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Benefits and Complications of the New Single Hole Chest Tube: Study of 100 Cases

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ABSTRACT

Background: *Chest tube is indicated in many situations and can be life saving in certain patients. Some of the chest tube complications are related with the number of its holes. Tube length is associated with other complications. The present study was performed with the aim of comparing two types of chest tubes, one with several holes and the other with a single hole.*

Materials and Methods: *A randomized clinical trial was performed on 100 patients in Imam Hossein Hospital. Patients were randomly divided into two groups, and each group used one type of tube, one with several holes and the other with a single hole. Radiographic pattern, duration of use, complications, and need for a second tube were compared in the two groups.*

Results*: There was no significant difference between the two groups regarding age, sex, duration of use, reason for tube insertion, clinical findings and laterality of chest tube placement. Hemothorax was significantly observed more frequently in radiographs obtained 1 hour and one-day later. In the 3rd day, two groups were similar in terms of hemothorax. Inadequate drainage was a complication observed in those with single hole tubes. Kinking was a complication seen in patients with multiple hole tubes. None of the patients needed second tube placement.*

Conclusion: *There was no significant difference between the two tubes regarding their function but hemothorax occurred more frequently in those with multiple hole (conventional) tubes. Thus, we recommend the use of single holes tubes. Mass production of these tubes is cost effective considering less production costs and similar function.* ***(Tanaffos 2007; 6(2): 27-31)***

Key words: *Chest tubes, Pneumothorax, Penetrating trauma.*

INTRODUCTION

Thoracostomy tube can be life saving (1). Chest tubes are inserted to empty the pleural space of air or fluid prohibiting full lung expansion (2). The most common life- threatening complication of blunt and penetrating thoracic injuries is hemothorax.

Approximately 85 percent of these patients can be treated definitively with a chest tube. In almost all types of penetrating traumas, placement of a chest tube is mandatory. In case of blunt trauma if pneumothorax is less than 30% and vital signs are stable, a conservative approach can be taken based on surgeons' judgment. Chest tube insertion with extended indication is not mandatory for all blunt trauma patients. In many cases of pleural effusions and also following completion of any thoracic

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surgery, a chest tube is placed. In cases with blood, air, pus or fat collection as the result of different diseases or surgeries, chest tube placement is indicated.

A nonfunctioning chest tube is a liability to the patient because of discomfort and the risk of dislocation from the skin wound into the pleural clot. Especially in case of penetrating trauma, a hemothorax draining adequately through intercostal catheters may convert into empyema. An additional hazard is the organization of residual clot to develop a fibrothorax (4).

Some chest tube complications are related with the number of its holes.

Subcutaneous emphysema (due to air leak through the holes) is one of these complications. Tube length is associated with other complications, such as kinking which is clearly more probable in long tubes.

This study was performed with the aim of comparing two types of chest tubes; one with several holes and the other with a single hole (made by SUPA company) in terms of radiographic findings, duration of use, complications, and need for a second tube. Single hole tubes are acceptable considering their function and complications, mass production of them will reduce costs and burden imposed to patients and national economics.

MATERIALS AND METHODS

This was a randomized clinical trial performed on 100 patients who had undergone thoracostomy tube insertion due to different causes. These patients were emergency and elective cases of Imam- Hossein Hospital in whom, chest tubes were indicated. Patients were selected consecutively and assigned randomly in one of the two groups. There were 2 types of chest tubes:

1) Conventional chest tubes that are used in all centers and have several holes were used for group 1 patients.
2) Special tubes with the same diameter, single hole and shorter length. The hole is located in 2 cm from the tip. These tubes were used for group 2 patients.

Special single hole tubes were made to special order of authors of this article and had the same range of price compared to conventional chest tubes that are used in all centers.

Chest tubes were indicated in all patients. Reasons of chest tube placement included penetrating and blunt trauma resulting in pneumothorax or hemothorax and thoracotomy surgery (e.g. esophageal cancer and etc). The surgeon decided whether the thoracostomy tube was required.

All patients requiring chest tube were included in the study and no one was excluded.

Chest tube placement

In thoracotomy cases the tube was placed in the space below the thoracotomy incision. In other cases, tubes were placed in the 5th intercostal space in anterior midaxillary line. The sizes of tubes were 28, 32 and 36 according to patients' stature.

Table 1. Site of chest tube insertion.

Site	Multiple hole tube group (No)	Single hole tube group (No)
4th space	6	8
5th space	32	30
8th space	4	5
9th space	8	7

Collecting data

Data regarding age, sex, reason of chest tube placement, findings of initial examination, laterality, radiographic findings one hour, one day and 3 days after the operation, complications (if any), and need for second tube were recorded in special datasheets. Radiographs were interpreted by the same radiologist. The exclusion criteria were less than

100 cc drainage per day (5, 6, 7) and absence of pneumothorax for at least 24 hours (4, 5, 6). The need for a second tube was determined by the surgeon.

Statistical analysis: Data were analyzed by using SPSS Ver.11.5 software, Chi-square and Mann-Whitney tests. Ethical considerations were followed as well.

RESULTS

Patients using single hole tubes were in the age range of 17-67 years with a mean age of 34.74± 13.56 yrs. While, the mean age of patients with multiple hole tubes was 34.28 ± 13.52 yrs. Mann-Whitney test showed that there was no significant difference in terms of age between the two groups (p= 0.746).

Duration of use was between 2-7 days in those with single hole tubes (mean 2.78 ± 1.03 days). Mann- Whitney test showed that was no significant difference in regard to duration of use between the two groups (P= 0.798).

Among patients using single hole tubes, 11 patients (22%) were females and 39 patients (78%) were males. Among those using multiple hole tubes, 10 patients (20%) were females and 40 patients (80%) were males. There was no significant difference between the two groups regarding gender distribution (p= 0.806).

Reasons for chest tube insertion are shown in table 2. The most common reason in both groups was penetrating trauma involving 31 patients (62%) in each group. There was no significant difference between the two groups regarding the reason of chest tube insertion (p= 0.951) and clinical findings (p= 0.231).

Among those with single hole tubes, in 24 patients (48%) the chest tubes had been placed on the right side while in 26 patients (52%) they had been placed on the left side. Among those with multiple hole tubes, in 25 patients (50%) the chest tubes had been placed on the right side while in 25 patients (50%) they had been placed on the left side. There was no significant difference between the two groups regarding the laterality of chest tube placement (P= 0.841).

Table 2. Reasons for chest Tube insertion

	Multiple hole tube group	Single hole tube group
	No (%)	No (%)
Reasons		
Penetrating trauma	31 (62)	31 (62)
Blunt trauma	6 (12)	7 (14)
Thoracotomy due to esophageal cancer	8 (16)	7 (14)
Thoracotomy due to penetrating trauma	-	1 (2)
Thoracotomy due to vertebral TB	2 (4)	2 (4)
Thoracotomy due to scoliosis	1 (2)	1 (2)
Thoracotomy due to vertebral fracture	1 (2)	1 (2)
Thoracotomy due to severe hemothorax	1 (2)	-
Clinical findings		
Pneumothorax	27 (54)	29 (58)
Pneumothorax + hemothorax	-	2 (4)
Vertebral fracture + pneumothorax	1 (2)	3 (6)
None	13 (26)	12 (24)
Vertebral fracture + pneumothorax	2 (4)	3 (6)
Hemopneumothorax	1 (2)	1 (2)
Vertebral fracture + pneumothorax + Hemothorax	1 (2)	-
Hemothorax	5 (10)	-

Frequency and proportional frequency of radiographic findings are summarized in table 2. Radiographic findings 1 hour after the operation were significantly different between the two groups (p= 0.0277). Radiographic findings 1 day after the operation were significantly different between the two groups (P= 0.006). After 3 days, there was no significant difference between the two groups regarding radiographic findings (p= 0.0378).

Table 3. Radiographic findings

	Multiple hole tube group	Single hole tube group
	No (%)	**No (%)**
Radiographic findings after 1 hour		
Normal	33 (66)	41 (82)
Mild hemothorax	14 (28)	2 (4)
Mild pneumothorax	---	3 (6)
Pneumothorax	---	3 (6)
Hemothorax	2 (4)	1 (2)
Kinking of the tube in the chest	1 (2)	---
Radiographic findings after 1 day		
Normal	40 (80)	44 (88)
Effusion	---	3 (6)
Mild hemothorax	10 (20)	---
Radiographic findings after 3 days		
Normal	50 (100)	47 (94)
Pneumothorax	---	1 (2)
Effusion	---	2 (4)

In those with single hole tubes, one case of complication was observed due to improper drainage and in those with multiple hole tubes, kinking of the chest tube occurred in one case. Other cases showed no complication. Overall, there was no significant difference between the two groups regarding complications. None of the patients needed second tube placement.

DISCUSSION

Absence of significant difference between the two groups regarding age and sex, showed that the two groups were matched in terms of these background variables. There was no significant difference between the two groups regarding duration of chest tube use. This finding clarifies that time required for drainage of air or fluid collected in the pleural space has been similar in both groups and function of the two tube types were similar in this regard.

The most common reason of chest tube placement in our study was penetrating trauma that is one of the most important indications of this procedure. Absence of significant difference between the two groups regarding the reason of chest tube placement and clinical findings is another criterion that shows underlying conditions of patients in both groups were similar and our findings regarding these two potentially confounding variables are relatively reliable and valid.

Hemothorax was significantly observed more frequently in radiographs obtained one hour and one day later. It is probably due to more traumas during chest tube placement. This type of tube is more traumatic potentially due to the longer length. Nevertheless, absence of this significant difference in the 3rd day shows that after 3 days, two groups were similar regarding hemothorax.

Inadequate drainage was a complication observed in patients using single hole tubes which could result from obstruction of the one and only hole (and there is no extra hole to compensate its function). Kinking of the tube was a complication noticed in patients using multiple hole tubes which was due to the longer length of such tubes.

Nevertheless, absence of a significant difference in frequency of complications shows that this difference is slight and ignorable and in the majority of patients in the community, this problem is not important.

None of the patients needed second tube placement. This finding is another indicator of the similar function of the two tubes, because the need for a second tube placement emerges when the first tube is not functioning properly.

CONCLUSION

There was no significant difference between the function of the two tubes. However, prevalence of hemothorax is higher in patients using multiple hole

(conventional) tubes. Thus, we recommend the use of single hole tubes. Mass production of these tubes is cost effective considering less production costs and similar function.

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