



Complications of Tube Thoracostomy using Advanced Trauma Life Support Technique in Chest Trauma

Les complications de la thoracostomie utilisant une technique avancée de soutien pour trauma vie dans un traumatisme thoracique

P. E. Iribhogbe*, O. Uwuigbe

ABSTRACT

BACKGROUND: Tube thoracostomy (TT) is central in the management of chest trauma sufficing in over 80% of cases. As a result the procedure is commonly performed in most emergency departments.

OBJECTIVE: The aim of this study was to assess the efficacy and complications of TT using Advanced Trauma Life Support (ATLS) technique in chest trauma.

METHODS: This prospective study was done at the Trauma Unit of the University of Benin Teaching Hospital in Nigeria. All patients with chest trauma who needed tube thoracostomy between February 2006 and February 2009 were studied. Data recorded for each patient included injury, mechanism of injury, Glasgow Coma score, revised trauma score, and indications for tube thoracostomy. Chest radiographs were obtained preinsertion, post insertion and post extubation for all the cases. Patients were monitored for tube thoracostomy complications.

RESULTS: Of 9415 trauma patients seen during the period 105 patients had tube thoracostomy but only 70 (56 male, 14 female) had adequate data for analysis. Seventy-four tubes were passed in the 70 patients with unilateral tubes in 66 (94.3%) and bilateral tubes in 4 (5.7%). Blunt chest trauma occurred in 32 (45.7%) and penetrating chest trauma in 38 (54.3%) of the patients. Simple haemothorax and haemopneumothorax were the commonest indications for tube thoracostomy. Complications recorded include four cases of kinked tubes, four of superficial wound infection and 10 cases of residual haemothorax.

CONCLUSION: Tube thoracostomy in the Emergency Department using advanced trauma life support principles is effective in chest trauma and associated with few complications. *WAJM 2011; 30(5): 369–372.*

Keywords: Tube thoracostomy, trauma, Nigeria, Advanced trauma life support, Revised trauma score, Glasgow coma scale.

RÉSUMÉ

CONTEXTE: thoracostomie (TT) est un élément central dans la gestion des traumatismes thoraciques se suffire à plus de 80% des cas. En conséquence, la procédure est couramment pratiquée dans la plupart des départements d'urgence.

OBJECTIF: Le but de cette étude était d'évaluer l'efficacité et les complications de la TT en utilisant Advanced Life de soutien pour trauma (ATLS) technique dans un traumatisme thoracique.

MÉTHODES: Cette étude prospective a été réalisée à l'unité de traumatologie de l'Université de l'hôpital universitaire de Bénin au Nigeria. Tous les patients atteints d'un traumatisme thoracique qui avait besoin thoracostomie entre Février 2006 et Février 2009 ont été étudiés. Les données enregistrées pour chaque patient inclus blessures, mécanisme de la blessure, le score de Glasgow, trauma score révisé, et les indications pour thoracostomie. Les radiographies pulmonaires ont été obtenus préinsertion, après l'insertion et l'extubation après pour tous les cas. Les patients ont été suivis de complications thoracostomie.

RÉSULTATS: Parmi 9415 patients victimes de traumatismes observés au cours de la période 105 patients ont eu thoracostomie mais seulement 70 (56 hommes, 14 femmes) avaient des données suffisantes pour l'analyse. Soixante-quatre tubes ont été adoptées au cours des 70 patients avec des tubes unilatérales dans 66 (94,3%) et les tubes bilatéraux dans 4 (5,7%). Traumatisme thoracique survenu dans les 32 (45,7%) et trauma thoracique pénétrant dans 38 (54,3%) des patients. Hémothorax simple et haemopneumothorax étaient les plus fréquentes indications pour thoracostomie. Les complications enregistrées incluent des quatre cas de tubes ont été pincés, quatre d'infection des plaies superficielles et 10 cas de hémothorax résiduel.

CONCLUSION: Thoracostomie dans le département d'urgence à l'aide de pointe principes traumatismes de la vie de soutien est efficace dans les traumatismes thoraciques et associée à des complications rares. *WAJM 2011; 30(5): 369–372.*

Mots-clés: Thoracostomie, un traumatisme, le Nigeria, avancés de réanimation traumatologique, Revised Trauma Score, Échelle de Glasgow.

INTRODUCTION

Chest trauma is common. It is associated with great morbidity and mortality accounting for 20% of all trauma deaths.^{1,2}

Tube thoracostomy (TT) is central in the management of chest trauma.³ Thoracotomy is necessary in 10–15%⁴ of cases with TT often sufficing in the majority of cases.⁵ However, TT could be associated with complications.^{6,7,8}

The aim of this study was to assess the efficacy and complications of tube thoracostomy using ATLS technique⁹ in chest trauma in a University Teaching Hospital Trauma and Critical Care Unit in Southern Nigeria.

SUBJECTS, MATERIALS, AND METHODS

This was a prospective study conducted at the University of Teaching Hospital in Benin City—a 700 bedded hospital in Edo State in the Niger-Delta region of Nigeria. The Trauma and critical care unit was created in October 2005

All patients with chest trauma who were resuscitated by the trauma team and who needed TT between February 6, 2006 and February 5, 2009 were included in the study.

Clinical Procedures

A data form was completed for each recruited patient. Patients' demographic and clinical data were recorded including mechanism of injury, injuries sustained, Glasgow coma score (GCS), Revised trauma scores (RTS), findings on physical examination, trauma series, the indications for TT as well as results of patient management.

All the TT were passed using a standard technique with chest drainage sets made by Smith Medical Int. Ltd. United Kingdom and our thoracostomy packs under sterile conditions usually in the Emergency theatre but at times in the Emergency Room or main theatre. The surgeon was usually the Trauma Registrar.

The arm was abducted, sterile preparation done with cetrimide or hibitane followed by methylated spirit or simply with 10%w/v povidone iodine. The fourth or fifth intercostal space was identified and 3–5cm incision made just

above the rib. The incision was developed with blunt technique using curved artery forceps into the pleural cavity. A finger was inserted to confirm entry and to break adhesions before the tube (size 28–36 French gauge) was passed in with a trochar and led in a postero-superior direction and then connected to under-water seal drainage without suction. The tube was secured to the skin using No 0 Nylon suture. A U stitch using O Nylon was equally placed around the tube but left untied and dressing applied.

Chest X-Rays were done pre-insertion, post insertion and post extubation and the findings recorded. Extubation was done when drainage was less than 100ml per day. The tube was removed in maximum inspiration under Valsalva maneuver. Management details including use of antibiotics, analgesics, physiotherapy and surgical intervention were also recorded. Absence of an airleak or complete resolution of pneumothorax was equally noted as confirmed by chest radiographs.

Antibiotics were not routinely administered, but were given in penetrating injuries and for associated injuries where indicated.

The patients were monitored throughout their hospital stay for TT complications. Complications were categorised into three groups using the classification recommended by Bailey:⁸ Insertional complications refer to organ injuries, or damage to neurovascular structures; positional complications refer to ectopic catheter placement and non or poor function, kinking or tube dislodgement,⁵ and infective complications were either superficial (wound infection) or deep (empyema).

Statistical Analysis

Ordinal data were analyzed using the Chi square test and Fisher's exact test while analysis of continuous data was by student's t-test.

Consent was duly obtained and the hospital Institutional Review Board approved the study.

RESULTS

A total of 9415 trauma patients were seen during the period of the study. Of

this number 105 patients with chest trauma had tube thoracostomy. However 35 patients who had incomplete radiology, incomplete documentation or missing medical records were excluded, thus 70 patients qualified for final analysis.

A total of 74 TT were passed in the 70 patients. The age range of the patients was 12–88 years with a mean of 32.1 ± 12.9 years. There were 56 (80%) males and 14 (20%) females. Blunt chest trauma occurred in 32 (45.7%) while 38 (54.3%) patients had penetrating chest trauma. (Table 1).

Unilateral tubes were passed in 66 (94.3%) of the patients, and Bilateral tubes in four (5.7%) patients. In the four subjects with bilateral TT, one had bilateral haemothorax following motor vehicle crash while another had bilateral haemopneumothorax following attack with a matchette. The third patient had a gunshot injury in zone 1 region of the neck with a left side haemothorax and a right side haemopneumothorax while the fourth patient had bilateral flail chest and right haemothorax due to motor vehicle crash.

Indication for Tube Thoracotomy

The distribution of the various indications for tube thoracostomy are shown in Table 2.

Rib fractures occurred in 21 (30%) of patients with chest injury. Flail chest occurred in nine (12.8%) patients. Eight of these nine (88.9%) resulted from motor vehicle crash and one (11.1%) was a

Table 1: Mechanism of Injury

Mechanism	Number (%)
Blunt Injury	
Motor Vehicle Crash	21 (65.6)
Pedestrian Hit By Car	5 (15.6)
Motor Bike Accident	2 (6.3)
Fall from Height	2 (6.3)
Assault	2 (6.3)
Penetrating Injury	
GSW	23 (60.5)
Stabs	13 (34.2)
Other	2 (5.3)
Assault	–
Weapon	–
Total	70(100.0)

Table 2: Indications for Tube Thoracostomy

Indication	Number (%)		
	Left Side	Right Side	Total
Simple haemothorax	21(27.7)	13(18.2)	34(45.9)
Simple pneumothorax	2(2.7)	–(0.0)	2(2.7)
Tension pneumothorax	–(0.0)	1(1.4)	1(1.4)
Haemopneumothorax	15(19.6)	13(18.2)	28(37.8)
Open haemopneumothorax	4(5.4)	5(7.0)	9(12.2)
Total	42(55.5)	32(44.5)	74 (100.0)

pedestrian hit by a moving car. Bilateral flail chest occurred in one patient.

Occult pneumothorax occurred in six (8.10%) cases and occult haemothorax in one (1.42%).

There was one case of tension pneumothorax (1.42%). Tube thoracostomies were passed for the occult haemothorax and two pneumothoraces while the other pneumothoraces responded to conservative management.

The RTS varied from 5.9672 to 7.8408 with a mean of 7.5539 ± 0.4413 .

Forty-two tubes were passed in the Emergency theatre, 15 in the Emergency Room, eight in the main theatre, four in the wards and one in the intensive care unit.

The average time interval from ED arrival to chest tube passage was 15 minutes.

Complications and Outcome

Complications occurred in 18 (24.3%) cases. There were no insertional or dislodgement complications. Positional complications were kinked tube in four (5.4%) patients and residual haemothorax in 10(13.5%) patients. One case of residual haemothorax needed reinsertion of TT. The others responded to conservative management.

Wound infection around the thoracostomy site occurred in 4(5.4%) cases. These comprised three cases of gunshot injury and one of blunt chest trauma following motor vehicle crash. Comparing wound infection rates between gunshot wounds and stab wounds yielded no statistical difference ($P=0.54$). These infections responded to wound dressing and appropriate antibiotics following wound swab and cultures. There was no case of empyema thoracis.

Four (5.7%) patients had thoracotomy. These comprised one case of stab wound and three gunshot wounds. One patient died (1.4%). This was due to severity of his injuries (RTS 5.9672). No mortality resulted as a complication of tube thoracostomy.

DISCUSSION

The male preponderance and the mean age in this study reflect the general trauma pattern with males) and first four decades of life being predominantly at risk.^{1,10–12}

Mechanism of Injury

There were more penetrating chest traumas because of increasing violence in our sub region. Reasons that have been adduced for this include rising wave of unemployment, poor economy and inadequate security measures in the country.^{13–17} This contrasts sharply with reports from Massachusetts.^{3,18,19}

Motor vehicle crash (MVC) which topped the list of causes of blunt chest trauma continues to be a leading cause of death in Nigeria as is the situation in several low and medium income countries (LMICS).²⁰ It is estimated that there is a 7% risk of a serious thoracic injury with any MVC and in the USA at least 1500 patients a day present with a life threatening thoracic injury for MVC alone.^{21,22}

The need for bilateral thoracostomy tubes is often results from severe trauma as was the case in our series.

Indications for the Tube Thoracostomy

Haemothorax and haemopneumothorax as we found remain common indications for TT.^{18,19,21} The relatively high rate of open haemo-

pneumothorax might have been due to the increase in frequency of violence related penetrating chest injuries. Rib fractures occurred in a third of the patients studied. This agrees with reports in literature.²³

Flail chest is estimated to occur in 5–13% of patients with chest wall injury.¹ Management is usually supportive and in our series none needed operative fixation. It is usually a marker of severe chest trauma as evidenced by all the cases being motor vehicle crash with one case of pedestrian hit by a fast moving car.

The low rates of occult pneumothorax and occult haemothorax might be due to the infrequent use of CT chest at our facility owing mainly to affordability issues on the part of the patients.²⁴

Absence of a National EMS may have been responsible for the low figure recorded for tension pneumothorax, as such patients have a high probability of dying prehospital. Solagbeu *et al* in a study put preventable trauma death in Nigeria at 73.7%.²⁵

Complications

Recorded complications using this technique were minor and had no major impact on outcome. There were no insertional complications. This is similar to findings in Australia.¹⁹ The absence of empyema and the low wound infection rate despite a high prevalence of penetrating chest injury might have been due to the fact that the tubes were passed under strict aseptic technique as well as quick intervention of the trauma team. The emergency theatre was adjacent to the Emergency Room with prepacked thoracostomy sets available. A previous study²⁶ has suggested that the duration of tube placement and severity of chest injury were predictive of empyema.

There was no statistical difference in wound infection rate between penetrating and blunt chest trauma and between gunshot wound and stab wounds. However, because of the low number of cases it is difficult to draw definite conclusions.

Thoracotomy rates in chest trauma vary from 10–15%.²⁷ The low rate recorded in this study may be explained

by the fact that majority of the penetrating injuries were low velocity mechanism. High velocity weapons are not readily available to hoodlums in Nigeria. In addition victims of high velocity gunshot injuries most likely died prehospital and "dead on arrival" patients were not included in our study.

In conclusion passage of tube thoracostomy in the ED by a well motivated trauma team using ATLS technique is associated with minimal complications.

Conflict of interest and financial support

There is no conflict of interest and no financial support was received.

ACKNOWLEDGMENTS

The authors wish to thank all the Resident doctors and Interns in rotation through the trauma unit at the time the study was conducted. They worked assiduously to adhere to the study protocol.

REFERENCES

1. Locicero III J, Mattox KL. Epidemiology of chest trauma. *Surg Clin North Am* 1989; **69**: 15–19.
2. Voggenreiter G, Eisold C, Sauerland S, Obertacke U. Diagnosis and immediate therapeutic management of chest trauma. A systematic review of the literature. *Unfallchirurg* 2004; **107**: 881–891.
3. Baolu A, Akda AO, Celik B, Demircan S. Thoracic trauma: an analysis of 521 patients. *Turkish Journal of Trauma and Emergency Surgery* 2004; **10**: 42–46.
4. Hines MH, Meredith JW. Special problems of thoracic trauma in: Ritche WP Steele Jr. G, Dean RH, ed. *Gen. Surgery*, JB Lippincott Philadelphia 1995: 859–872.
5. Adegboye VO, Ladipo JK, Brimmo IA, Adebayo AO. Blunt chest trauma. *African Journal of Medicine and Medical Sciences* 2002; **31**: 315–320.
6. Adrales G, Huynh T, Broering B, Sing RF, Miles W, Thomasin MH *et al.* A thoracostomy tube guideline improves management efficiency in trauma patients. *J Trauma* 2002; **52**: 210–261.
7. Luchette FA, Barrie PS, Oswanski MF, Mullins CD, Palumbo F, Prasquale MD *et al.* Practice management guidelines for prophylactic antibiotic use in tube thoracostomy for traumatic haemopneumothorax: The EAST Practice Management Guidelines Work Group. *J Trauma* 2000; **48**: 753–757.
8. Bailey RC. Complications of tube thoracostomy in trauma. *J Acc Emerg Med* 2000; **17**: 111–114.
9. American college of Surgeons. Advanced Trauma Life Support. Chicago. *American College of Surgeons* 2008.
10. Muckart DJ. Trauma the malignant epidemic. *South African Medical Journal* 1991; **79**: 93–95.
11. Kobusingye OC, Lett RR. Hospital-based trauma registries in Uganda. *J Trauma* 2000; **48**: 498–502.
12. Otieno T, Woodfield JC, Bird P, Hill AG. Trauma in rural Kenya. *Injury* 2004; **35**: 1228–1233.
13. Adesanya AA, Afolabi IR, Da Rocha Afodu JT. Civilian abdominal gunshot wounds in Lagos. *JR Coll. Edin* 1998; **43**: 230–234.
14. Ohanaka EC, Iribhogbe PE, Ofoegbu RO. Gunshot injuries in Benin City. *Nigerian Journal of Surgical Sciences* 2000; **10**: 81–85.
15. Osime C, Kpolugbo J. Pattern and outcome of penetrating injuries in Irrua, a suburban community in Nigeria. *African Journal of Trauma* 2004; **2**: 40–44.
16. Osime OC, Elusoji S.O. Outcome of management of gunshot injuries by Nigerian traditional doctors. *Pak J Med Sci* 2006; **22**: 316–319.
17. Adotey JM, Jebbin NJ and Ekere AU. Gunshot injuries in the Niger Delta Region of Nigeria. *Port Harcourt Medical Journal* 2006; **1**: 34–38.
18. Pankay Kulshrestha, Imtiaz Mumshi and Richard Wait. Profile of chest trauma in a level 1 Trauma Center. *J. Trauma* 2003; **57**: 573–581.
19. Kenneth Heng, Adams Bystrycki, Mark Fitzgerald, Robert Gocentas, Stephen Benard, Louise Niggemeyer *et al.* Complications of intercostal catheter insertion using EMST techniques for chest trauma. *ANZ J. Surg* 2004; **74**: 420–423.
20. World Health Organization. Road safety is no accident: A brochure for World Health Day 7 April 2004. World Health Organization, Geneva 2004. Page 8.
21. National safety council 2002. Injury facts, 2002 edition. Itasca (IL): National safety council 2002.
22. Newman RJ, Jones IS. A prospective study of 413 consecutive car occupants with chest injuries. *J Trauma* 1984; **24**: 129–135.
23. Conn JH, Hardy JD, Fain WR, Netterville RE. Thoracic trauma: analysis of 1022 cases. *J Trauma* 1963; **3**: 22–40.
24. Iribhogbe PE, Osemwenkhai EA, Imarengiaye CO, Elusoji SO. Trauma preparedness in Nigeria – A questionnaire survey. *Sahel Med J* 2007; **10**: 97–102.
25. Solagberu BA, Kuranga SA, Adekanye AO, Ofoegbu CPK, Udoffa US, Abdur-Rahman LO *et al.* Preventable trauma deaths in a country without Emergency Medical Services. *Afr J Trauma* 2003; **1**: 39–44.
26. Maxwell RA, Campbell DJ, Fabian TC, Croce MA, Luchette FA, Kerwin AJ *et al.* Use of presumptive antibiotics following tube thoracostomy for traumatic haemopneumothorax in the prevention of empyema and pneumonia – A multi-centre trial. *J Trauma* 2004; **57**: 742–749.
27. Wall MJ, Huh J, Mattox KL. Indications for and techniques of thoracotomy. In *Trauma* 2004 6th Ed. Mc Graw Hill Publishers New York: 513–523.