

Institutional report - Thoracic non-oncologic Chest drain insertion is not a harmless procedure – are we doing it safely?

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Abstract

The incorrect insertion of a chest drain can cause serious harm or even death. All elective drains should be inserted in the 'triangle of safety' in line with the British Thoracic Society guidelines. The aim of this study was to test the awareness of junior doctors involved in inserting chest drains with these guidelines. Fifty junior doctors were questioned. Participants were asked to grade their experience of chest drain insertion and mark on a diagram where they felt was the optimum site for inserting a drain for a large pneumothorax in an elective situation. Only 44% ($n=22$) of doctors indicated they would insert a chest drain within the safe triangle. Level of experience, seniority and specialty all had an effect on knowledge of the correct site. Of those who had inserted drains unsupervised, 48% ($n=16$) would site the drain outside the safe triangle as would 75% ($n=6$) of those who had performed the procedure supervised. Only 25% of medics knew where to insert a drain, compared with 58% of doctors working in surgery. The majority of junior doctors do not have the basic knowledge to insert a chest drain safely. Further training in this procedure is needed for junior doctors.

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1. Introduction

Chest drains are used in several clinical settings and doctors in nearly all specialties need to be capable of their safe insertion. Pneumothoraces are commonly seen in emergency departments, on acute medical takes, in intensive care units, and in trauma patients on orthopaedic and surgical wards. Hence, most doctors will be exposed to intercostal drains regardless of their speciality.

British Thoracic Society (BTS) guidelines suggest that a chest drain should be inserted for a malignant pleural effusion, empyema, traumatic haemothorax, some types of pneumothorax and in some cases postoperatively, such as after cardiac surgery [1]. The drain should be inserted within the 'safe triangle' (Fig. 1) which is defined as the area bordered by the anterior edge of latissimus dorsi, the lateral edge of pectoralis major and a line superior to the horizontal level of the nipple with the apex below the axilla [1].

The aim of this study was to test the awareness of junior doctors involved in inserting chest drains with the BTS guidelines regarding the optimum site of chest drain insertion.

2. Materials and methods

An observational study was performed where 50 junior doctors working within the Royal Liverpool Hospitals Trust

were questioned. This included doctors working in medicine, surgery, accident and emergency and anaesthetics across two sites: The Royal Liverpool Hospital and the Liverpool Heart and Chest Hospital. Participants were asked to give their grade, current specialty and whether they had previously worked in respiratory medicine or cardiothoracic surgery. They were then asked to grade their experience of chest drain insertion into one of the following categories:

1. Have performed unsupervised.
2. Have performed supervised.
3. Have observed the procedure.
4. No experience.

Doctors were then asked to mark on the diagram below (Fig. 2) where they felt was the optimum site for inserting a chest drain for a large pneumothorax in a non-emergency situation. The site marked was then analysed by a specialised registrar in cardiothoracic surgery to determine whether it was within the triangle of safety.

3. Results

Of the 50 doctors who were questioned, 38% ($n=19$) worked in cardiothoracic surgery, 24% ($n=12$) in medicine (chest medicine and cardiology), 24% ($n=12$) in the emergency department and 14% ($n=7$) in anaesthetics. The diagram below shows where the site for chest drain insertion was marked by participants (Fig. 3).

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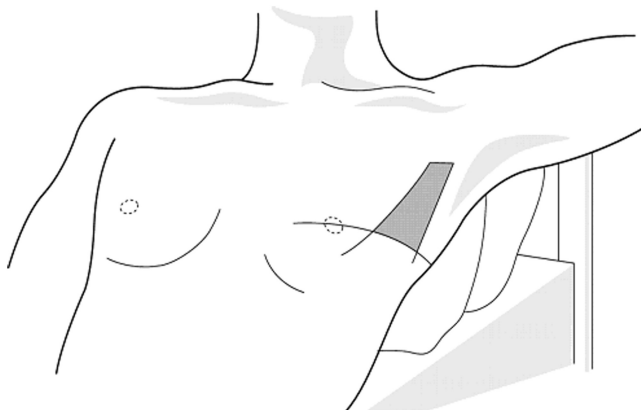


Fig. 1. The 'safe triangle' of the chest as recommended by the BTS guidelines. BTS, British Thoracic Society.

Only 44% ($n=22$) of doctors indicated they would insert a chest drain within the safe triangle of the doctors working in cardiology or chest medicine sampled; only 25% ($n=3$) knew where to insert a drain. This is compared with 58% ($n=11$) of doctors working in cardiothoracic surgery (Fig. 4). Level of experience had an effect on knowledge of the correct site (Fig. 5). Of those who had inserted drains unsupervised, 48% ($n=16$) would site the drain outside the correct area. This is compared to 75% ($n=6$) of those who had performed the procedure supervised. Seniority also affects the number who would site a drain correctly. Only



Fig. 2. Picture used to mark the site suggested as the optimum site for inserting an elective chest drain.

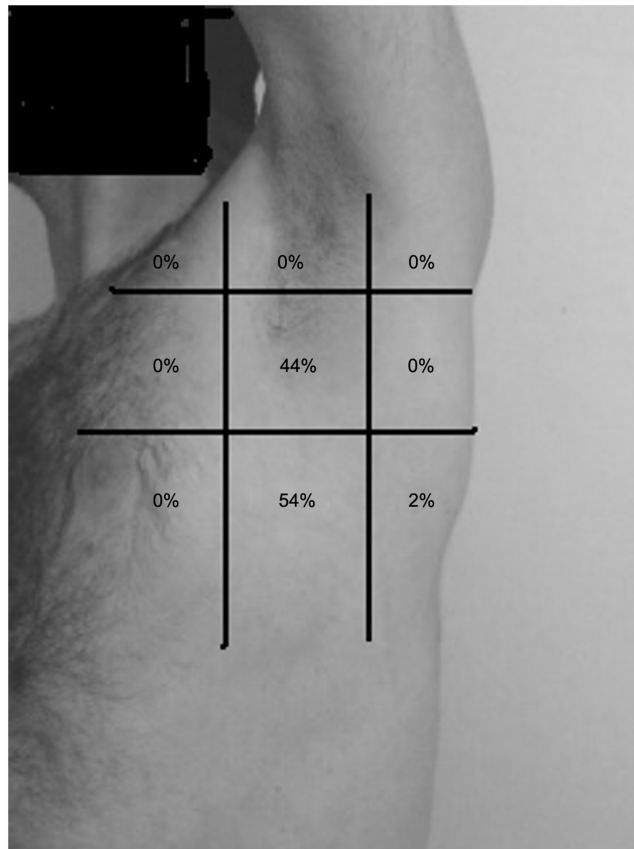


Fig. 3. Location suggested by participants for optimum site of chest drain insertion.

31% ($n=8$) SHO's identified the safe triangle with 63% of junior registrars and 56% of senior registrars being correct. The values were all not statistically significant.

4. Discussion

Although chest drain insertion is a common daily procedure preformed across all NHS hospital, this procedure is also associated with significant morbidity and occasional mortality. Incorrect insertion of a chest drain can have disastrous consequences. Perforation of both the right and left ventricle has been described. Examples of incorrect placement also included the pericardium with subsequent

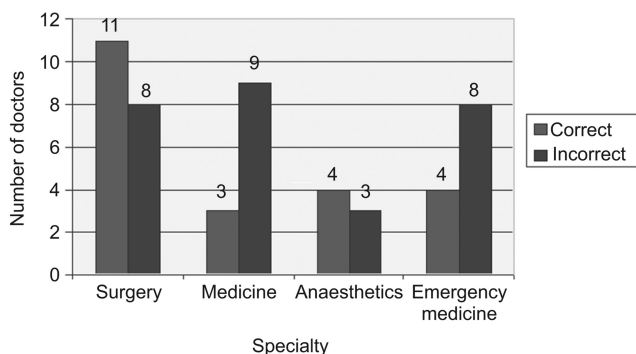


Fig. 4. Bar graph showing the effect of specialty on correct placement of chest drain.

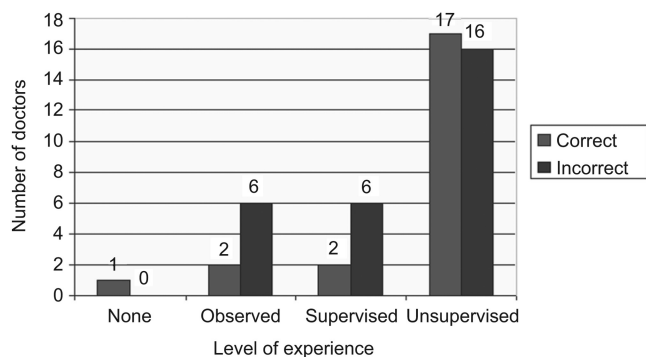


Fig. 5. Bar graph showing the effect of level of experience on correct chest drain placement.

tamponade, intra-pulmonary including the contra-lateral hemi-thorax and the liver [2].

While the BTS guidelines agree that the 'safe triangle' is not the only available area for insertion of a chest drain, it suggests that any other placement of a chest drain outside the 'triangle of safety' should be discussed with a senior clinician as in the presence of an apical pneumothorax where placement of a chest tube in the second intercostal space in the mid-clavicular line should be considered. This is not recommended routinely as it may be uncomfortable for the patient and may leave an unsightly scar [1]. While inserting a chest drain in the 'triangle of safety' is considered the safest location, it occasionally may not be the preferred site for some physicians as it is more uncomfortable for the patient to lie on after insertion and there is a risk of the drain kinking [3].

A specific position may also be required for a loculated effusion. A more posterior position may be chosen if suggested by the presence of a locule. Loculated apical pneumothoraces are not uncommonly seen following thoracotomy and may be drained using a posteriorly sited (suprascapular) apical tube [4]. This technique should be performed by an operator experienced in this technique – for example, a thoracic surgeon.

If the drain is to be inserted into a loculated pleural collection, the position of insertion will be dictated by the site of the locule as determined by imaging. Before insertion, air or fluid should be aspirated; if none is forthcoming, more complex imaging than a chest radiograph is required. The use of ultrasonography-guided insertion is particularly useful for empyema and effusions as the diaphragm can be localised and the presence of loculations and pleural thickening defined [5]. Using real-time scanning at the time of the procedure can help to ensure that the placement is safe, despite the movement of the diaphragm during respiration. The complication rate following image-guided thoracocentesis is low with pneumothoraces occurring in approximately 3% of cases [5]. Success rates of image-guided chest tube insertion are reported to be 71–86% [6]. It is a routine now in our hospital to use ultrasound for insertion of chest drains to drain pleural fluid.

The National Patient Safety Agency reported 2152 patient safety incidents relating to chest drains between January 2005 and March 2008 [7]. There were 15 cases of serious

harm and 12 deaths relating to chest drain insertion. The majority of the incidents of serious harm or death were related to the site of drain insertion. This has raised a national concern regarding the danger of incorrect placement of chest drains and the need to improve the training level among junior doctors in inserting chest drains. It is claimed that doctors that are adequately trained can safely perform tube thoracostomy with 3% early and 8% late complications [8].

A number of training programmes are currently running in our hospital for improving juniors' skills in chest drain placement. We had a total of five cases of serious harm and deaths related to chest drain insertion in 2008 and 2009 but this has dropped to zero in the last eight months. Our policies aim to ensure that chest tubes are to be placed in the pleural cavity; significant force should never be used as this risks sudden chest penetration and damage to essential intra-thoracic structures. Open incision with blunt dissection of deep tissues with forceps or introducer-guided insertion of the drain is the preferred technique. The operator should ensure controlled spreading of the intercostal muscles on the superior surface of the ribs to avoid injury to the intercostal vessels and nerves that run below the inferior border of the ribs. Alternatively, a small bore chest drain using the Seldinger technique may be used. This is more frequently used by doctors in non-surgical specialities inserting chest drains [9].

It is not the routine to use a trocar for chest drain insertion in our institute due to the danger of parenchymal damage. This is supported by other studies. Remérand and his colleagues in a study of 122 patients who had a chest drain and were followed up by a CT-chest found 21% of drains to be intra-fissural and 9% to be intra-parenchymal with the only predicting factor associated with the risk of malposition was the use of a trocar for the insertion of the chest tube [10].

Although residents at our institution are instructed to perform a finger sweep within the thoracic cavity to ensure the lung is non-adherent to the chest wall before tube placement and to place the chest tube on the superior rib margin to avoid injuring the inferior intercostal neurovascular bundle, it is unclear how often these techniques were actually employed. We plan to address this as a quality-control issue.

The latest BTS guidance suggests that emphasis should be placed on training junior doctors to insert chest drains safely before allowing them to perform the procedure on patients [1]. A study carried out in 2005 suggested that 55% of junior doctors were able to correctly position a chest drain [11]. This is compared with only 44% in this study. Even with this procedure being taught on courses, such as the Advanced Trauma Life Support, clearly junior doctors are not picking up the basic skills essential to insert a chest drain safely. Even more concerning is the illustration that of those who had performed the procedure unsupervised, only 52% would site the drain in the correct place, and consequently their supervision was inadequate for more junior doctors who only achieved a 25% rate of correct site insertion.

Clearly, given such a discrepancy in the awareness rates between various trainee specialties, the manner in which doctors are trained must be further examined. Whereas surgical trainees are trained in a technical manner on a daily basis, the availability of supervised training in tube thoracostomy while in the emergency department is more opportunistic. It is also dangerous and irresponsible to suggest that chest tube thoracostomy should be reserved solely for those with surgical training. Although we tend to discourage the use of ‘inappropriate training’ to describe this issue [12], we recognize that perhaps better training models do exist for the cohort of trainees that need to perform critical interventions infrequently. Some authors recommend that a ‘given number’ of procedures should be observed for minimal competence [13]; however, most successful instructional formats for teaching and retaining vital invasive techniques include a skill performance component along with didactic teaching [14].

Individual clinical departments should specify what level of seniority is expected to insert chest drains and should be indicated in relevant induction programmes. Postgraduate teaching programmes should make training on the insertion and management of chest drains a priority for all relevant grades and professions in all specialties. There should be repeated audit recycling in these hospitals and some teaching programmes are still failing to allow adequate implementation of the BTS guidelines. Medford and his colleagues studied 52 cases of spontaneous pneumothorax and found the management deviated considerably from the 2003 BTS guidelines in the initial audit – deviation rate 26.9%. After a training intervention, the number of clinical management deviations persisted with a 32.1% deviation rate [15].

The BTS suggestion of small group teaching using mannequins with a sign-off of doctors to ensure competency may help to improve juniors’ clinical skills [1] but may be impractical to achieve. With the reduction in junior doctors’ working hours and the policy in some hospitals to only allow respiratory registrars to insert drains, we would argue that doctors are becoming de-skilled at key procedures. As the BTS guidelines demonstrate, doctors from most specialties may need to insert an intercostal drain at some point, but if they have not seen or performed the procedure properly supervised enough times they will not have the necessary skills. A reduction in the number of hours worked by doctors may protect patients from being treated by tired staff, but this could be at the cost of sufficient training for the consultants of the future.

5. Conclusion

Clearly, with more than half of the doctors participating in this study and involved in inserting chest drains inserting them outside the safe area recommended by BTS, these figures are not acceptable and should alert us to the potential risk patients could face.

More awareness is needed in implementing the BTS guidelines for insertion of chest drains. We also need to develop

strategies to improve the level of training for junior doctors in inserting chest drain.

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eComment: Risks and pitfalls in chest tube placement – are we doing it safely?

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We read with great interest the report by Elsayed et al. [1] regarding the queries it raised about chest tube insertion and we would like to make a few remarks.

First of all we believe it is a very informative, intriguing and well-organised study which is easy to follow and which reflects the everyday clinical dilemmas concerning the issue of the correct chest tube placement. Though it is a common procedure it still carries a significant risk of morbidity and occasional mortality [2]. Chest drain insertion, as the principles of advanced trauma life support dictate, is a life-saving procedure which should be performed by every physician who is in the line of emergency, regardless of the speciality. Therefore, extra care should be given for adequate training not only to surgical trainees but to a broader spectrum of young physicians. The definition of the ‘safe triangle’ is useful and reveals the optimum site of chest drain insertion but every patient has a different underlying disease as well as unique anatomic characteristics. Loculated pleural collections, empyemas, previous chest tube placements, an anamnesis relevant to pulmonary disease and former operations should differentiate and individualize the strategy we follow. Complex procedures which require an approach outside the ‘safe triangle’ is, to our opinion, essential to be executed or at least supervised by a thoracic surgeon.

Last but not least we have to emphasize the pivotal role of local anesthetic infiltration prior to the placement of the tube and the need for a minimum traumatic procedure. This is an issue of major importance which is poorly addressed by Elsayed et al. [1]. Placement of the chest tube, particularly in patients with multiple morbidities, must be carried out with extreme cautiousness in order to minimize the patient's anxiety and pain [3]. Inexperienced residents often tend to place tubes before anesthetics have taken effect. This makes the tube insertion even more difficult and increases the risks of complications. Conscious sedation in some patients should be also considered. In regard to the authors' query [1], sufficient analgesia is definitely making chest tube insertion a safer procedure.

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