Procedures in Family Practice

Model for Teaching Insertion of Chest Tubes

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Closed-chest thoracostomy with tube drainage is recognized as a necessary skill for primary care physicians. The usual teaching methods used to train medical students and resident physicians involve either instruction on patients or the use of costly animal models. An inexpensive model using commonly available materials to teach this skill is described.

Trauma is surpassed only by cancer and arteriosclerosis as the cause of death in all age groups, and in the United States it is the leading cause of death in the first three decades of life. The mortality from traumatic injuries is increasing each year. Chest injuries are responsible for one of four trauma deaths occurring in this country. Two thirds of the fatalities due to chest injuries can be saved by prompt diagnosis and correct management upon arrival at the hospital. Most of these injuries occur some distance from a major medical center. Less than 15 percent of chest injuries require major surgery. The remaining 85 percent can be managed by simple procedures that should be within the capabilities of any physician.[1]

With the improvement of emergency medical services and better prehospital care, more trauma victims are reaching the hospital emergency rooms alive and in need of immediate treatment. The American College of Surgeons Advanced Trauma Life Support curriculum designates the decompression of pneumothorax and hemothorax as a necessary skill second in importance only to airway maintenance.[1] In 1976 the Certification Task Force of the American College of Emergency Physicians developed the "Emergency Medicine Conditions/Skills List."[2] Thoracostomy by tube insertion was designated as a mandatory skill by this group.

Closed-chest thoracostomy by tube insertion has been taught by a variety of techniques. The American College of Surgeons Advanced Trauma Life Support Course uses live anesthetized dogs. This method, although effective, is expensive and time-consuming. It is often difficult for the student to gain repetitive experience and requires sacrifice of the animal. The indications for and techniques of closed-chest thoracostomy have been well described in a previous paper in this journal.[3]

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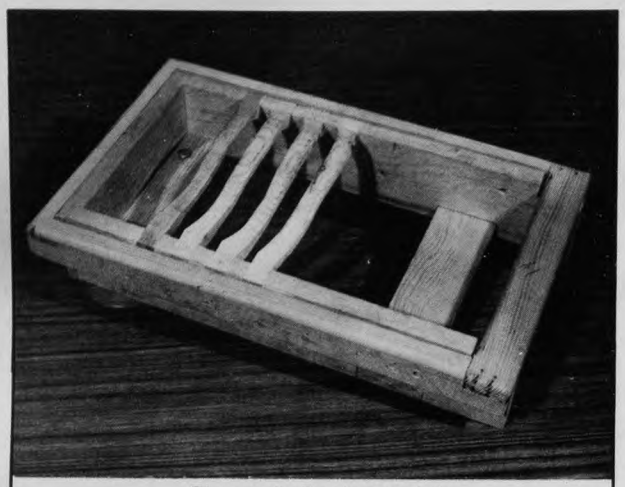

Figure 1. Basic model

Figure 2. Shower curtain layers

This paper describes a model, made from easily available materials, that closely simulates the experience of closed-chest thoracostomy by tube placement. This model permits easy preparation and maintenance. Multiple procedures can be performed by the student at several sessions prior to use of the technique in patient care situations.

Materials and Methods

The model was developed using readily available materials. "Ribs" were carved from stock lumber and mounted on a wooden frame (Figure 1). Four layers of plastic shower curtain are stretched over this frame to simulate the intercostal and pleural tissues (Figure 2). A sheet of 1-in thick foam rubber is next applied to simulate the subcutaneous tissue (Figure 3). Additional layers of foam rubber can be added to simulate tube placement in the obese patient. A layer of inner-tube rubber is stretched and stapled over the outer frame to simulate the skin, and the outer frame is locked over the prepared basic frame to complete the model.

Students are instructed to surgically incise the "skin." A Kelly clamp is used to develop a "Z" track through the "subcutaneous tissue" to the "pleura" (Figure 4). The "pleura" is then punctured and spread with the Kelly clamp (Figures 5 and 6) and the student introduces a finger into the "pleural space" to ensure proper tube placement. Using the "Kelly clamp technique," the chest tube is inserted into the "pleural cavity" (Figures 7A and B). The "skin" is closed in the appropriate manner to secure the tube and prevent air leaks (Figure 8). A proper dressing is applied to the "chest wall."

Results

The model was tested by a number of physicians who had had experience in chest tube insertion. Twenty family physicians, 2 emergency medicine specialists, 4 general surgeons, and 18 residents were asked to test the model, and all felt that it permitted a highly satisfactory representation of the experience of closed-chest thoracostomy and tube placement.

The most difficult task encountered in the development of this model was the identification of a material that would simulate the pleural and intercostal structures. A number of materials were tried. The inner-tube rubber, although satisfactory for simulated skin, provided too much resistance to tube insertion and retracted too readily. Sheets of foam rubber did not give the resistance necessary to permit the student to feel the "give" when the pleura was entered. Styrofoam was too brittle and did not permit multiple insertions. The four layers of shower curtain satisfactorily reproduced

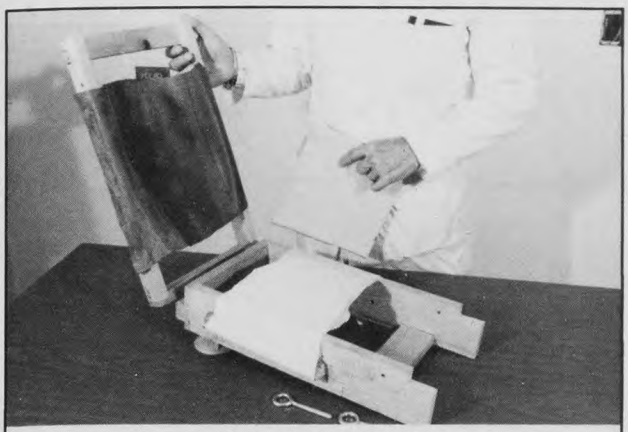

Figure 3. Foam rubber layers

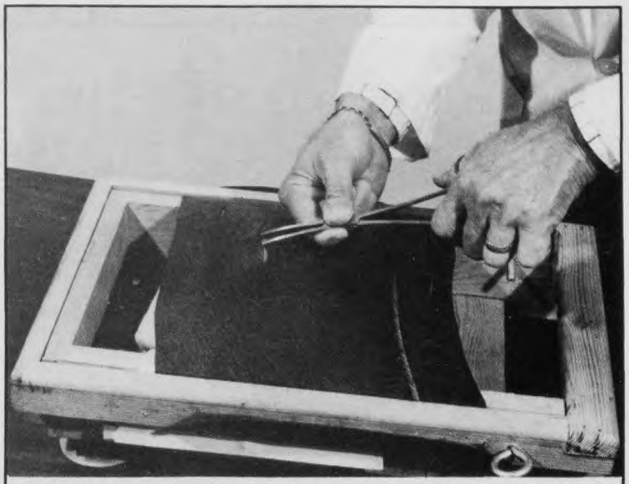

Figure 4. Blunt subcutaneous dissection

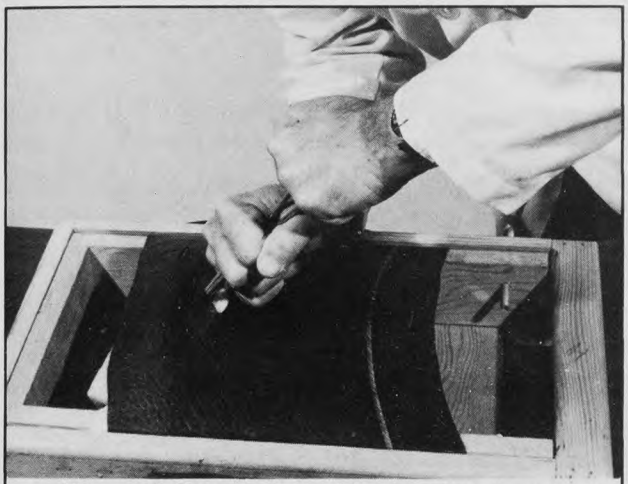

Figure 5. Penetration of intercostal tissues

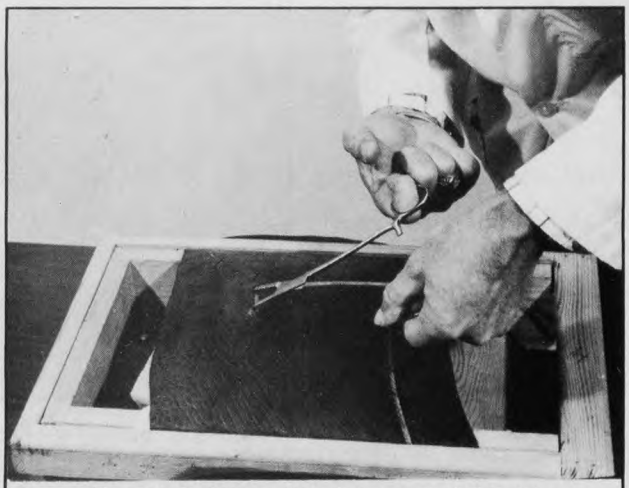

Figure 6. Spreading intercostal tissue

the qualities of pleural and intercostal tissues. Additional or fewer layers could be used to simulate clinical situations where more or less resistance was desired.

It was found that stapling the "skin" of inner-tube rubber to the frame was necessary to provide the appropriate tension. As a result, more time is required to replace the "skin" after multiple incisions. Because of the nature of the inner-tube rubber, scalpel blades quickly became dulled, and the blade had to be changed after three incisions in the rubber "skin." Paper tape adhered better to the rubber "skin" for dressings.

The total preparation time for the production of the model was approximately six hours. The model is also commercially available.*

Multiple procedures can be done on a single model "set-up"; twelve procedures have been performed easily without the need to replace the "tissues." If the "skin" incision is not done for

*Custom Woodcrafts, Inc, 4776 Gay Lane, Gainesville, GA 30501.

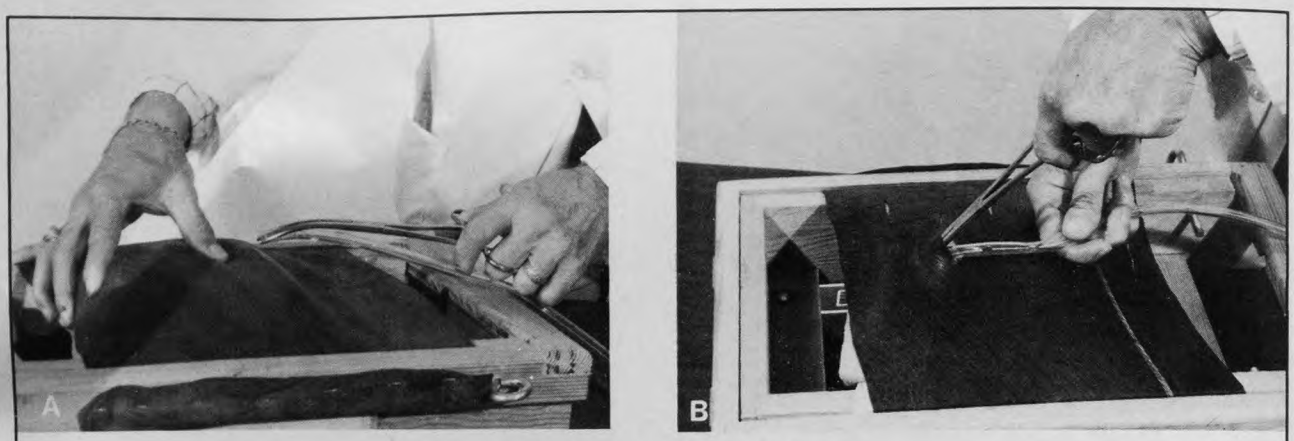

Figure 7. (A and B) Insertion of chest tube

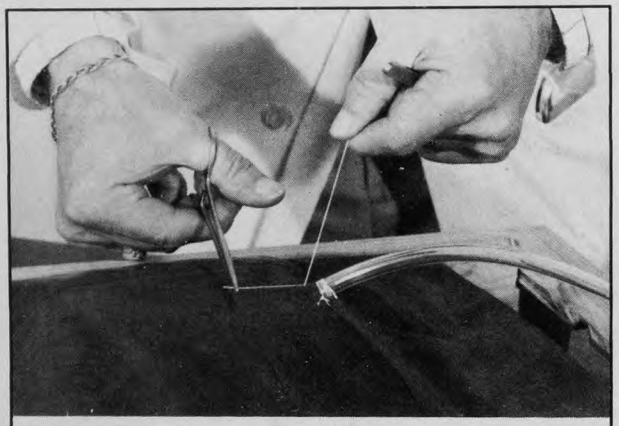

Figure 8. Suturing skin and anchoring chest tube

each episode of chest tube insertion, as many as 30 insertions can be performed through the 12 incisions before changing the "subcutaneous tissue and intercostal membrane." Storage and maintenance on this model are easy, and it can be available to students and residents at their convenience for practice. Comparison of this model to use of the anesthetized dog showed that the educational experiences were equally favorable, while this model was more convenient and less costly.

References

1. Advanced Trauma Life Support, syllabus. Chicago, American College of Surgeons, 1981
2. Emergency medicine condition/skills list. JACEP 5: 599, 1976
3. Richards V: Tube thoracostomy. J Fam Pract 6:629, 1978