A QUESTIONNAIRE SURVEY ON PRACTICE OF CHEST TUBE MANAGEMENT

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ABSTRACT

Aim : With the aim towards better education of junior medical staff on chest tube management, we designed a questionnaire to survey their practice and at the same time to assess their level of understanding of the physical principles of chest tube and its drainage system.

Methods : The questionnaire was distributed to 130 junior medical staff (house officers, medical officers, trainee medical officers and specialist medical officers) from 7 Medical and Surgical Departments in Singapore General Hospital. Eighty-seven (66.9%) candidates responded. The mean age of the respondents was 27 ±2.1. They had an average of 3.2 ±1.9 years after basic medical qualification and 5 hospital postings. Nine respondents had obtained higher medical qualifications.

Results : About a quarter of the respondents, and 40% of those with higher medical qualifications gave appropriate answers. Ninety percent indicated that they received no lectures on chest tube management. Incomplete response ranged from 0% to 6%.

Conclusion : To improve education on chest tube management, our results and the feedback we obtained from the respondents, suggest that lectures on important physical principles of chest tube and its drainage system should be delivered to all junior medical staff.

Keywords: chest tube management, junior medical staff, education

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INTRODUCTION

Chest tube insertion is a commonly performed procedure in hospital practice. Inappropriate management of chest tubes and their drainage systems may lead to delayed or incomplete evacuation of the collected air or fluid in the pleural space, delayed re-expansion of the collapsed lung, and even development of tension pneumothorax[1-3]. These complications are associated with significant morbidity, leading to prolonged hospitalisation or even mortality. It is therefore important that every member in the team taking care of patients with chest tubes, should have adequate understanding of the physical principles of chest tube and its drainage system. We have noticed a lack of understanding on these physical principles among junior medical staff. With the aim towards better education of junior medical staff on chest tube management and to confirm our observation, we therefore conducted a questionnaire survey on their practice and at the same time to assess their level of understanding on the physical principles of chest tube and its drainage system.

METHODS

The survey was conducted over a period of three months from August to October 1994. Seven Surgical and Medical Department in Singapore General Hospital (SGH) participated in the survey. Permission to conduct the survey was granted from all departmental heads. The questionnaire was formulated and distributed to the candidates through the departmental heads or their representatives. All candidates did not have prior knowledge of being selected for the survey. Names of the candidates were not required. The questionnaire was designed to focus mainly on management of chest tube and its drainage system. All candidates were encouraged to answer the questionnaire according to their practice. Their answers were compared with recommendations in standard medical texts and peer reviewed articles in English journals. A copy of the questionnaire is shown in Appendix A.

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Definitions

Basic medical qualification is defined as Bachelor of Medicine and Bachelor of Surgery (MBBS) awarded by the National University of Singapore or its equivalent. Higher medical qualification is defined as Master of Medicine (M Med) awarded by the National University of Singapore, or being a member of one of the Royal Colleges of Physicians (eg MRCP), or being a fellow of one of the Royal Colleges of Surgeons (eg FRCS), or their equivalents. Hospital posting is defined as any hospital-related medical practice. Outpatient posting is defined as medical practice in Maternity and Child Health Clinics, outpatient polyclinics or the School Health Services. Junior medical staff were grouped according to their seniority in these departments: house officers, medical officers, trainee medical officers and specialist medical officers (ie those who have obtained higher medical qualifications).

Statistical analysis

All statistical analyses were accomplished using SPSS statistical data analysis software (SPSSPC+, SPSS Inc., Chicago, IL). Frequencies, means ± standard deviations and percentages were computed for each individual item as appropriate, and included only the candidates responding to the individual item. Percentage differences between groups were assessed by chi-square and Fisher's Exact tests as appropriate. All p values were obtained from two-tailed tests, and p values less than 0.05 were considered as statistically significant.

Characteristics of respondents

There were 130 junior medical staff in these 7 departments. Only 87 candidates (66.9%) returned the questionnaires with answers. No reasons were given for failure to return the answers, but some of the candidates were reported to be on vacation. Six respondents (6.9%) did not indicate the age and the number of

Select only one answer

Question 1
You would clamp the chest tube if :

1) the drainage unit is upset or broken.
2) the patient develops a fresh pleural air leak.
3) you need to locate the source of an air leak.
4) the patient must be transported.

Question 2
A patient had a chest tube placed on the right side for a large pneumothorax. The chest tube was connected to a drainage bottle with an under-water seal. He needed to be transported to the Radiology Department for an urgent abdominal computerized tomography (CT).

1) I would clamp the chest tube during the transportation and throughout the entire radiological procedure.
2) I would clamp the chest tube during the transportation only but unclamp it during the CT.
3) I would clamp the chest tube only when the drainage bottle has to be raised above the patient during transportation. The duration of clamping is limited to < 1 minute.
4) I would never clamp the chest tube regardless of the position of the drainage bottle.

Question 3
A patient had a chest tube placed for large right sided pneumothorax. While on the way to the Radiology Department for a head CT, the drainage bottle with an under-water seal was accidently dropped on the floor and broken into pieces, you would :

1) clamp the chest tube immediately with artery forceps provided and bring the patient back to the ward for a new drainage bottle.
2) clamp the chest tube immediately and order to go ahead for the head CT with the chest tube clamped until a new drainage bottle arrives.
3) not clamp the chest tube but immediately look for a container with water and place the open end of the connecting tubing under the water.
4) not clamp the chest tube but make a flutter valve from a rubber glove and attach it to the open end of the connecting tubing.

Question 4
Dependent loops in the pleural drainage tubing:

1) provide a reservoir for bacterial growth.
2) increase the chance of accidental disconnection.
3) interfere with drainage from the chest tube.
4) create excessive dead space in the drainage system.

Question 5
The optimal level of the under-water seal in the drainage bottle is:

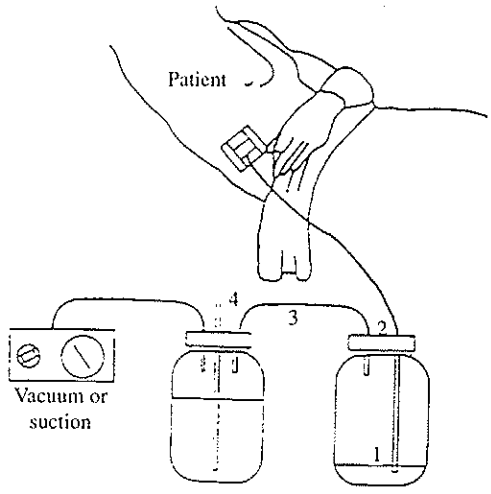
1) 2 cm
2) 4 cm
3) 6 cm
4) the higher the level of the under-water seal, the safer it will be.

Question 6
The minimal height the drainage bottle must stay below the patient should be

1) 10 cm
2) 20 cm
3) 40 cm
4) 60 cm

Question 7
When an attached suction pump is turned off and gravity drainage is begun, you would (please refer to the diagram below):

1) disconnect the water seal.
2) disconnect the suction pump tubing from the vent on the water-seal bottle.
3) clamp off the tubing to the suction pump.
4) seal any vent to the atmosphere.



Question 8
Please tell us how did you learn the management of the chest tube and its drainage system in the ward (you can have more than 1 answer).

1) senior medical colleague.
2) fellow medical officer.
3) house officer.
4) staff nurses.
5) lectures, books and journals.

Please answer Yes or No to the following questions

Question 9
Please tell us if you have ever attended a formal lecture/ teaching session on the management of the chest tube and its drainage system in the ward?

years after basic medical qualification. The mean age of the 81 respondents was 27 ± 2.1. The youngest was 23 and the oldest 33. The mean year after basic medical qualification was 3.2 ±1.9. Of the 79 respondents who indicated the number of hospital postings they had been through, the majority (75 out of 79 respondents or 95%) fell between 1 and 9 postings and the median was 5 postings. Of the 80 respondents who indicated the number of outpatient postings, 1 (1.3%) had 3 postings, 29 (36.2%) had 1 posting and 50 (62.5%) had none. Of the 82 respondents who indicated their positions at the time of survey, 13 (15.9%) were house officers, 45 (54.9%) were medical officers, 15 (18.3%) were trainee medical officers and 9 (11.0%) were specialist medical officers. Nine respondents had obtained higher medical qualifications.

RESULTS

Chest tubes clamping (Table I)

Candidates were surveyed specifically on chest tube clamping during patient transportation in a hypothetical situation (Question 1). Forty-one out of 87 (47.1%) respondents gave appropriate answers. There was 1 missing answer (1.1%) to the question on chest tube clamping when the drainage unit was upset or broken in a hypothetical situation (Question 2). Twelve (14%) out of 86 respondents gave appropriate answers.

Dependent loops in the pleural drainage tubing, optimal water-seal level, position of drainage bottle below patient, and disconnecting the suction pump tubing when suction is turned off.

There were 5 missing answers (5.7%) on the issue of dependent loops (Question 3) in pleural drainage tubing. Only 17 out of the 82 (20.7%) respondents gave appropriate answers. Of the 86 respondents (1 or 1.1% missing answer) who answered the questions on optimal water-seal level (Question 4), only 10 (11.6%) acknowledged that the optimal under-water seal level in the drainage bottle should be about 2 cm. Only 10 out of 87 respondents (11.5%) acknowledged that the drainage bottle should be at least 60 cm below the patient (Question 5). Forty-eight (58.5%) out of the 82 respondents (5 or 5.7% missing answers) indicated that they would disconnect the suction pump tubing from the vent on the water-seal bottle after suction is turned off (Question 6).

Learning chest tube management

Nine out of all 87 respondents (10.3%) indicated that they had received previous lectures (Question 8) on chest tube management. Up to the time of survey, 44 (51.7%) indicated that they learned from their senior medical colleagues, 46 (54.1%) from their fellow medical officers, and 38 (44.7%) from reading

Table I – Frequency and percentage distribution of respondents with appropriate answers according to number of hospital postings, number of years after basic medical qualification and higher medical qualifications.

	Overall Frequency of Appropriate Answers	No. of Hospital Postings		No. of Years After Basic Medical Qualification		Higher Medical Qualification	
		< 4 Postings	> 5 Postings	1 to 3 Years	≥ 4 years	Respondents with Higher Medical Qualifications	Respondents without Higher Medical Qualifications
Concerning clamping the chest tube during patient transportation	41/87 (47.1%)	15/37 (40.5%)	24/42 (57.1%)	19/42(45.2%)	20/39(51.3%)	4/9(44.4%)	35/72(48.6%)
		n = 79	NS	n = 81	NS	n = 81	NS
Concerning clamping of chest tube the drainage unit is upset or broken	12/86 (14%)	1/37(2.7%)	11/42(26.2%)	2/42(4.8%)	10/39(25.6%)	5/9(55.6%)	7/72(9.7%)
		n = 79	p < 0.01	n = 81	p < 0.01	n = 81	p < 0.01
Concerning the dependent loops in the pleural drainage tubing	17/82 (20.7%)	7/36(19.4%)	8/39(20.5%)	7/39(17.9%)	9/37(24.3%)	3/9(33.3%)	13/67(19.4%)
		n = 75	NS	n = 76	NS	n = 76	NS
Concerning the optimal level of under-water seal in the drainage bottle	10/86 (11.6%)	3/36(8.3%)	7/42(16.7%)	2/41(4.9%)	8/39(20.5%)	2/9(22.2%)	8/71(11.3%)
		n = 78	NS	n = 80	p < 0.05	n = 80	NS
Concerning the minimal height the drainage bottle should stay below the patient	10/87 (11.5%)	3/37(8.1%)	6/42(14.3%)	3/42(7.1%)	7/39(17.9%)	0/9(0%)	10/72(13.9%)
		n = 79	NS	n = 81	NS	n = 81	NS
Concerning disconnecting the suction pump tubing from the vent on the water-seal bottle after suction is turned off	48/82 (58.5%)	19/36(52.8%)	25/39(64.1%)	19/41(46.3%)	27/36(75%)	6/8(75%)	39/69(56.5%)
		n = 75	NS	n = 77	p < 0.05	n = 77	NS

NS = statistically not significant

books and journals. Only 1 (1.2%) learned from his or her fellow house officers and 10 (11.7%) learned from the nurses (Question 7). As the candidates were allowed to give more than one answer in this question, we therefore had a reason to believe that they learned from various combinations of the above.

DISCUSSION

Chest tube insertion is a commonly performed procedure in SGH. An estimation of about 500 chest tubes were placed in 1994. It is indicated for drainage of abnormal collection of air or fluid in the pleural cavity. Inappropriate management of chest tube and its drainage system can lead to significant morbidity and even mortality [1-3]. Our results showed that on the average, only a quarter of the respondents and 40% of those with higher medical qualifications gave appropriate answers, although we had numerical as well as statistical significantly more appropriate answers from the more senior respondents (Table I). They demonstrated a neglect in the education on the physical principles of chest tube and its drainage system among the junior medical staff. Ninety percent of our respondents did not receive lectures on chest tube management although they gained practical knowledge from their senior medical colleagues and fellow medical officers. The nurses were also an important source of their knowledge. The feedback from the candidates after the questionnaire survey and our results suggest that the overall results may improve if the physical principles of chest tube and its drainage system were delivered by formal lectures or teaching sessions. These principles may not be mentioned at all during daily teaching ward rounds.

Wrong concepts seem to prevail among our junior medical staff concerning chest tube clamping. During patient transportation, significant proportion (36 out of 87 respondents or 41.4%) of the respondents would clamp chest tube with artery forceps, and 10 respondents (11.5%) would not, regardless of the position of drainage bottle. It is recommended that chest tubes should not be clamped at all except under the following conditions: 1) to locate the source of an air leak, and 2) when changing the drainage bottle [4-6]. Under these conditions, the duration of clamping must be as short as possible [4,5,7]. It is dangerous to clamp chest tube during patient transportation when there is a possible air leak into the pleural cavity. Such a practice should be discouraged [8-11]. In SGH, a single drainage bottle serves as a collection bottle as well as a water-seal bottle. Therefore, when transferring patient between the bed and the trolley, it is appropriate to clamp chest tube only when drainage bottle has to be raised above the patient to prevent syphoning of bottle content back into the pleural cavity [3,7,11]. Duration of clamping has to be as short as possible. The clamps have to be removed during patient transportation from place to place. Because forgetting to unclamp the chest tube is a real risk, we suggest manual kinking of drainage tubing to replace the practice of chest tube clamping with artery forceps.

Seventy-four out of 86 respondents (86%) would clamp chest tube when the drainage bottle is broken. We also consider this practice as inappropriate. The pleural pressure is constantly kept at subatmospheric, ie negative relative to the atmospheric pressure. An accidentally disconnected or broken chest tube drainage unit will create an immediate pleural-atmospheric fistula through the existing chest tube. When such an event occurs, which usually happens without warning, there is an immediate equalisation of the pleural pressure with the atmospheric pressure. The idea that clamping of the chest tube after such an event to prevent atmospheric air from entering the pleural cavity and thus preventing a pneumothorax, is therefore doubtful. No human action is fast enough to prevent such kind of pneumothorax and the patient will experience immediate respiratory embarrassment. While oxygen therapy may be prudent in patients with limited respiratory reserve, clamping of the chest tube at that time just converts an open pneumothorax into a closed pneumothorax. Although it may do no further harm to patients without continuous airleak, it may actually place those patients at risk of tension pneumothorax if there is an active airleak. The most appropriate thing to do is to attach an one-way valve (Heimlich valve) to the open end of the pleural drainage tubing to replace the drainage bottle temporarily while waiting for a new replacement [8,10,11]. Heimlich valve is a simple device that allows air or fluid to escape yet effectively prevents air from entering into the pleural cavity [12,13]. Heimlich valves were used in the Vietnam war with satisfactory results for drainage in both penetrating and non-penetrating chest injuries [12]. They are now commercially available. An emergency one-way valve can also be constructed by tying a rubber glove over the open end of the chest tube and cutting a small hole in the end of a glove finger [8,10]. The benefit of our traditional practice of carrying artery forceps for such an event during patient transportation is doubtful. Artery forceps should be replaced by one-way valves, which should be readily available at all times in an ideal situation. In addition, the medical or nursing staff must also learn to make an emergency one-way valve from a rubber glove.

To improve our education on chest tube management, the following important physical principles of chest tube and its drainage system need to be emphasized: 1) to do their best to avoid dependent loops in pleural drainage tubing because these cause resistance to pleural drainage; 2) to maintain only minimal (2 cm) under-water seal level to reduce resistance to pleural drainage; 3) to always keep drainage bottle at least 60 cm below the patient to promote gravity drainage and prevent the content of drainage bottle from entering the chest; and 4) to routinely disconnect suction pump tubing from the vent on drainage bottle after negative suction is turned off to avoid creating a closed system, blocking air escape, causing pressure build-up and interfering with pleural drainage [2-5,8].

We agree that our candidate sample was not a random sample. However, we do not think it will affect the final conclusions. Firstly, our junior medical staff came from a common pool of Ministry of Health. They were rotated to various hospitals and departments every six monthly. They represented not only SGH but other hospitals as well. Secondly, our data showed that these candidates spent majority of their training time in hospitals rather than in the outpatient clinics (99% had none or one outpatient posting). Finally, it was common to find patients with chest tubes in the medical and surgical wards, which was one of the reasons we surveyed junior medical staff from these departments.

CONCLUSION

We feel that formal lectures on the physical principles of chest tube and its drainage system are essential part of the education on chest tube management. To the best of our knowledge, they are not part of the under-graduate or post-graduate medical courses. We sincerely hope that our results and the feedback we obtained from the respondents serve to highlight the necessity to improve education on chest tube management.

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