

Avoidable complications following chest tube insertion

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Epstein, Jayathissa and Dee report (in this issue of the *Journal*) on their review of small-bore chest tube insertion practices for drainage of pleural fluid at Hutt Valley District Health Board (HVDHB). They report a surprising number of complications and conclude that specialist societies need to take leadership in providing guidance on chest drain insertions to secondary and tertiary hospitals in Australia and New Zealand. This appears to abdicate the responsibility of education away from the teachers of our resident staff.

The ability to place a safe chest tube should be in the repertoire of all doctors of registrar or greater positions. Unfortunately, bad techniques are often passed down to generations of resident medical officers (RMOs) based on a teaching principle of “see one, do one, teach one”.

One of the authors (DS) of this editorial, a cardiothoracic surgeon, has been involved with/made aware of/consulted on complications inclusive of cardiac insertion, lung parenchyma insertion, liver insertion, IVC insertion (via liver), splenic insertion, damage to intercostal vessels, pulmonary artery, axillary vein, portal vein, bowel, and so on. Informal analysis of these errors has led us to the conclusion that they are almost universally avoidable and a product of inexperience and ignorance on the part of the operator with regard to anatomy, physiology, and dealing with complications.

The objective is simple. A tube is to be placed within the pleural cavity through the chest wall without damaging contents of the chest cavity or chest wall and if damage occurs it is noted and managed appropriately. In order to do this, a very basic understanding of anatomy, physiology and human factors is required.

Kindergarten anatomy for chest tube insertion:

- The chest cavity is smaller than you think: if standing, the top of the diaphragm is approximately level with the nipple. No chest tube should be placed below this level without careful thought.
- The apex of the lung is a couple of centimetres above the mid point of the clavicle. Many individuals erroneously think that the lungs occupy the middle of the rib cage. This is wrong. Patients with marked lung collapse, like those on the ventilators in ICU, may have the diaphragm considerably above the level of the nipple line.
- The intercostal blood vessels only become under-cover of the inferior border of the rib at approximately the posterior axillary line. More proximally they are within the intercostal space and very easy to lacerate on instrumentation. Unfortunately this territory is frequently the sight of “x marks the spot” place by an ultrasonographer. Fluid in this territory, in the majority of cases, can be accessed by a laterally placed tube directed to the paravertebral gutter.

Fortunately the majority of structures one wishes to avoid are located medially hence the thoracic surgical axiom “go high, go laterally”.

The plane of the manubriosternal angle denotes the bifurcation of the pulmonary artery, inside arch of aorta, and so forth. Classic teaching of mid clavicular lines/second interspace for emergency chest tube placement is, in the opinion of the authors, inherently dangerous. Tales of pulmonary artery injury etc nearly always associated with this site. It should only be used by experienced personnel when lateral access is not an option.

The surgical teaching, that the safest way to place a tube in the chest is to place a finger in first, still holds. There is an illusion that the ease of a Seldinger technique makes it inherently safer. This is wrong. Unfortunately there is a generation of RMOs ignorant in the skills to place a tube in the classic manner. This had led to the inappropriate approach of “only one screwdriver for all screws”.

While it is not the intention of this editorial to provide detailed instructions of the technique of inserting a classic chest drain please bear in mind the following:

- The skin and pleura are the most sensitive. Target local anaesthetic to these areas (local anaesthetic with a vasoconstrictor can reduce bleeding). To anaesthetise the pleura, place half of the local anaesthetic as an intercostal nerve block, i.e. tap down the rib with tip of the needle, at the inferior margin, slide in approximately 1mm or 2mm to place the local anaesthetic. **Let the local anaesthetic infiltrate.** A dentist would not start immediately after a nerve block, neither should you. Use this time for setting up the rest of the procedure.
- Make the hole adequate. Skin incision should be approximately 3cm long, dependent upon the size of the operator’s finger. To safely enter the chest, grasp a “Roberts” type clamp a few centimetres from its tip, in a manner similar to a one handed hold on a golf club. With the grasp fingers resting on the skin, roll the tip of the instrument over the top of the rib. A pop can be felt as it enters the pleura. Opening the jaws along the axis of the rib will bluntly dissect safe entry into the chest.
- A finger is then inserted into the chest to sweep away minor adhesions if necessary, to ensure the tube will be in the pleura (to the uninitiated it can be difficult to recognise if a finger is placed into lung parenchyma. A finger in the parenchyma of adherent lung may meet no more resistance than a finger swept through the centre of a pavlova).
- This tube is guided into place **gently** with the aid of a finger or the side can be grasped by a Roberts forcep as a temporary stiffener. **Do not** use centre stylets as they are dangerous (be aware that drains with centred trocars are sometimes found less enlightened smaller hospitals).

A thoracic drain connected to an underwater seal system is simply a manometer within the chest. With inspiration there is negative intrathoracic pressure that not only draws in air for breathing but will “suck” the “water” up the tube. The water goes down during inspiration then the tube is not measuring intra thoracic pressure, it is

most likely in the abdominal cavity and thus an urgent general surgical opinion should be sought.

While good technique and an understanding of relevant anatomy/physiology will not guarantee freedom from complications, a poor technique applied without understanding will guarantee avoidable complications.

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1. Epstein E, Jayathissa S, Dee S. Chest tube drainage of pleural effusions—an audit of current practice and complications at Hutt Hospital. N Z Med J 2012;125(1354). <http://journal.nzma.org.nz/journal/125-1354/5182/content.pdf>