Auditing of Intercostal Tube Insertion (Thoracostomy) in Abbassia Chest Hospital, Cairo, Egypt

Sahar Y. Ibrahim*, Samar M. Abdel Sattar**

ASTRACT: Background: Intercostals tube/catheter insertion is an invasive procedure usually done outside operating theater. If it is inserted without full aseptic technique, it will lead to a serious infective complication (EMPYEMA). A protocol of insertion must be designed, instructed and followed to do it safely to decrease rate of complication. All personnel involved in insertion of chest drain should be adequately trained and supervised. **Objective:** This study aimed to detect the compliance of chest tube insertion procedures with the standard Guideline and to detect the relation between, actual practice and occurrence of infection (superficial and deep). **Methods:** A descriptive prospective study-using auditing technique was conducted at Abbassia chest diseases hospital (one of the Ministry of Health hospitals with a total of 700 beds). Surgical and ICUs were chosen, a 119-inserted tubes were observed while they were introduced. Those were of patients admitted during a period of 6 months. **Results** indicated that the infective complication was 66.4%, while complications other than infection were 33.6%. The study discussed the relation between different practices as ; washing hands before the insertion, wearing personal protective equipment (PPE), using sterile tools, insuring sterility of dressing, avoiding touching environment while putting on sterile gloves and the occurrence of infection (superficial and deep).

Key words: Intercostals tube / catheter, invasive procedure, aseptic technique, Empyema, chest drain

INTRDUCTION

Tube thoracostomy is the insertion of chest tube in the pleural space to drain air, fluid, blood or pus around the lung to allow it to expand and to restore its function.[1]

There are several reasons for insertion.[2] Pneumothorax is the most common reason. It is either caused by external air entering the pleural space or by air in the lungs entering through a hole in the pleura. The air disrupts the normal negative pressure within the lungs (The vacuum that keep it expanded). Loss of

*Public health, Faculty of medicine, Cairo university
**Infection control team Abbasia chest hospital

this vacuum causes its collapse leading to respiratory disturbance. Haemothorax is another reason. It is the accumulation of blood in the pleural space. Usually it is a combination of both air and blood hence called Haemopneumothorax. While Empyema is a collection of purulent material in the pleural space.

The chest tube and drainage system unit composed of a sterile, flexible, non-thrombogenic catheter of vinyl or silicone. The diameter of the selected tube depends on the patient's condition. Small diameter is adequate for a pneumthorax. But a wider tube is needed to drain accumulated fluid.[3] The tube's proximal end, which rests in the pleural space has several eyelets -small holes- to drain air or fluid and to prevent catheter occlusion. The distal end connects to catheter drainage unit (CDU). All CDUs incorporate three basic components a collection chamber, a water seal chamber and a suction-control chamber.[2]

Equipment used for insertion: chest tube, closed drainage system including sterile water if underwater seal will be used, sterile gloves and goggle, sterile drapes and gown, sterile dressing, syringes and needles (21-25 gauze), scalpel and blade, suture e.g. (1 silk), instrument for blunt dissection e.g. curved clamp. Local anesthesia e.g. Lignocaine 1% or 2% must be given.[4] The following procedures must be performed before inserting the chest drain: taking consent, giving premedication, confirmation of the site of insertion clinically and on radiography, positioning of the patient, determine size of the chest tube. While during insertion we have to: follow aseptic technique and wear PPE, put local anesthesia, blunt dissection if required, secure drain, suture and underwater seal system.[5] Potential complication of a tube thoracostomy including bleeding, inadequate drainage of fluid or blood, inadequate re-expansion of the lung. Improper positioning of the tube and

infection (superficial or deep). The shorter the time a patient has a chest tube inserted, the lesser the risk of complications.[4]

This study aimed to detect the compliance of the procedures used during chest tube insertion, conforming to the British Thoracic Guideline, and to detect the relation between, actual practice and occurrence of infection (superficial and deep). Moreover, to prepare a protocol for proper practice that should be used during chest tube insertion, in order to improve the quality of care.

METHODS

Study setting: This study was conducted at Abbassia chest diseases hospital in surgical and ICUs. The surgical sector has 32 beds; 8 beds in each room, one examination room, and one procedural room. There is only one sink in the procedural room, one cabinet in which supplies are kept and one procedural table. In the ICU, there is 3 sectors each has 5 beds and one sink, and 4 isolated rooms with one sink in each. All supplies are temporary stored in a special ICU storage area. In the ICU, the insertion procedures were done at bedside.

Study population: All patients admitted to surgical or ICUs requiring chest tube insertion. Both sexes, and all ages were included with exclusion of cases diagnosed as empyema on admission. A total sample of 119-inserted tube were subjected to our observational study.

Study design: This is a descriptive study-using auditing as a tool for monitoring of practice during a period of 6 months**.** An auditing check list was prepared to observe the insertion procedure of intercoastal catheter (Chest tube) in patients who are indicated for insertion outside the operating theatre and to follow up the patients until the removal of the tube. The auditing checklist was a modification of the one pre-prepared for insertion of intercostals catheter designed

by Queensland intercostals catheter collaborative according to the British thoracic society standards of care committee (BTS). The checklist was piloted and tested for its reliability and validity and was modified according to the pilot results to cover the following items to cover the following items:

1- What was indication for inter-costal cannula (icc) insertion? 2-Was the relevant consent form completed? 3-Was icc insertion documented, signed & dated in patient record by doctor who inserted it? 4-Was local anesthetic aseptically used? 5-Was analgesia prescribed & given as required? 6-What is size of icc used? 7-Is a wound closure suture present? 8-Is the drainage braced appropriately to prevent drag? 9-Is an adequate anchoring suture present?

10. Are all tube connections visible & secured lengthwise? 11-Did health care worker (HCW) do surgical hand wash (HW) before procedure? 12-Did HCW wear new disposable sterile gloves when conducting procedure? 13-Did HCW wear sterile gown, mask & goggle? 14-Did HCW touch any environmental surface after putting on PPE before procedure? 15-Did HCW disinfect patient skin Correctly? 16-The procedural table is cleaned & disinfect between patient? 17-Did HCW use sterile tools & instruments? 18-Ensure the sterility of tools & instruments. 19-Ensure the sterility of Dressing & Drops 20-Did HCW use sterile water in ICDU? 21- Were complication other than infection of ICC documented in pt record(ICC blocked tube/tubing dislocation/broken bottle)? 22-Is sign of superficial infection (wound erythema/pain/pus) present? 23-Is deep infection Empyema present?

Data within the auditing checklist were mainly obtained from the observation of the insertion procedures and of the wound site as well as from patient's medical record.

Collection of data

Each surgical unit and ICU was visited after administrating agreement at different times a day, for all days of the week by external observer (high qualified three nurses of infection control team in addition to the researcher).

These nurses were trained on data collection in two weeks before the study time.

The audit was conducted using the designed check list, A designed form about the existence of infrastructure supplies

STATSTICAL ANALYSIS

The SPSS package version 15 was used for statistical analysis. Aseptic technique score was calculated as follow: Sum of the seven questions represent aseptic technique steps used to insert intercostals tube (Q4,Q11,Q14,Q15,Q16,Q18,Q19), each question took score one if the procedure properly done and took zero if not, (maximum score 7). T-test used to compare between mean score of aseptic technique steps after dividing the patients according to complications into two groups; a group suffered from one of the complications and the other group not; as for example group with superficial infection and other group without. Scoring system was used also to compare mean of suturing score (Q7,Q8,Q9) concerning superficial infection and Empyema. Chi square test was used to compare qualitative variables while Fisher exact test was used if there was value less than 5.

RESULTS AND DISCUSSION

Infrastructure supplies

1. <u>Available Sinks</u>: Two sinks were available in the surgical unit, one inside the procedural room and another one inside the examination room. There is no sinks in the inpatient's bed area, seven sinks in the ICU.

2. <u>Available</u> <u>Supplies</u>: Soap, alcohol gel, povidine iodine, sterile dressing, single use clean gloves, sterile gloves, goggles, gowns, Intercostals tube different sizes, saline were all within adequate amount for three successive months.[8]

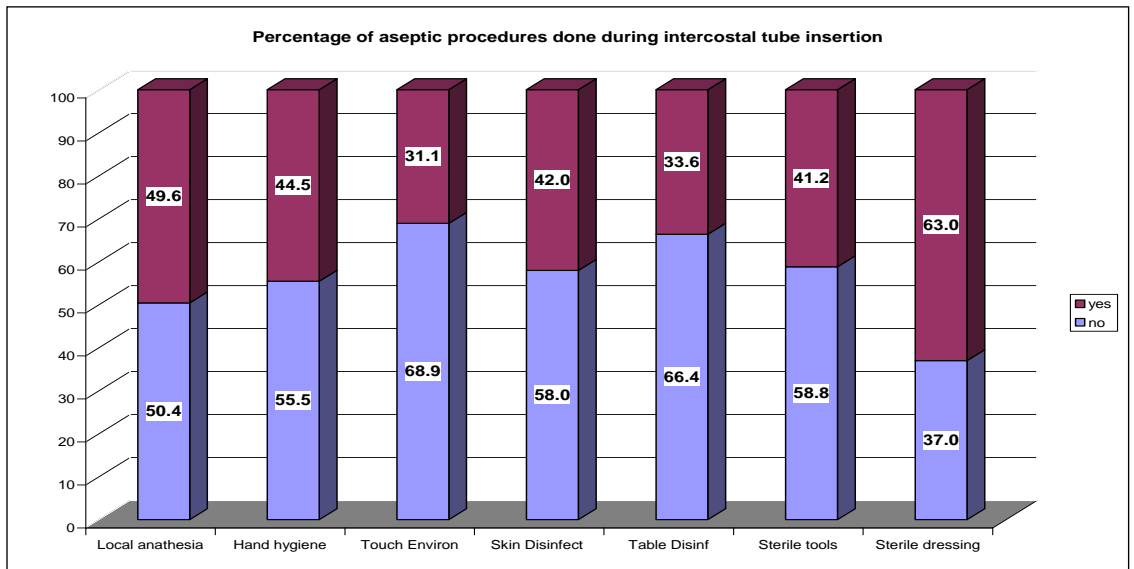Observation of 119 inserted intercostals tube revealed

Figure 1: Percentage of compliance with aseptic procedure techniques performed during intercostals tube insertion

Table 1: Percentage of non-compliance of health care workers with aseptic technique

Aseptic technique according to British Thoracic Guideline	% of non-compliance
1- No-touch technique after wearing sterile gloves	68.9
2- Cleaning and disinfections of the procedural table	68.4
3- Hand hygiene before the procedure.	66.6
4- Aseptic local anesthesia	60.4
5-Sterility tools and instruments	58.8
6- Sterility dressing and drapes	37.7

Table 2: Comparison between patients with superficial infection at the site of tube insertion and others without concerning aseptic techniques during insertion of intercostals tube

	Superficial infection		No superficial infection		P-value
	no =48	(%)	no =71	(%)	
Hand Hygiene not followed	37	(77)	29	(40.8)	0.000*
Disinfections of skin not correctly done	29	(60.4)	40	(56.3)	0.658*
Sterile dressing Not used	20	(41.6)	24	(33.8)	0.383*

*Using Chi-square test with significant level at P value <0.05

Table 3: Comparison between patients with Empyema and others without concerning aseptic techniques during insertion of intercostals tube

	No Empyema		Empyema		P-value
	no=38	(%)	no =81	(%)	
Hand Hygiene not followed	23	(60.5)	43	(53.1)	0.446*
Disinfection of skin not correctly done	26	(68.4)	43	(53.1)	0.114*
Sterile dressing Not used	25	(65.8)	19	(23.5)	0.000*

*Using Chi-square test with significant level at P value <0.05

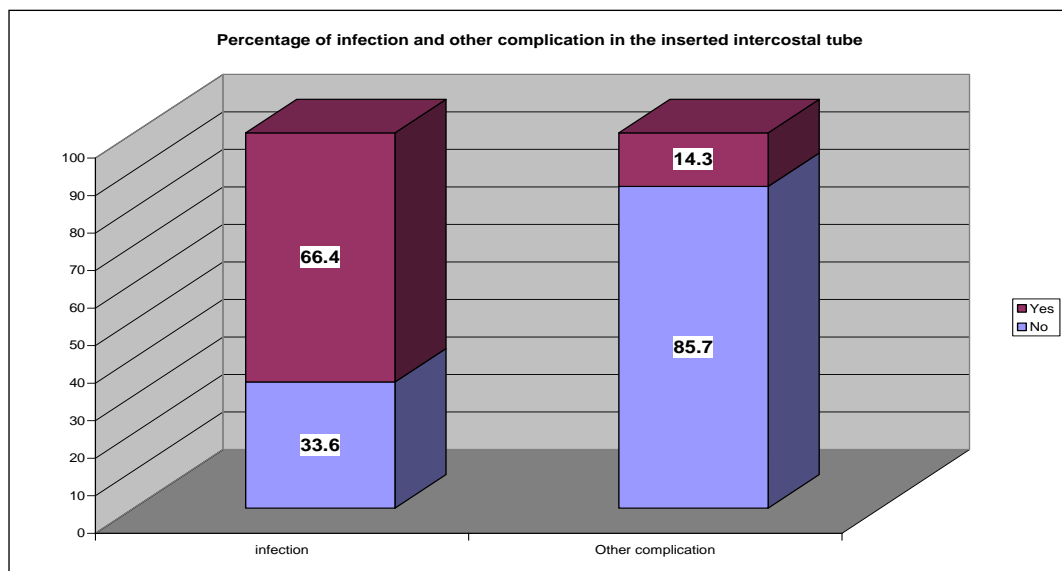**Figure 2: Percentage of both infection and other complications(blocked tube/tubing dislocation/broken bottle) in patients with inserted tube**

Percentage of different types of tube associated infection

6%

34%

34%

26%

- no infection
- Empyema
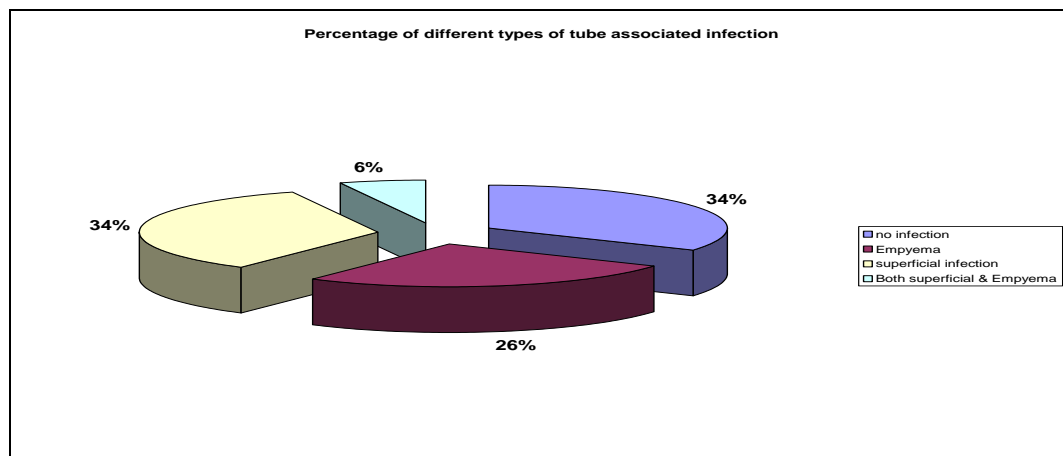- superficial infection
- Both superficial & Empyema

Figure 3: Percentage of different types of tube associated infection

Table 4: Comparison between mean score of aseptic procedures concerning superficial infection, Empyema and complications (maximum score7)

Aseptic procedures score	Present		Absent		P value
	no	Mean ± SD	no	Mean ± SD	
Superficial infection	48	2.6 ± 1.4	71	3.4 ± 1.6	0.005*
Empyema	38	2.50±1.24	81	3.30±1.60	0.004*
Other Complications	17	3.11±1.61	102	3.03±1.54	0.85*

*Using T-test with significant level at P value <0.05

Percentage of PPE wore during insertion procedure

20%

43%

37%

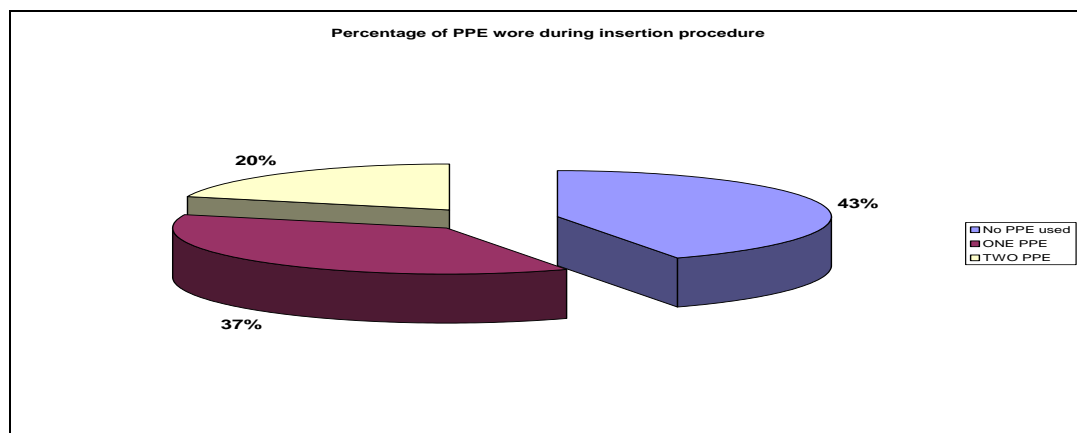- No PPE used
- ONE PPE
- TWO PPE

Figure 4: Percentage of compliance of health care workers to wear personal protective equipment (PPE) during intercostals tube insertion

	Empyema		No Empyema		P-value
	no=38	(%)	no=81	(%)	
Sterile gloves Not used	28	(73.7)	28	(34.6)	0.000*
Sterile PPE other than gloves Not used	31	(81.6)	59	(72.8)	0.301*

Table 5: Comparison between using of sterile gloves and other PPE before intercostals tube insertion and occurrence of superficial infection at the site of the tube

	Superficial infection		No superficial infection		P-value
	no=48	(%)	no= 71	(%)	
Sterile gloves Not used	20	(41.7)	36	(50.7)	0.333*
Other sterile PPE Not used	41	(85.4)	49	(69)	0.041*

*Using Chi-square test with significant level at P value <0.05

Table 6: Comparison between using of sterile gloves and other PPE than gloves for intercostals tube insertion and occurrence of Empyema

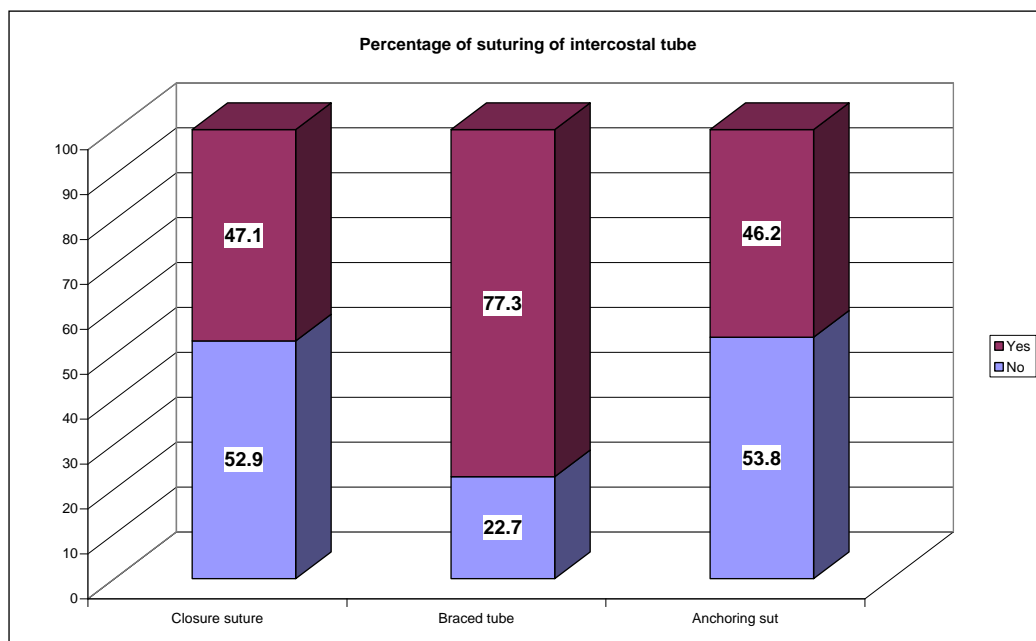*Using Chi-square test with significant level at P value <0.05

Figure 5: Percentage of suturing intercostals tube

Table 7: Comparison between number of patients had properly fixed tubes and patients had improperly or not fixed tubes concerning occurrence of superficial infection at the site of the tube, Empyema and other complications

Types of complication	Present			Absent			P-value
	Total no	Improperly or not		Total no	Improperly or not		
		fixed	no (%)		fixed	no (%)	
Superficial infection	48	45	(93.8)	71	54	(76.)	0.012*
Empyema	38	30	(78.9)	81	69	(85.1)	0.39*
Other complications	17	16	(94.1)	102	83	(81.3)	0.29*

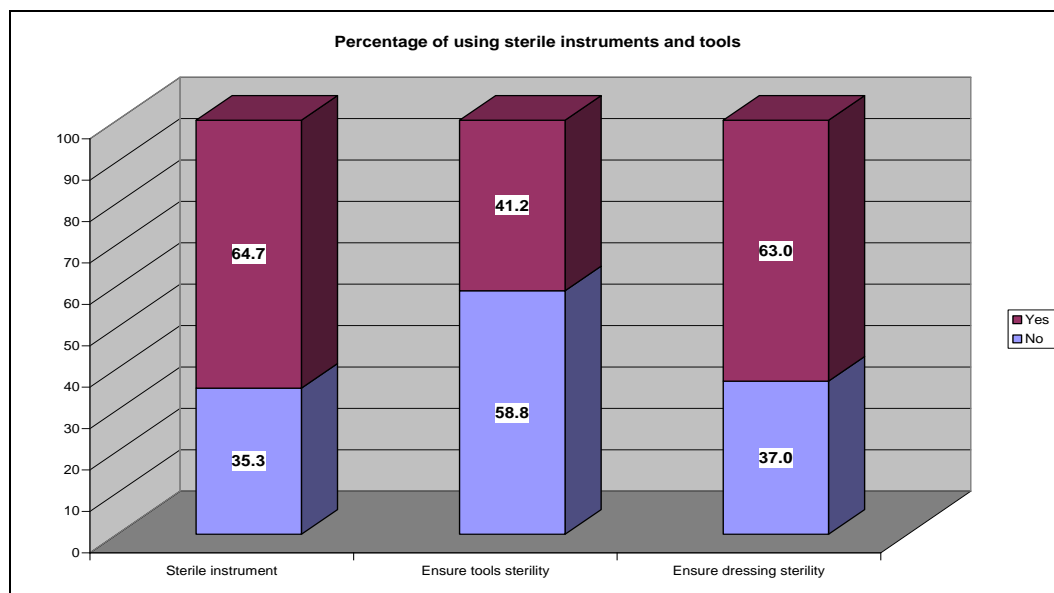*Using Chi-square test with significant level at P value <0.05

Figure 6: Percentage of using sterile instruments and tools during insertion of intercostals tube.

Table 8: Comparison between ensuring the sterilization of instruments and occurrence of superficial infection at the site of the tube, and Empyema

Types of complication	Present		Absent		P-value
	Total no	Improper instrument sterilization	Total no	Improper instrument sterilization	
Superficial infection	48	35 (72.9)	71	35 (49.3)	0.010
Empyema	38	31 (64.6)	81	39 (54.9)	0.001

Table 9: Comparison between asepsis during local anesthesia and occurrence of superficial infection at the site of the tube and Empyema

Types of complication	Present	Absent	P-value

	Total no	No aseptic technique during local anesthesia		Total no	No aseptic technique during local anesthesia		
		no	%		no	%	
Superficial infection	48	27	(56.3)	71	33	(46.5)	0.296
Empyema	38	23	(60.5)	81	37	(45.7)	0.131

Table 10: Comparison between using sterile water in inter costal drainage unite (ICDU) and occurrence of superficial infection at the site of the tube, Empyema and Complications

Types of complication	Present			Absent			P-value
	Total	Distilled water not used		Total	Distilled water not used		
	no	no	%	no	no	%	
Superficial infection	48	35	(72.9)	71	39	(54.9)	0.047
Empyema	38	34	(89.5)	81	40	(49.4)	0.000
Other complications	17	10	(58.8)	102	64	(62.7)	0.75
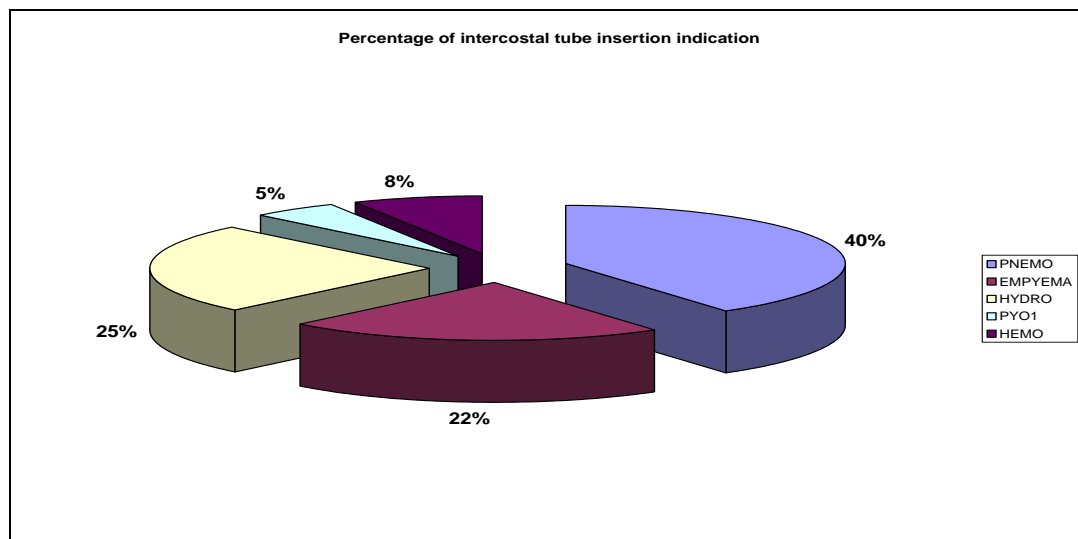
Figure 7: Percentage of intercostals tube insertion indications

Percentage of patient file documentation fulfilness
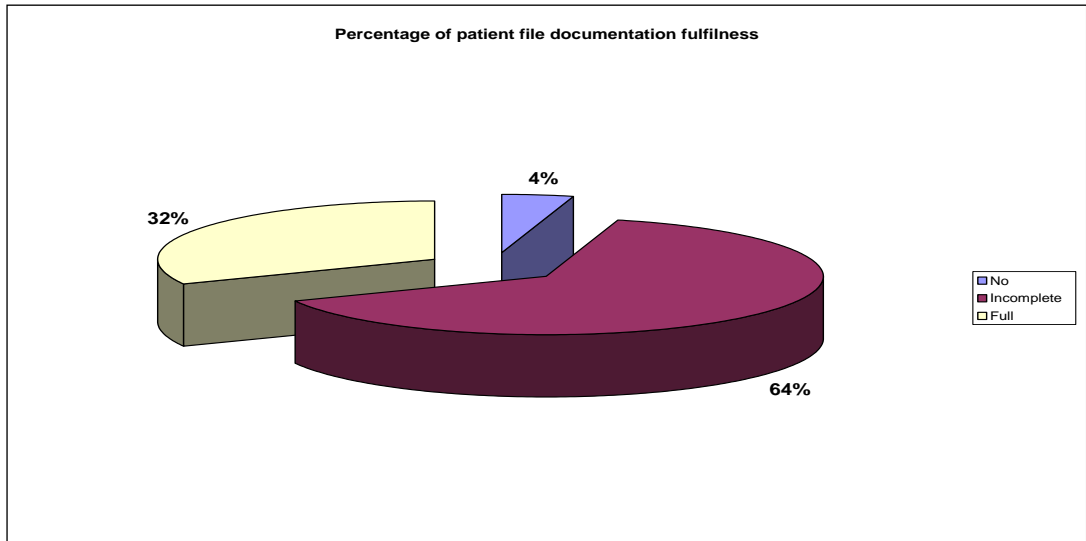
4%

32%

64%

- No
- Incomplete
- Full

Figure 8: Percentage of compliance with completion of patients' file documentation concerning intercostals tube insertion items

Chest physicians need to be capable of their safe insertion.[4]

DISCUSSION

The progress of modern medicine has been advanced in part by the wide use of invasive medical devices including chest tube/catheter insertion. In current hospital practice chest drains are used in many different clinical setting & doctors specially who work in ER, ICUs, surgical units &

Collop NA (1997) has been shown that trained physicians can safely perform tube thoracostomy with 3% early complication & 8% later.[6]

The nosocomial infection control committee in our hospital received many reports from the infection control members about the increased infection rate associated with chest tube insertion in

surgical department unit. Auditing showed major problems concerning complication of tubal insertion as shown in (figure2)

The percentage of complication other than infection is 33.6 while the percentage

of infective complication is 66.4.

The percentage of superficial wound associated infection equal 34% and deep infection (Empyema) represents 26% (figure3) and this is serious complication in contrast to Davis (1994).[7] study that showed no infective complication in 80 cases (100% of cases) as well as Millikan (1980) showed that Empyema rate following drain insertion is 2.4%.[9]

As a chest drain may potentially be in place for a number of days, aseptic technique is essential to avoid infective complication. Our study showed comparison between compliance of healthcare workers to different items of aseptic procedure. Touching environment after putting on sterile gloves & PPE

disrupting the sterile field having highest percentage 68.9%. More than half of the procedures done without hand hygiene is 55.5% (figure and table1).

Superficial infection occurs in 77% from those who didn't wash hands before the procedure which was significantly higher than those who wash hands (table 2).

Although patient skin preparation is essential component of aseptic technique as mentioned in national guideline (1st version 2003).[8] In our study, the percentage of incorrect skin disinfections is 60.4% yet there is no significant difference in occurrence of superficial infection concerning skin disinfections (P value = 0.65) as shown in Table 2.

BTS guidelines.[4] state that large amount of tape and padding are unnecessary and may impair chest wall movement or increase moisture collection. A transparent dressing allows the wound site to be inspected by the nursing staff for leakage or infection.[9] Aside from a

transparent dressing the chest tube shouldn't be taped to the dressing due to the risk of dislodgement of the intercostals cannula when the dressing is changed.[2] The percentage of those used sterile dressing during the procedure was 63.0%,. There is no statistical difference concerning using sterile dressing and superficial infection as P value =0.38 (Table2).

In our study Empyema occurred in 68.4% from all who didn't disinfect skin correctly with P value = 0.114 from those disinfect the skin (table 3) Empyema occurs in 65.8% from those who did not use sterile dressing with P value = 0.000. (Table 3)

In our study, there is statistical significant difference between mean score of practice following aseptic procedure concerning patients with superficial infection with p value = 0.005, and also patients with empyema with P value = 0.004. While other complications than infection didn't show significant difference in following aseptic practice (P value =

0.85) (table 4). The personal protective equipment (PPE) including protective eye wear should be worn, for ICC insertion.[4] in our study the compliance of wearing PPE is very poor as seen in figure 4.The percentage of using any PPE is 43% while the use of gloves represented only 20%, and the use of two different PPE was 37%. Mellor (1996) said that a gloved finger should be inserted into the plural cavity.[10]

In our study 41.7% from those who did not use sterile gloves suffered from infection with no significant difference with those who used sterile gloves. (P value =0.333). (Table 5)

Superficial infection occurred in 85.4% from those who didn't use PPE which significantly higher than those who used PPE, P value = 0.041(Table 5).

Deep infection (Empyema) occurred in 73.7% of those who didn't use sterile gloves which significantly higher than those who used a sterile gloves. P value =0.000 (Table 6).

While using sterile PPE other than gloves, had no significant difference with the occurrence of Empyema. P value=0.301 (Table 6).

As regarding securing the drain and suturing, a wound closure suture should be inserted before blunt dissection.[11] A strong suture as silk is appropriate.[6,21] and the drain should be secured after its insertion to prevent its falling out.[4] A simple technique of anchoring the tube has been used[4]. In our study (fig.5) 52.9% had absent closure suture, 53.8% had absent anchoring suture, while 22.7% of the tubes were un-praised.

After dividing the patients into two groups according to tube fixation; first group had properly fixed tube and the second group had improperly or not fixed tube, 93.8% of the patients with superficial infection had improperly or not fixed tube versus 76.1% without superficial infection had improperly or not fixed tube , P value =0.01 which indicated significant

difference. While occurrence of empyema and complication other than infection had no statistical significant difference concerning tube fixation procedures (P value =0.39 - 0.299 respectively) (Table 7).

The study showed the usage of unsterile tools was 58.8% while in 37.0% of the patients, unsterile dressing and drapes were used and lastly the usage of unsterile instruments was 35.3% (fig.6). Superficial infection and Empyema occurred in 72.9% , 64.6% respectively from all who didn't insure using of sterile instruments which differ significantly from all who insure that, with P value =0.01, 0.001 respectively (table 8).

Local anesthesia is infiltrated into the site of insertion of the drain, a small gauge needle is used to raise a dermal bleb before deeper infiltration of the intercostals and the pleural surface.[12] There was no significant difference between patient who developed superficial infection or empyema concerning aseptic technique used during

local anesthesia before insertion (P value= 0.29 & 0.131, respectively) (Table 9)

Distilled water should be used in ICDU [13]. In the present study superficial infection occurred in 72.9% and Empyema occurred in 89.5% in those who didn't use distilled water with P value =0.047 &0.000, respectively. While complication other than infection occurred in 58.8% when using un- distilled water with no significant difference with those who used distilled water (P value =0.758) (Table 10)

About indication of insertion, Figure 7 showed the most frequent cause of insertion is pneumothorax 40%. After auditing the completeness of patients files documentation only 32% were properly filled. Figure 8.

CONCLUSION AND RECOMENDATION

Intercostals tube / catheter insertion is an invasive procedure usually done outside operating theater. If it is inserted without full aseptic technique it will lead to a serious infective complication (EMPYEMA).

A protocol of insertion must be designed, instructed and followed to do it safely and to decrease rate of complication. Moreover, all personnel involved in insertion of chest drain should be adequately trained and supervised

Full aseptic technique should be employed during catheter insertion, sterile water should be used. Prior to commencing chest tube insertion the procedure should be explained fully to the patient and consent recorded

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