, 12–14].

Pre-hospital Transport

Pre-hospital medical care was not provided to the thoracic trauma patients during their transfer in most cases (98.4%). The national fire department was the single professional service providing pre-hospital rescue for trauma patients in Togo. It is a public service that includes intervention companies in the capitals of the five administrative regions of Togo. They have vehicles with rescue equipment and staff trained for providing only first aids. But this was insufficient in cases of severe trauma. Only dedicated pre-hospital medical services, such as the Emergency Medical Service (EMS) have the appropriate equipment and skills to manage severe trauma patients properly [15]. The absence of pre-hospital medical care is responsible for a high mortality rate and contributes to worsening the prognosis of trauma patients. Low pre-hospital medicalization is frequent in other sub-Saharan countries [7, 11, 12].

Diagnosis

Chest X-ray was the most common imaging test (98.9%). This examination was permanently available and more accessible in our hospital. It was also the most common imaging examination performed in most African studies [3, 7, 11]. CT scan was not available at SO UH for long periods because of breakdowns. The private clinics where this examination was available were far from our facility and were too expensive for some patients since costs have to be borne by themselves. Even in developed countries, CT scans can be limited by the patient's critical or unstable state. When feasible, it provides excellent information. According to a previous study, up to 43.3% of thoracic injuries and 75% of lung contusion may be missed on chest X-rays, but can be diagnosed on CT scan [9]. The Focused Assessment with Sonography for Trauma (FAST) is a performant tool for the triage of severe trauma patients in emergency departments, and diagnosis of pleural, peritoneal, and pericardial effusions in the intensive care units [16, 17]. But this device was not available in our ICU at the time of the study. Most TT occurred upon polytrauma (92.5%). Head trauma was the most frequent associated injury (44%). A high occurrence of associated head trauma has been reported, ranging from 33.3–66% [5, 7, 18].

Icu Management

In our hospital SO UH, management of severe trauma patients presenting with life-threatening conditions was carried out in the operating room or in the ICU because the emergency department had no lifesaving equipment. In developed countries, trauma centers are equipped with life-saving materials and trained multidisciplinary teams able to effectively manage severe trauma patients from admission to the intensive care unit [19–21].

Pain control was obtained using a combination of intravenous and subcutaneous analgesia. Epidural analgesia is one method widely used to provide analgesia, and whose effectiveness has been demonstrated in the management of thoracic trauma, especially those with major rib fractures [1, 22, 23]. But this procedure was not used in our series because its materials were expensive and scarce. Respiratory resuscitation involved most commonly the standard oxygen therapy by mask. Mechanical ventilation was applied in 15% of the cases. This frequency was lower compared to other studies. In Senegal, 26.8% of patients with TT were receiving invasive ventilation and 5.7% non-invasive ventilation (NIV) [11]. In large trauma centers in Europe, the frequency of mechanical ventilation in TT was high, up to 81.1% [24]. The low rate of mechanical ventilation in our setting could be attributed to the insufficiency of ventilators and the non-application of any trauma severity score on admission. Arterial blood gas test, which is an important test for diagnosis and follow-up of various hematosis disorders, was not available in our ICU.

Surgical procedures were mostly performed for associated injuries (21.9%). Only 4.8% were operated on for thoracic or thoracoabdominal injuries. Patients with rib fractures did not undergo any surgical procedure, except one with a blowing wound of the thorax with costal flap who underwent a lifesaving surgery, while surgical rib fixation is often recommended for multiple rib fractures and flail chest. It allows a significant decrease in ventilation and ICU stay duration, and a reduction of pneumonia, sepsis and

mortality risk [25–30]. There was no cardiothoracic surgeon in Togo before the year 2016, so that general surgeons preferred conservative treatment in most patients. Despite the arrival of the cardiothoracic surgeon, this specialty is still underdeveloped because of a lack of adequate equipment, and impossibility to provide permanent service.

Evolvements

Complications occurred in 55.8% of patients in our ICU. Most of these complications were infectious. The management of those infectious complications faced challenges related to difficulties in the identification of pathogens, and the high frequency of antibiotic resistance resulting in high lethality. The high frequency of infectious complications was related to lack of aseptic conditions during care in the emergency department as well as in the ICU, and to the delay in the management of open injuries such as fractures. High incidences of infectious complications have been reported by other authors [12, 21, 25, 30, 31]. We reported a mortality rate of 44.9% in TT, which was higher than the one reported in previous studies. Niang EHM et al reported 20.3% [11], Jörg Bayer et al 10.6% [24] and Gabriel E et al 6.5% [18] in adult patients. In pediatric ICUs, Sumudu P Samarasekera et al reported 16% [5] and Xicheng Denga et al 6.8% [8]. It seems important to identify the shortcomings in management of TT in SO UH ICU, so that corrective actions could be implemented. The following difficulties and shortcomings were identified:

1. Unavailability of the FAST and arterial blood gas test in the ICU,
2. Insufficiency of cardiothoracic surgeons and absence of adequate platform for thoracic surgery,
3. Insufficiency of surveillance monitors and ventilators,
4. Deficiency of asepsis during care,
5. Unavailability of the CT scan at SO UH for long periods,
6. The high cost of CT scans in private clinics compared to the income of some patients. For example, a thoracic CT scan cost, including ambulance fees, varied from 90,000 to 120,000 francs XOF CFA (USD 162.00 to USD 216.00) against a minimum monthly wage guaranteed at 35,000 francs XOF CFA (USD 63.00).
7. Other external factors influence negatively TT management in ICU too:

- Unavailability of the universal health insurance.

- Unavailability of pre-hospital medical services for the provision of life-saving care during the transportation of casualties from accident scenes to medical facilities.

- The lack of equipment and knowledgeable staff for the management of life-threatening distress in the emergency department of SO UH.

Recommendations:

1. National authorities should set up and equip emergency pre-hospital service.

2. Create a trauma center and trained the staff in severe trauma management at SO UH.
3. Install and maintain diagnostic equipment such as CT scan and ultrasound machines, and laboratory equipment, including gas analyzers.
4. Recruit additional cardiothoracic surgeons and equip the cardiothoracic room for cardiothoracic surgery.
5. Improve ICU equipment with surveillance monitors and ventilators.
6. National authorities to set up adequate universal health insurance and strengthen the prevention policy to reduce RTAs.

Study Limitation

This study was limited by its retrospective and monocentric nature. There was a potential for incomplete and missing data for some patients. The shortcomings in management did not allow comparative analysis as to identify morbidity and mortality factors. Further prospective and large studies could provide better results.

Conclusion

Thoracic trauma was common in the ICU of the SO UH of Lomé. It was often caused by RTA involving motorcycles. It occurred in polytrauma and head trauma was the most frequent associated injuries. Standard X-ray was the most commonly used diagnostic test. Resuscitation comprised pain relief, oxygen therapy, mechanical ventilation, sedation, blood transfusion, vascular filling, administration of vasopressors, and pleural puncture and drainage. That management succeeded in most cases but faced some challenges worsening the prognostic. Therefore, it is necessary to improve the management of trauma patients at all steps.

Abbreviations

- ARDS: Acute Respiratory Distress Syndrome

- CT scan: Computerized Tomography scan

- GCS: Glasgow Coma Scale

- ICU: Intensive Care Unit

- RTA: Road Traffic Accident

- **SO UH**: Sylvanus Olympio University Hospital

- SPO2: Peripheral Oxygen Saturation

- TT: Thoracic Trauma

- USD: United States Dollar

-XOF CFA: West African CFA (African Financial Community) Franc

Declarations

Ethics approval and consent to participate

This study has been approved by the Sylvanus Olympio University Hospital Research and Archives Board, with the reference number 1696/2018/MSPS/CHU-SO/DIR/DRH/SERV.PERS. As data were recorded retrospectively, patients were not directly involved in the study. All data were recorded in accordance with the declaration of Helsinki.

Consent for publication

Our manuscript does not publish any individual person's data.

Availability of data and materials

The datasets used and analyzed during the current study are available from the corresponding author on reasonable request.

Competing interests

The authors declare that they have no competing interests.

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Author's contributions

ETM, SA, DL, MA and GS contributed in conception and design of the work

ETM, SA, DL, KB, AEKM, MA and GS contributed in the acquisition, analysis and interpretation of data,

ETM, SA, DL, KB, AEKM, PE, IKS, MA, and GS have drafted the manuscript, ETM, SA, DL, KB, AEKM, PE, IKS, HDS, PT, PE, MP, MA, AYGM, and GS have substantively revised the manuscript.

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