Original Article

TUBE THORACOSTOMY COMPLICATIONS IN PATIENTS WITH ACUTE BLUNT THORACIC TRAUMA DUE TO ROAD TRAFFIC ACCIDENTS - A COMPARATIVE STUDY"

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ABSTRACT:

OBJECTIVE:

To determine the differences in the frequency and types of Tube thoracostomy complications (TTCs) between two groups of patients (A and B) with blunt thoracic trauma (BTT), as a result of road traffic accidents (RTA).

STUDY DESIGN:

Prospective, comparative study.

PLACE AND DURATION OF STUDY:

Dawadmi General Hospital (DGH), a level II trauma center, Riyadh, from December 4, 2011 to December 3, 2012.

METHODOLOGY:

The problem of a high number and variety of TTCs resulting due to various technical aspects of tube thoracostomy (TT) are highlighted in this study. This is a prospective comparative study enrolling a total of 140 patients with BTT due to RTA, referred to this hospital with indwelling Tube thoracostomies (TTs) (group A) or undergoing TTs at this hospital (group B) by a single thoracic surgeon within 10-15 minutes of arrival. Patients' demographic and clinical details were recorded and confirmed with the referring physicians, if necessary. The two groups were matched for age, gender, indications for TTs and the number and types of accompanying injuries. Informed consent was obtained before the procedure. Results were analyzed using SPSS v 19. Statistical significance achieved was translated into p values at 95% confidence interval.

RESULTS:

Of the 119 patients, who satisfied the inclusion criteria, group A had 49 (41.2%) and group B, 70 (58.8%) patients. Males were in

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the majority in both groups. A total of 130 chest tubes were placed in 119 patients. Contralateral chest tubes were indicated in 3 patients in group A and 8 patients in group B (table I). The overall TTCs rate was 61.5% (80/130), with the majority in group A (88.7%; p= 0.0001). The number of technical, infective and miscellaneous TTC in group A and B were 47 (92.2%), 6 (85.7%), 18 (81.8%), and 4 (7.8%), 1(14.3%), and 4 (18.2%), respectively (table II). The majority of the chest tubes in group A were smaller than 28 Fr (p=0.0001; RR=2.98; 95% CI=2.17-4.10). Mortality due to TT in groups A and B was 2% and 0%, respectively (P=0.416;RR=2.43;CI=1.96-3.01). Patients were followed up for 56 ±23 days after discharge.

CONCLUSION:

There is a significant difference in the frequency and types of TTCs for BTT due to RTA, between groups A and B. There is an urgent need to devise targeted training modules for emergency physicians with special emphasis on recognizing TTCs and having a low threshold for rectifying these before safe transfer to a higher center. In BTT the use of small caliber (< 24 Fr) tubes with trocars should be discouraged to avoid most complications.

KEY WORDS:

Tube thoracostomy complications (TTCs); Blunt thoracic trauma (BTT); Road traffic accident (RTA).

INTRODUCTION:

Most civilian blunt thoracic trauma (BTT) is a result of traffic accidents.[1] Upto 25% of all trauma deaths are a direct result of BTT due to RTA.[1,2] Life saving management involves Tube Thoracostomy (TT) which is the commonest intervention performed in more than 85% of patients with severe BTT.[1] TT is an invasive procedure, has a learning curve and requires supervised training to provide quality care to patients with thoracic trauma.[3,4,5] Complications, both technical and infective arise if the operator is untrained or lacks knowledge of thoracic wall anatomy.[4] Harris et al, in a national survey of chest physicians in the UK recorded their experiences regarding serious TTCs. The survey revealed that 67% of NHS trusts have experienced major TTCs.[6] Furthermore, trocar tube insertion is known to have a higher complication rate even in experienced hands.[7,8] The problem of high number of TTCs seen in patients of BTT prompted the authors to record the number and the types of these complications. Furthermore, the etiology of these complications is discussed and a specific message to actively identify and rectify them before transfer is made, is an important purpose of this study.

With this view, this prospective, comparative study aims to shed light on the differences in the number and types of TTCs in BTT patients due to RTA, managed by non-ATLS certified emergency physicians (group A) and a thoracic surgeon (group B) at DGH.

METHODOLOGY:

This prospective, comparative study was carried out between December 4, 2011 and December 3, 2012. The study groups were labelled as Group A, who had their TTs performed by emergency physicians in a peripheral health facility and Group B, who first presented to DGH with BTT. These patients were assessed by a thoracic surgeon and when indicated, TT was performed in the emergency department or Intensive care unit within 10-15 minutes of arrival. Chest pain and co-morbidities were controlled, and informed consent was sought. Among group B patients, thoracic catheters sized 24-28 Fr. were used and an identical (Ocean™ Water Seal Chest Drain) drainage system was employed for all patients. A daily record of the effluent volume or air leak was kept. Duration of TT, method of insertion, need of low pressure suction, TTCs and resolution methods were recorded. Antibiotics were used as prophylaxis against infection. Data gathering was terminated when a study goal was reached. Data was analyzed with SPSS v. 19 statistical program and results were obtained with appropriate application of Fisher's exact test with determination of 2-sided p values. Relative risk was also calculated for any particular occurence (complications, mortality, etc). Statistical significance was reached with p values < 0.05 at a Confidence Interval (CI) of 95%. Follow-up clinical data on these patients was recorded on an outpatient basis. Pertinent literature was searched using search engines like Medline, PubMed and full text journal publications for relevant references to the text.

INCLUSION CRITERIA:

All patients with BTT due to RTA having TT or indicated for TT with GCS ≥8/15

EXCLUSION CRITERIA:

All patients with penetrating thoracic trauma or superficial BTT or having a GCS <8/15

RESULTS:

A total of 140 patients with BTT due to RTA were brought to DGH for definitive management over a period of one year. Twenty-one (21) patients were excluded as they either had superficial BTT (20) not requiring TTs, or had a GCS of <8/15 (1). Of the 119 patients, who satisfied the inclusion criteria, group A and B had 49 (41.2%) and 70 (58.8%) patients, respectively. Both groups were similar in age and gender distribution (Table I). A total of 130 chest tubes were placed in 119 patients. Contralateral chest tubes were indicated in 3 patients in group A and 8 patients in group B. The overall complication rate in the study was 61.5% (80/130), with the majority in group A (88.7%; P=0.0001;RR=7.89;CI=4.24-14.67). The number of technical, infective and miscellaneous complications in group A and B were 47 (92.2%), 6 (85.7%), 18 (81.8%), and 4 (7.8%), 1(14.3%), and 4 (18.2%), respectively (Table II). The majority of the chest tubes used in group A patients were smaller than 28 Fr as compared to Group B (p=0.0001; RR=2.98; 95% CI=2.17-4.10). The frequency of trocar thoracostomy was 42.9% (21) and 0 % (0) in groups A and B, respectively (p=0.0001; RR=3.52; 95%C.I.=2.61-4.74). Patients were followed up for 56 ±23 days after discharge. Mortality due to TT in groups A and B was 2% and 0%, respectively (P=0.416;RR=2.43;CI=1.96-3.01).

Table I. Patient demographics and injury characterization in the two groups

Variable	Group A (49)	Group B (70)	Total	P value; RR; 95% CI
Age	Mean= 28.7±13 Range=6-70 years	Mean=29.5±12.8 Range=9-75 years		P=0.739; t=0.333; 117df
Gender	Males=41(83.7%); Females=8 (16.3%)	Males=58 (82.9%); Females=12 (17.1%)	99(83.2%) 20(16.8%)	P=1.0;RR=1.035;CI=0.586-1.86
Laterality Right sided Left sided Bilateral **Total no. of Tubes**	**49 patients** 29 (55.8%) 17 (32.7%) 03*2= 6 (11.5%) **52**	**70 patients** 39 (50%) 23 (29.5%) 08*2=16 (20.5%) **78**	**119 patients** 68 (52.3%) 40 (30.8%) 22 (16.9%) **130**	 P=0.850;RR=1.088;CI=0.701-1.687 P=0.846;RR=1.05;CI=0.669-1.644 P=0.522;RR=0.640;CI=0.238-1.723
Single chest tube	46 patients	62 patients	108 patients	P=0.521; RR=1.56; CI=0.580-4.20
Two chest tubes	03 patients	08 patients	11 patients	P=0.521; RR=0.640; CI=0.238-1.72
Trocar tubes	**21 (42.9%)**	**0 (0%)**	**21 patients**	**P=0.0001;RR=3.52;CI=2.61-4.74**
Injury Severity Score (mean±S.D)	24.4±3.4	23.3±3.2		P=0.074; t=1.799; 117 df
Indications (multiple) Pneumothorax Hemothorax	 09 21	 12 35	 21 56	 P=1.00; RR=1.05;CI=0.606-1.81 P=0.462;RR=0.84;CI=0.54-1.31

Hemo-pneumothorax Tension Pneumothorax Multiple Rib Fractures	19 01 06	20 03 11	39 04 17	P=0.321; RR=1.29;CI=0.846-1.99 P=0.642;RR=0.59; CI=1.08-3.31 P=0.791;RR=0.837; CI=0.423-1.657
Patients on ventilatory support	**12**	**7**	**19**	**P=0.043;RR=1.71;CI=1.11-2.62**
Duration of Mechanical ventilation in days(mean)	5.7 ±3.8 days (0-20 days)	4.68 ±3.4 days (0-18 days)		P=0.127; t=1.534; 117 df
Days in ICU	7.3±1.4 days (6-10 days)	6.1±1.6 days (3-9 days)		**P=0.0001; t=4.235; 117 df**
Days in hospital	13.4±5.0 days (8-30 days)	11.9±4.1 days (7-25 days)		P=0.075
Tube Thoracostomy duration	9.53±2.6 days (5-13 days)	6.2±1.76 days (3-9 days)		**P=0.0001;t=8.336;117 df**
Duration of air-leak	3.2±1.5 days (1-6 days)	2.5±1.0 days (1-4 days)		**P=0.0028;t=3.055; 117 df**
Blood volume drained	547±315ml; range 120-1500 mls	496±260ml; 120-950 mls		P=0.143; t=1.475; 117 df
Mortality due to tube thoracostomy	01/49 (2.0%)	00/70 (0.0%)	01/119 (0.84%)	P=0.416;RR=2.43;CI=1.96-3.01
Size of chest tube				
16 Fr	04/52 (7.70%)	00/78 (0.00%)		**P=0.024;RR=2.625;CI=2.101-3.280**
20 Fr	19/52 (36.5%)	02/78 (2.60%)		**P=0.0001;RR=2.988;CI=2.177-4.10**
24 Fr	12/52 (23.1%)	06/78 (7.70%)		**P=0.018;RR=1.867;CI=1.238-2.814**
28 Fr	17/52 (32.7%)	70/78 (89.7%)		**P=0.0001;RR=0.24;95%CI=0.15-0.37**

Table II: Tube thoracostomy complications (TTCs)

Tube Thoracostomy Complications (TTCs)	Group A	Group B	Total	P Value; RR; 95% CI
Technical				
Insertional & Positional:				
1. Blocked and kinked Tubes	9	1	***10***	***P=0.001;RR=2.51;CI=1.83-3.45***
2. outside triangle of safety	9	0	***9***	***p=0.000;RR=2.81;CI=2.21-3.57***
3. Intraparenchymal placement	8	1	**9**	***p=0.003;RR=2.44;CI=1.75-3.40***
4. Intrafissural placement	4	2	**6**	p=0.216;RR=1.72;CI=0.94-3.16
5. Loose connection between chest tube and	4	0	***4***	***p=0.024;RR=2.63;CI=2.10-3.28***
drain	3	0	***3***	*p*=0.062;RR=2.59;CI=2.08-3.23
6. Last hole extra-pleural	3	0	**3**	p=0.062;RR=2.59;CI=2.08-3.32
7. Extrapleural placement	3	0	**3**	p=0.062;RR=2.59;CI=2.08-3.32
8. Purse-string suturing	2	0	**2**	p=0.158;RR=2.56;CI=2.06-3.17
9. Mediastinal position	1	0	**1**	p=0.417;RR=2.43;CI=1.96-3.01
10. Pulmonary artery injury	1	0	**1**	p=0.400;RR=2.53;CI=2.04-3.13
11. Intra-abdominal placement				
Total	47 (92.2%)	4 (7.8%)	***51(100%)***	***p=0.0001;RR=11.75;CI=4.57-30.21***
Infective:	4	1	**5**	
1. Thoracostomy wound infection	2	0	**2**	p=0.157;RR=2.08;CI=1.27-3.41
2. Loculated Empyema Thoracic				p=0.158;RR=2.56;CI=2.06-3.18
Total	**6 (85.7%)**	**1 (14.3%)**	***7 (100%)***	***p=0.016;RR=2.29;CI=1.57-3.35***
Miscellaneous:	8	2	**10**	
1. Incomplete lung expansion on day 5	5	1	**6**	***p = 0.014;RR=2.18;CI=1.48-3.22***
2. Massive Sub-cutaneous Emphysema	5	1	**6**	***p = 0.037;RR=2.20;CI=1.44-3.36***
3. Ventilator associated Barotrauma				***p = 0.037;RR=2.20;CI=1.44-3.36***
Total	**18 (81.8%)**	**4 (18.2%)**	***22 (100%)***	***p = 0.0001;RR=2.60;CI=1.85-3.65***
Overall Tube thoracostomy Complications (TTCs)	**71 (88.7%)**	**09 (11.3%)**	**80 (100%)**	***P=0.0001;RR=7.89;CI=4.24-14.67***

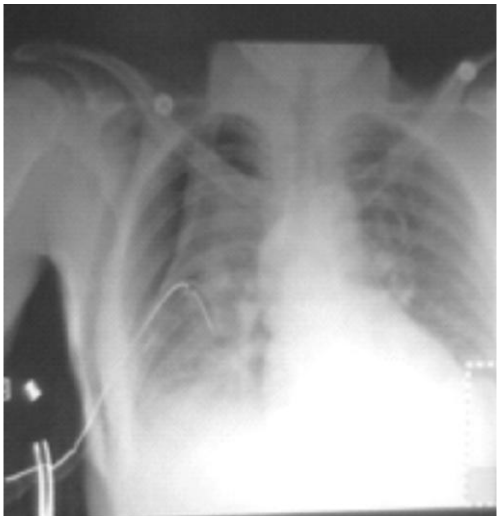

Figure I. Right Lung Collapse due to clamped chest tube with ipsilateral sub-cutaneous emphysema

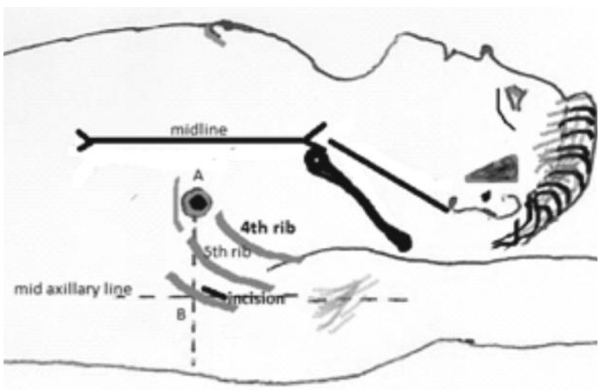

Figure II. Intersection of vertical line from the nipple (A) to the mid-axillary line- thoracostomy site is just above

Figure III. Right sided Tension Pneumothorax in a patient with positive pressure ventilation

DISCUSSION:

The objective of this study is to determine the difference in the frequency and types of complications among patients undergoing TT due to BTT as a result of RTA at DGH and surrounding health facilities. The hospital is a 200 bed Level II trauma center situated on the well travelled old Makkah road. In a report issued by the World Health Organization (WHO), Kingdom of Saudi Arabia has the highest road accident toll in the world among males aged 16 to 36 years amounting to 13 deaths per 1000 accidents or 18 deaths per day.[9,10]

Tube thoracostomy (TT) is a life saving procedure and should be part of the skills of any doctor working in emergency health facilities.[3,4,8] Yet, when it comes to performing a safe TT it is surprising that many emergency physicians lack knowledge of which tube size and type to use and where to site the TT.[4,11] Furthermore, the ability to recognize immediately any complications arising due to the procedure is a crucial aspect in the safe management of critically injured patients.[5,8] It is claimed that adequately trained doctors can safely perform TT with 3% early and 8% late complications.[4,12] Significantly higher complication rates (13% vs 6%, P<0.0001) were seen when TTs were performed by trainee physicians as compared to trained surgeons. Similarly, TTs performed outside a level 1 trauma care facility were found to have significantly more complications (38%; p=0.0001).[13] In another study seniority of the operator was found to be a significant factor in determining TTC (p=0.043).[14] In agreement with these observations, it is clear that the number of TTC in group A patients is significantly higher than in group B patients (88.7% vs 11.3%; p= 0.0001; RR=7.89;CI=4.24-14.67).

The very high overall TTCs rate (61.5%) identified is perhaps due to combining all minor, moderate and severe TTCs together. The reported TTC rates in various studies are between 6-38% with a majority of studies reporting a rate between 20-35%.[11,14] In most studies if a minor TTC is recognized and rectified early it is not counted as a complication. In our study, we have noticed that many of the avoidable, simple TTCs easily recognizable either clinically or radiologically were ignored by the primary treating physicians before transferring. Another reason for a higher complication rate seen in group A patients is that most patients were critically ill and a large number (12, 24.5%) were on ventilatory support (P=0.043;RR=1.71;CI=1.11-2.62). TTC rates have been found to be higher in the critically ill mechanically ventilated patients.[13,15,16]

Table II shows the number and types of simple technical TTCs. If these are excluded from our study the overall rate of TTCs falls from 61.5% to less than 45%. Unfortunately, among group A there were many other simple technical complications not listed. These were capped air vents (5), clamped bubbling tubes (3) (Figure I), visibly clotted tubes (3), a tube without an anchorage stitch and a drain connected to the air vent instead to the underwater seal resulting in lung collapse, difficulty breathing and severe subcutaneous emphysema (SE). In two cases the underwater seal was compromised. These technical complications show that the operators were not careful in assessing the functionality of the system or left the task to someone inexperienced. In most cases kinked tubes can be corrected by simply repositioning with radiological confirmation before transferring. These simple technical errors are counted as complications to stress the importance of providing quality care by avoiding catastrophic consequences.

TECHNICAL (INSERTIONAL & POSITIONAL) COMPLICATIONS:

A significant TTC is blocked drains**.**[16] In most cases this is due to using small caliber soft tubes or tubes getting kinked and clotted. If one is not vigilant in witnessing adequate column fluctuation and confirming tube position radiologically, this can result in inadequate drainage of blood, lung collapse or worse like a tension pneumothorax with grave consequences. This complication was seen a total of 10 times with a clear difference in group A (9) and B (1) (P=0.001; RR = 2.51; CI=1.83-3.45). Table I lists the frequency with which the various sized tubes were used in groups A and B. Tubes of 28 Fr were used in only 32.7% (17) of cases in group A as compared to 89.7% (70) in group B (p=0.0001; RR=0.240; 95% C.I=0.15-0.37). This is reflective of the higher number of complications in group A (p=0.0001). Chest drains should be made functional as soon as possible to avoid the above complication.

The triangle of safety is advocated as the site for insertion of the TT.[4,12] Nine (17.6%) tubes were sited outside the triangle of safety in group A. In another study[16] junior residents placed 45% of all chest tubes outside the triangle of safety with the most common error of choosing a site too low (20%). In another multi-center study from the U.K. only 58% of doctors working in cardiothoracic surgery inserted the drains according to guidelines. This percentage was even less in non-surgical specialties like cardiology and pulmonology.[4,5] It was also found that seniority of the doctor also affected the number who would site a drain correctly.[1,4,14] Intra-abdominal placement with the diaphragm, solid or hollow viscus injury results when the site chosen is too low. In this study, one patient (2%) in group A was found to have intra-abdominal tube which was removed on discovery. The patient recovered fully. In our study, we followed the simple method of dropping a vertical line from the nipple (point A) to the mid-axillary line (figure II), and sited the drain on or just above the intersection (point B), in the 4-5th space, avoiding muscle or nerve injury. This method can be safely followed in male patients with BTT who are self or mechanically ventilating. There was no intra-abdominal placement when we followed this method.

Intraparenchymal placement of TTs, was more frequent among group A patients (8; 15.7%), table II. All eight had trocar assisted TTs confirmed from the size of the skin incision and the referring doctor. One (2%) such complication was encountered in group B (p=0.003;RR=2.44;CI=1.75-3.40) despite using blunt dissection technique. It is recognised that using a sharp trocar to place a TT is prone to complications if safety measures are not followed.[7,12,17] Chest CT scan was not available at the peripheral facility and chest radiographs were available for 3 patients only. Five of these patients were on ventilatory support for head trauma or polytrauma. It is discouraged to perform trocar assisted TTs in such cases as the sharp tip can cause lung parenchymal injury if the lung remains partially expanded either due to positive pressure ventilation or adhesions between the chest wall and lung, due to any previous pulmonary infection.[16,17] The use of a trocar to create a track is strongly discouraged.[17] These patients are best managed with an open approach with careful blunt dissection and puncturing the pleura with a finger.[12,16] Patient should be disconnected from the ventilator or PEEP (positive end-expiratory pressure) turned off briefly as the pleural space is entered.[18,19] Adhesions should be gently brought down using a finger sweep and lung parenchyma avoided while siting the tube anteriorly or posteriorly.[12,17] Intra-parenchymal tube placement is sometimes not readily apparent. Any sudden increase in the air-leak or development of new subcutaneous emphysema with failure to evacuate air, are ominous signs of intra-parenchymal tube placement. In such an event, it is advisable to remove and reposition the tube and confirm its position with a chest CT scan.[19] Another precaution one should take while placing TTs is to be gentle and not use unnecessary force in placing tubes.[17]

Intrafissural tubes were seen in 4 (7.8%) and 2 (3.9%) cases in group A and B, respectively. There was no significant difference between the two groups (p=0.216). There are contrasting views on the effectiveness of tubes placed in fissures with recommendations to reposition them if not functional.[15,16]

Three patients in group A had tubes failing to reach the pleural cavity with another three patients having tubes with the last hole in the subcutaneous space. All 6 patients were on ventilatory support, three with significant flail segments. Three of these patients had increasing SE which resolved gradually over 48 hours once the tubes were repositioned. Multiple rib fractures and an unstable chest wall are reported to be among etiological factors predisposing to this complication.[13] It is important to emphasize that in artificially ventilated patients who are fully sedated or paralyzed the normal column fluctuation in the drainage system is not evident and the clue to this mal-position is the length of the tube outside the chest or radiological evidence.[20]

Purse-string sutures to anchor the tube are no longer recommended as they produce skin necrosis, infection, unsightly scars and fail to prevent air-leaks.[12,16] Three tubes (5.9%) in group A were anchored using this method, which lead to wound infection. All tubes in group B were anchored with stout non-absorbable mattress sutures. Only one patient had wound infection.

Mediastinal placement of TT seen in up to 14% of mal-positioned tubes is more likely in critically injured patients with pre-existing pulmonary disease like COPD or thoracic cage anomalies.[21] Contralateral pneumothorax, major vascular, cardiac, esophageal, and nerve injuries can result in such cases.[16,21] Literature identifies trocar TT as a risk factor leading to these complications.[15,16,21] Mediastinal placement of TT was seen in 2 patients (3.9%) in group A and none in group B. Best prevention is by avoiding Trocars, keeping an adequate length of the tube outside the chest wall and confirming the tube position with a CT scan.

Serious TTCs like pulmonary artery injury are reported at a rate of 2-3% and most are due to the use of trocars. Definitive management is surgical.[16,22] When there is brisk hemorrhage in the thoracostomy drain, pulmonary vascular injury should be suspected if the tip of the tube lies in or beyond midline.[22] Pulmonary artery injury was seen in one patient (2%) in group A. This 60 year old poly-trauma patient on ventilator support with multiple co-morbidities was transferred to our hospital in extremis. The unclamped chest tube showed a stream of bright red blood with 1500 mls of blood in the bottle. Emergency thoracotomy was performed with a left pneumonectomy but the patient could not be salvaged. The trocar tube had lacerated the partially adherent left lung and the left pulmonary artery. If there is any suspicion of major vessel injury and a transfer is in process, it is recommended to clamp the chest tube to promote clotting and stoppage of bleeding.[23]

INFECTIVE COMPLICATIONS:

A number of TTCs are identified as risk factors leading to empyema formation. These are contamination of the pleural space due to failure to follow aseptic technique, non-functioning tubes due to blockage and mal-position, multiple chest tubes, and placing new tubes through previous infected thoracostomy incisions. The duration of thoracostomy, length of ICU stay and presence of retained hemothorax and nosocomial infection are factors directly increasing empyema rates in TT patients.[24] A higher injury severity score (ISS)(31.4±26) as opposed to a lower score (22.6±13; P=0.03) was found to have a higher incidence of empyema in BTT patients.[16,25] Although a higher ISS was evident in group A patients (24.4±3.4), the difference in empyema rates was not found to be significant (p=0.074). Similarly, TT duration, length of ICU or hospital stay had no impact on empyema rates in the two groups. The routine prophylactic use of antibiotics for TTs in cases of BTT has not been supported in various randomized controlled trials.[1] We followed the latest guidelines recommending the use of prophylactic antibiotics as risk of empyema due to TT is reduced by 5.5-7.1%.[12,16] Two cases of loculated empyema were seen in poly-trauma patients in group A with residual hemothoraces due to mal-positioned and blocked thin bore chest tubes. It is notable that none of the patients in group B had empyema as a complication.

MISCELLANEOUS COMPLICATIONS:

In group A there were 8 instances of incomplete lung expansion with recurrent air leak in seven patients on day 5 as compared to only 2 in group B. Seven tubes among these 8 were found to be of smaller size ranging from 16 Fr (3 tubes) to 20 Fr (4 tubes). Patients were dyspnoeic and took longer to mobilize. Once these chest tubes were replaced with larger sized tubes (24-28 Fr) the leak gradually disappeared and the lungs expanded as patients became better mobilized.

TT induced subcutaneous emphysema (SE) is not a rare occurrence in trauma patients, especially when trocar tubes are used in a closed thoracostomy method. At most instances, the parenchymal injury to the lung heals expectantly, with spontaneous resolution of the SE. Injury to the bronchus or esophagus cannot be ruled out and definitive care provision is necessary to avoid long term morbidity and mortality. This complication is seen with prolonged drainage, mechanical ventilation with PEEP or auto PEEP, mal-position or multiple TTs on the same side, tube blockage and side hole migration.[26] Larger chest drains on low suction are useful in SE resolution. High-flow oxygen therapy has been shown to speed resolution by resorption of nitrogen from the distended tissues.[27] Other innovative modalities are rarely needed. In the present study, 5 such complicated TTs were encountered as opposed to only one in group B (p = 0.037;RR=2.20;CI=1.44-3.36). Trocar use (3), small caliber tubes (4), kinked and slotted tubes (4) and accidental dislodgement (1) were identified as causes. In one patient erroneous connection of the drain to air vent lead to this complication. All patients recovered over a period of 36-48 hours after correction of the cause. A similar incidence of pneumothorax and SE due to barotrauma was seen in the two groups (A=5; B=1).

Residual post extubation pneumothorax is avoided by confirming full lung expansion, the absence of air-leak in the underwater seal and avoiding premature extubation.[3,12,16] It was our practice to remove chest tubes after full explanation of the valsalva maneuver to the patients.[16] Others remove the chest tube at end-inspiratory phase with suspended breathing as the wound is stitched tight.[12] We encountered clinically insignificant residual pneumothorax in 5 (4.2%) patients. One patient required reinsertion of the chest tube and made a full recovery.

This study has clearly identified TT as an operator-dependent invasive procedure. In one study the author has concluded that there is an almost tenfold increased risk of TT when performed by individuals other than a thoracic surgeon.[11] Our results are not different. A strong relationship exists between iatrogenic TTCs and adequacy of operator training. There are several other known TTCs like hemorrhage, nerve injuries and organ perforation injuries, none of which were encountered in this study.

Tube thoracostomy is a life saving procedure and its morbidity is a direct result of serious iatrogenic intra-thoracic or intra-abdominal organ injuries.[5] The gravity and extent of the injury, the speed with which it is recognised and the urgency with which it is repaired play a vital role in prognosis. In critically injured, poly-trauma patients with BTT, the role of TT is both prophylactic and therapeutic. In peripheral centers where CT is not available, a small pneumothorax can easily escape detection and has the potential to quickly develop into a tension pneumothorax (Figure III) when the patient is on positive pressure ventilation. A prophylactic TT in preparation of transfer of the patient to a higher center is suggested to avoid such a catastrophe. A chest drain that is still bubbling should never be clamped as this may convert a simple pneumothorax into a tension pneumothorax.[27]

The scope of this study is limited as it does not particularly look at the patient factors related to TTCs. It tries to highlight the differences in care provided to patients in terms of a safe TT when performed by non ATLS certified physicians and a certified, trained thoracic surgeon.

CONFLICT OF INTEREST: None

CONCLUSION:

The study clearly demonstrates a significant difference in the frequency and type of TTCs for BTT due to RTA, between group A and B patients. There is an urgent need to devise targeted training modules for emergency physicians performing TTs in health care facilities around DGH. Emergency physicians need to recognize and correct easily amenable TTCs before transferring critically injured patients. The use of small caliber chest drains with trocars is associated with most TTCs and their use is strongly discouraged in BTT patients.

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