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ATRIUM

Clinical Update

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Different Chest Tubes Present Different Clinical Challenges

One of the latest developments in chest drainage is the FDA's approval of closed wound drains for postoperative drainage in cardiothoracic surgical patients. The main challenges in providing care to patients who have wound drains in the pleural space or mediastinum is understanding how wound drains differ from traditional chest tubes and how those differences affect bedside nursing care.

The three most common types of wound drains used for cardiothoracic surgery are: the Blake® drain from Ethicon Inc., the Bard Channel Drain, and the Cardinal Drain. The Blake drain is available in sizes 15 Fr, 19 Fr, and 24 Fr; the Bard drain: 10 Fr, 15 Fr, and 19 Fr; and the Cardinal drain: 15 Fr and 19 Fr. You'll know right away that a wound drain is being used if the catheter is attached to a reservoir bulb for drainage — the same type of reservoir bulb used for abdominal wounds, for example (more about reservoir bulbs and chest drainage in the next issue).

If the catheter is attached to a three-chamber chest drain system, it may be difficult to determine what type of tube is in the chest since the proximal ends of the tubes are similar. Your first responsibility is to know the type of catheter being used.

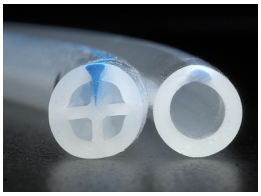
Distal Tube Structure

A traditional chest tube is a hollow catheter — a single lumen. The distal end of the catheter in the patient's chest has eyelets to facilitate drainage for a length of approximately 9 inches (24cm) from the tip. The number and placement of eyelets will vary with catheter size and manufacturer.

The Blake drain, by comparison, changes configuration three times from the patient tip to the proximal end that attaches to the drainage system. The distal end (approximately 12 inches or 30cm long) has a multilumen, four-channel design. At the tube's distal tip, you'll see a "t" — a silicone core divides the catheter into four separate sections for drainage.

Each of these sections is open inside the chest wall; four equally spaced 12-inch long slits allow fluid into the four channels instead of eyelets that allow fluid into a traditional chest drain.

The middle part of the tube, approximately 4 inches (10cm) long is called the "transition zone" (see figure). In this section, the silicone "t" remains, but the outside of the tube is closed. This section provides the changeover from the open multilumen catheter to the third part of the tube — a single lumen catheter — that connects to a drainage device.



Left: Blake drain transition zone, Right: HydraGlide XL

Check Your Knowledge...

Q. During report, you learn that a patient who had a thoracoscopic lung biopsy a few hours ago has a Heimlich valve that was connected to a urinary catheter drainage bag in the OR. When you enter the room, the patient is short of breath. Apart from a physical assessment, what will you look for to determine the cause of the dyspnea?

Answer on other side

Factors Affecting Blood Flow

Three main variables affect how well blood and fluid leave the chest through a chest tube: the length of the tube, the amount of negative pressure (suction) applied, and the inner diameter of the tube. Kam's research[1] showed that if the amount of suction stays the same, an inner diameter of 12mm yields a maximum flow of 50 to 60 LPM, while an inner diameter of 6mm yields a maximum flow of 15 LPM. Halve the diameter, and the flow rate drops by a factor of *four*.

A tube's ability to evacuate the chest is only as great as the smallest or most restrictive part of the tube. The transition zone is the most restrictive area of a three-zone Blake drain, whereas a traditional drain's flow rate through a single lumen is constant throughout the length of the tube.

According to Ethicon, the flow rate through a Blake drain is 200cc/min[2]. Under gravity, tests using porcine blood showed a flow rate of 107cc/min through the 19 Fr drain, and 263cc/min through the 24 Fr drain. By comparison, tests using bovine blood showed that the HydraGlide XL has a flow rate of 282cc/min through the 20 Fr catheter and 573cc/min through the 24 Fr catheter[3].

These data illustrate why an understanding of the tube's design is so critical. A tube's stated size is determined by its outer diameter, not the flow area inside. When the inner diameter is factored in, the 20 Fr HydraGlide XL allows for slightly greater flow than the 24 Fr Blake drain, and more than 2½ times the flow of a 19 Fr Blake drain. Thus, a surgeon who might be using a 24 Fr Blake drain to achieve better drainage can use a smaller HydraGlide XL that will disturb less tissue. Obney and colleagues[4] concluded that "larger is not necessarily better when draining the chest." The key is not to focus on the tube's outer diameter, but rather the flow rate through the tube. Also note whether flows are measured using blood or saline. Saline will flow three times faster than blood since it is less viscous, so if you are comparing manufacturer's flow data, be sure you are comparing fluids of the same consistency.

Slippery When Wet

When it's time to remove the tube, an important aspect to consider is how slippery the outside of the tube is — formally called the "coefficient of friction." For chest tubes, the lower the coefficient, the better. Uncoated silicone has a very high coefficient of friction. If you try to pull a silicone tube through your thumb and index finger, it will not slide smoothly. On the other hand, a tube with a hydrophilic coating, which has a low friction coefficient, will smoothly glide through your fingers. When the tube comes into contact with tissue fluids, its low coefficient of friction is enhanced.

The benefits of a low coefficient of friction? Tissue and bacteria are less able to adhere to a slippery surface, thus reducing the incidence of adhesions and infection. Combine fewer adhesions with a slippery tube and you get a tube that is easier to remove from the chest.

Next issue: Connecting the tube to a drainage system; critical issues you will not want to miss.

See sources on back page.

Clinical Update is an educational newsletter provided by Atrium Medical Corporation and is edited by Patricia Carroll, RN,BC, CEN, RRT, MS.

In The Literature

When You Have to Open a Chest in the ICU

When caring for cardiac surgical patients, the most life-threatening surgical complications are cardiac tamponade and exsanguination. Medically, cardiac arrest and possible graft closure or disruption may also require immediate intervention at the bedside.

Ideally, a cardiac surgical ICU is adjacent to the operating room staffed 24/7. If patients need mediastinal exploration, they can be quickly wheeled into the OR where the chest can be opened under more controlled conditions than those in the ICU. That option, however, is usually limited to major medical centers. The rest of us need to know how to facilitate a surgical procedure in the ICU without delay.

This article, written by an experienced OR nurse, provides a step-by-step orientation to OR procedure for ICU nurses. While many of the elements of care, such as the skin prep, are used daily in the ICU, other critical issues, such as keeping track of the number of sponges before they are placed in the wound, and tricks to reduce hazards associated with needles and scalpels in the operative field, are foreign to ICU nurses and could easily be missed.

This article is a must-read if you care for cardiac surgical patients in your ICU and you do not have 24-hour OR staffing — use these tips to adapt a program that addresses the needs of your practice setting.

Source: Tremper RS: Mediastinal exploration in the surgical intensive care unit. *Dimensions of Critical Care Nursing* 2004;23(1):24-30.

Yo! Keep it Down!

How noisy is your unit, particularly at night? Would you be able to sleep under the conditions you create in your workplace? That's what nurses from the thoracic surgery intermediate care unit at St. Mary's Hospital in Rochester, MN wanted to find out. Noise can delay healing, impair the immune system, and increase blood pressure and heart rate.

First, the researchers measured baseline noise levels in three empty rooms during the night shift, without the staff's knowledge. They analyzed the sources of noise and planned interventions that began with staff education about the importance of sleep and how staff can make minor changes in their routine that would provide big payoffs for patients.

Recommendations included:

- Move shift report to a designated room where the door could be closed, instead of in the open nurse's station (also important for confidentiality).
- Close patient room doors whenever the nurse is talking with a patient or carrying out procedures that can create more noise. This decreases the unit's background noise level, so people will not have to raise their voices to talk over it.
- Pay closer attention to the time an IV infusion will end so that the alarm does not sound.
- Eliminate overhead paging.
- Reinforce the unit's noise reduction efforts with other staff members who come to the unit (such as respiratory therapists, radiologic technologists, laboratory phlebotomists).

These nurses also identified unit-specific noisemakers, including the pneumatic tube system, patient chart holders, and paper-towel dispensers. After noise reduction measures were implemented, researchers not only monitored decibel levels, but also surveyed patients about their sleep.

Not mentioned in the article are the interventions that can be implemented to reduce the noise from chest drainage. Key is to switch to dry suction control to eliminate the sound of bubbling water. This can be done with a standard dry control chest drain, or by switching to a "mini" drain that is portable and does not require water. Also consider if patients really need suction or if gravity drainage will meet the patient's needs.

Source: Cmiel CA, et al.: Noise control: a nursing team's approach to sleep promotion. *AJN* 2004;104(2):40-48.

On the World Wide Web...

You can learn more about our feature article on these Web sites.

Conversions at Your Fingertips

A frequently asked question is the relationship between French measurements, millimeters, and inches. Endotracheal tubes are measured in mm; suction catheters are measured in French. Chest tubes are measured in French; adaptors are measured in inches! RFQ-Medizintechnik, a surgical products company in Germany, has provided a table of measures at their Web site. And while you're there, you might want to check out the 14kt gold-plated laryngoscope blade (look under gifts).
http://www.rfq.de/eng/service_eng.htm

Learn More About the Coefficient of Friction

It's a slippery subject, but the coefficient of friction is one of many lessons at the Web site "School for Champions," which was designed to supplement school lessons in nearly every curriculum area. The resources at this online educational community are used by students and teachers from hundreds of colleges, high schools and middle schools worldwide as well as by workers and management in a large number of companies. One area of focus for this non-profit group is how to enhance educational opportunities for people with visual impairments. If you have or work with children in school from K-12, take a look - there's a treasure trove of information here.

http://www.school-for-champions.com/science/frictioncoeff.htm

And here is their list of health resources:

http://www.school-for-champions.com/health/resources.htm

Check Your Knowledge...

A. This true case study highlights one of the main challenges that Heimlich valves present — there is no built-in drainage collection. When the nurse entered this patient's room, the urinary catheter bag was filled with air and looked as if the seams were about to burst. While collecting drainage in the bag initially seemed like an ingenious idea, the lack of an air vent could have been catastrophic.

For information on complications when a Heimlich valve is used with a small bore chest tube, see Bahnia MM, Garrett K: Association of tension pneumothorax with use of small-bore chest tubes in patients receiving mechanical ventilation. Source: *Critical Care Nurse* 2004;24(1):64-65.

Sources
1. Kam AC, O'Brien M, Kam PCA: Pleural drainage systems. *Anaesthesia* 1993;48:154-161.
2. Ethicon, Inc. Data on file. Available at:
http://www.jnjgateway.com/public/USENG/Blake%20drain.pdf
3. Atrium Medical Corporation. Data on file. Available at:
http://www.atriummed.com/Products/Chest_Drains/Catheters/HydraGlideXL_Catheters.asp
4. Obney J, Barnes MJ, Lisagor PG, Cohen DJ: Is bigger better for draining the mediastinum and thorax? [abstract] *Chest* 2000;118(4):116S.