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Technical note

An expansible cannula: a new technique for chest drain insertion

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Abstract

The insertion of a chest drain into the pleural space is a common procedure used by many specialties. The commonly used device is a prepacked, sterile plastic tube with its own central metal trocar. Complications may arise during its insertion, with the occasional penetration of intrathoracic and upper abdominal organs. As most chest drains are inserted by junior and relatively inexperienced doctors, it is therefore imperative that a simple, safe, and effective technique of insertion is found. A device has been developed that consists of a 5 cm conical length of an expansible cannula, made from rolled metal foil, which when inserted into the chest reaches only a few millimetres within the pleura. When an expander tube, 10 mm in diameter, is passed through the device from its proximal end the conical tube is distended into a hollow cylindrical one, through which a standard Portex chest catheter is passed. The whole appliance is then removed over the end of the tube, leaving the drain in situ. The efficacy of this unique device has been tested in a pilot study in 22 patients. There have been no complications.

The insertion of a chest drain into the pleural space is a common therapeutic procedure used by clinicians from various specialties. Despite various teachings on "safer" techniques of insertion[1–4] the available methods continue to have important disadvantages. The most commonly used method of chest drain insertion is that which uses the prepacked, sterile plastic tubes with their own central metal trocar,[5] such as the Argyle trocar and cannula. Thoracic surgeons unanimously insist that its safe insertion necessitates a formal dissection through the chest wall and pleura so that no force is used when the assembly is passed through. Nevertheless, this advice, in our experience, is not always followed, and drains are frequently inserted in a traumatic fashion.[6] It is often difficult to traverse the intercostal space and the temptation to push hard may be difficult to resist, resulting in sudden overpenetration. Most intrathoracic and upper abdominal organs have been penetrated at some time and some deaths have occurred.[7–13]

Formal dissection through the chest wall is not without its complications. Bleeding from the wound or from subcostal vessels is sometimes a problem,[14] and subsequent wound infection or secondary empyema has been reported to occur in 2–25% of patients who undergo this procedure.[15,16] After the pleural space has been entered the correct placement[17] of a drain is important if a therapeutic advantage is to be gained.[18]

In this paper we describe a simpler method of chest drain insertion using a newly developed device that we have evaluated in 22 patients.

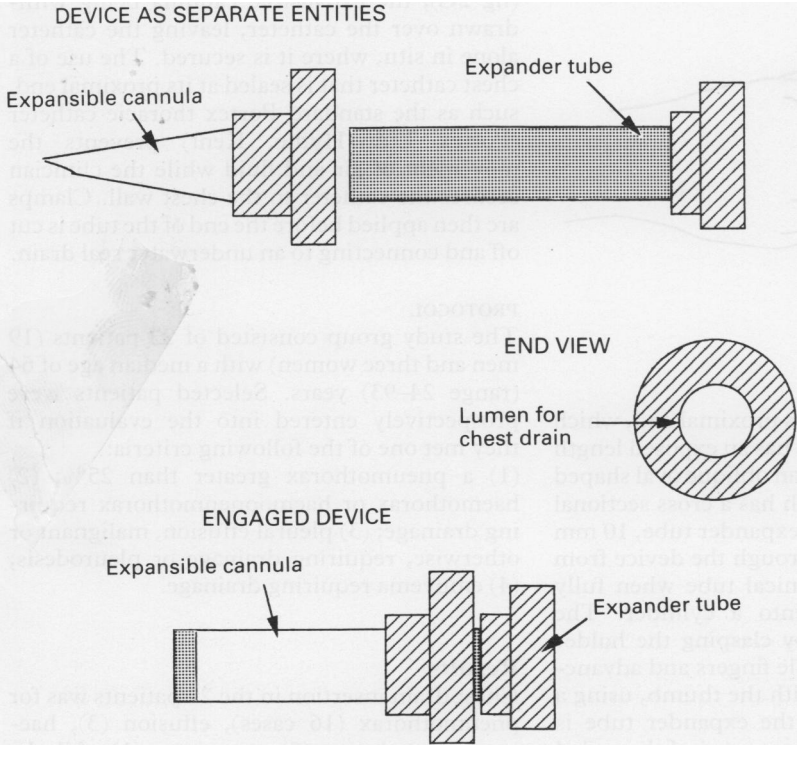

Figure 1 Diagram of the prototype device.

Materials and methods

DESCRIPTION OF DEVICE

The prototype device (fig 1) is an "expansible cannula," which in its closed condition is in the form of a conical tube made of coiled metal foil, 0·076 mm thick, which is surface coated with a low resistance plastic (Niflor, Fothergill Engineered Surfaces Ltd, Leeds). The conical

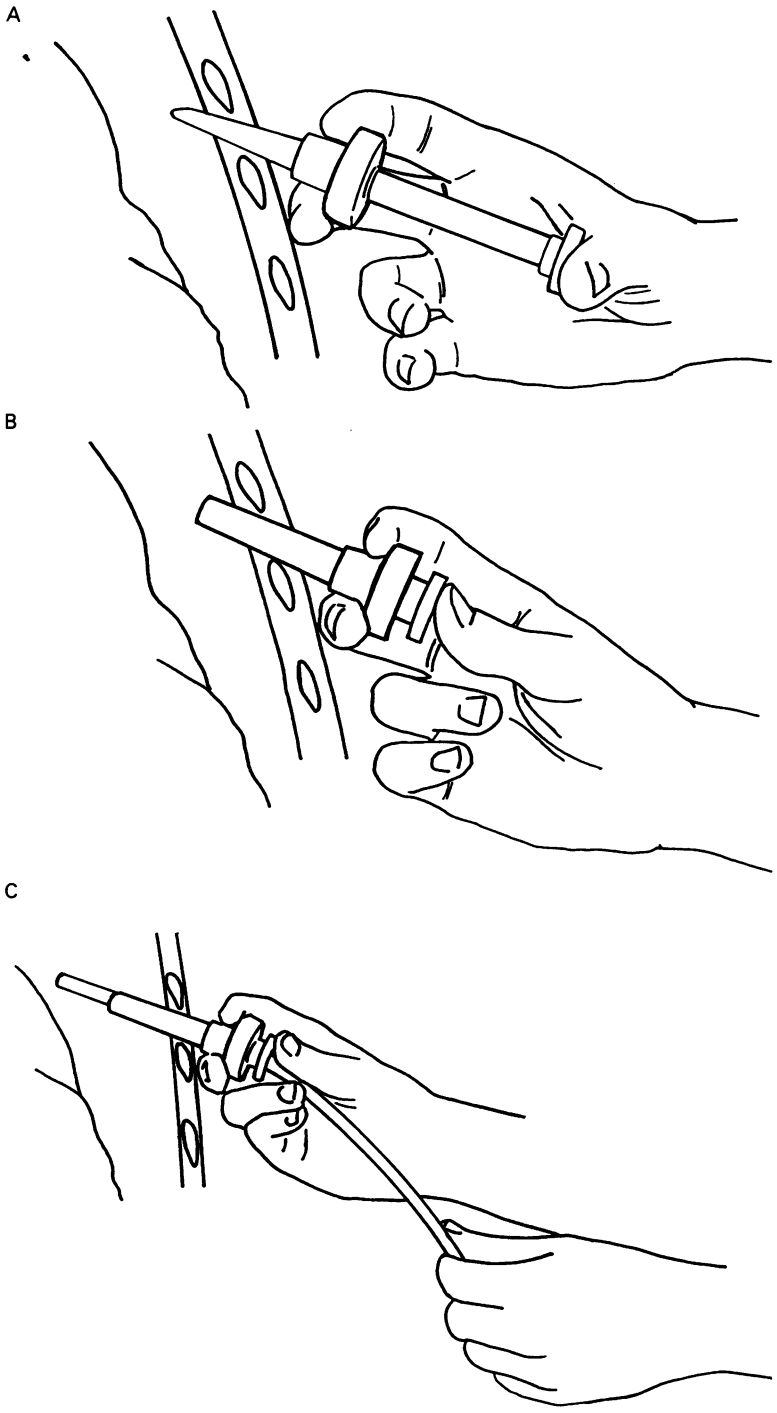

Figure 2 Operation of the expansible cannula (see text).

tube tapers down from its proximal end, which is located in a holder and has an exposed length of 5 cm. At its distal end an oblique oval shaped opening is formed, which has a cross sectional diameter of 2 mm. If an expander tube, 10 mm in diameter, is passed through the device from its proximal end the conical tube when fully engaged is distended into a cylinder. The operator achieves this by clasping the holder with the index and middle fingers and advancing the expander tube with the thumb, using a syringe like action. As the expander tube is advanced it drives the inner turns of the coiled metal foil both radially outwards and forwards, thereby providing the necessary material at the distal end of the device to form the cylindrical tube. Once opened a 28 F chest drain can be passed through the expander tube from its proximal end.

With the device in its open condition the expander tube projects beyond the distal end of the cannula's metal foil; this allows the device to be freely manipulated within the pleural cavity without risk of injury to the surrounding tissues. Only the chest drain tube passes deeply into the chest and this is easily directed to the chosen intrapleural target. The expansible cannula may be made in a range of sizes to accept drains of varying diameter.

TECHNIQUE OF CHEST DRAIN INSERTION

The technique of chest drain insertion is similar to classical techniques in that the site for insertion is identified radiologically. The skin is cleansed and isolated with sterile towels. A local anaesthetic is infiltrated through to the pleura, aspiration beyond this point confirming the nature of the material within the pleural cavity. A skin incision just wide enough to accommodate the diameter of the drain is made and sutures are then inserted for subsequent fixation of the drain and closure of the incision.

The expansible cannula in its conical configuration is passed through the incision, its finely tapering shape allowing easy controlled progress through the intercostal space into the pleural cavity. When it has entered the pleural cavity a movement of air or back flow of fluid down the cannula indicates that the instrument is correctly placed. The expander tube is depressed into the cannula with a syringe like action (fig 2A), thereby converting its conical shape into a cylindrical one (fig 2B). A chest drain catheter is next passed through the cannula and directed towards the appropriate site (fig 2C), the expansible cannula being withdrawn over the catheter, leaving the catheter alone in situ, where it is secured. The use of a chest catheter that is sealed at its proximal end, such as the standard Portex thoracic catheter (Portex Ltd, Hythe, Kent) prevents the movement of air and fluid while the clinician secures the catheter to the chest wall. Clamps are then applied before the end of the tube is cut off and connecting to an underwater seal drain.

PROTOCOL

The study group consisted of 22 patients (19 men and three women) with a median age of 64 (range 24–93) years. Selected patients were prospectively entered into the evaluation if they met one of the following criteria:
(1) a pneumothorax greater than 25%; (2) haemothorax or haemopneumothorax requiring drainage; (3) pleural effusion, malignant or otherwise, requiring drainage or pleurodesis; (4) empyema requiring drainage.

Results

Chest drain insertion in the 22 patients was for pneumothorax (16 cases), effusion (3), haemopneumothorax (2), empyema (1). All the drains were inserted without difficulty by

thoracic surgical registrars already familiar with conventional trochar techniques. The overall procedure appeared faster and less traumatic to the patients and the desired final position of the tube was easily achieved. No inexperienced operators have yet attempted the technique as only a limited number of hand made models are currently available.

In all cases the 5 cm penetrative length of the expandable cannula was adequate as confirmed by radiographs after insertion with the intrapleural drains appropriately positioned. There were no complications associated with insertion of drains.

Discussion

The technique of chest drain insertion by means of the expansible cannula has considerable advantages over existing methods. Its short penetrative length ensures that there is little risk of damage to intrathoracic or subdiaphragmatic organs and it is long enough for all builds of chest wall.

The finely tapering shape of the expansible cannula facilitates easy passage through the tissues, giving the operator excellent control of its insertion as he "feels" his way over the superior border of the rib. An oblique path into the pleural space is optimal as it creates a long subcutaneous tunnel, which is advantageous.[10]

As the device is opened it undergoes a true radial expansion and separates the fibres of the intercostal muscles without causing excessive trauma. The subsequent firm grip of the intercostal muscles on the chest drain prevents air and fluid from leaking around the drain. This reduces the risk of infection spreading along the drain passage and helps to hold the drain in position.

The expansible cannula is easy to handle and enable chest drain insertion to be accomplished swiftly and safely, thereby minimising patients' anxiety and discomfort. The feasibility of the production of this device, with regard to the costs of materials and packaging, is still being studied.

We thank the consultant surgeons at the London Chest Hospital and Harefield Hospital for enabling us to study their patients. The expansible cannula was developed in conjunction with Pratt Burnerd International Ltd, Park Works, Lister Lane, Halifax.

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