Surgical Vacuum Drains: Types, Uses, and Complications

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ABSTRACT

High- and low-pressure vacuum drains are commonly used after surgical procedures. High-pressure vacuum drains (ie, sealed, closed-circuit systems) are efficient and allow for easy monitoring and safe disposal of the drainage. Low-pressure vacuum drains use gentle pressure to evacuate excess fluid and air, and are easy for patients to manage at home because it is easy to reinstate the vacuum pressure. Perioperative nurses should be able to identify the various types of commonly used drains and their surgical applications. Nurses should know how to care for drains, how to reinstate the vacuum pressure when necessary, and the potential complications that could result from surgical drain use. AORN J 91 (February 2010) 266-271. © AORN, Inc, 2010

Key words: surgical drains, four-channel vacuum drains, low-pressure vacuum drains, high-pressure vacuum drains, negative pressure.

Drains are commonly used after surgical procedures and can be classified as either active or passive.1 Active drains use negative pressure to remove accumulated fluid from a wound. Passive drains depend on the higher pressure inside the wound in conjunction with capillary action and gravity to draw fluid out of a wound (ie, the difference in pressure between the inside and the outside of the wound forces the fluid out of the wound).

Passive drains, such as a Penrose drain, do not require special attention; the dressing is changed when it becomes saturated, or, if the drain is attached to a reservoir, then the reservoir is emptied or changed when it is full. Active drains, however, do require special maintenance. The collection reservoir of an active drain expands as it collects fluid drainage by exchanging negative pressure for fluid. The drain becomes ineffective if the vacuum is lost. This article provides information on the various types of commonly used vacuum drains, nursing care of drains, methods to reinstate a drain’s vacuum pressure, and potential complications of drain use.
USE OF DRAINS
Drains are used both prophylactically and therapeutically. The most common use is prophylactic after surgery to prevent the accumulation of fluid (eg, blood, pus) or air. In any surgery in which a dead space (eg, a cavity) is created, the body has a natural tendency to fill this space with fluid or air. Use of a prophylactic drain is not routinely recommended after clean surgical procedures, although some articles claim that use of drains results in seroma reduction, and results of research have shown that use of vacuum drains may not influence the outcome after tissue expander use in breast surgery. Surgical drains commonly are used after procedures on the thyroid, breast, and axillary area as well as after abdominal procedures and joint replacements. Vacuum drains may be used to drain perirectal wounds, and certain special vacuum drains (ie, endoluminal) are available to treat anastomotic leaks that may occur after intestinal resection and anastomosis.

DRAIN INSERTION
Typically, when a drain is required, it is inserted at the end of a surgical procedure. Frequently, the drain is inserted through a separate hole a few centimeters from the main incision to decrease the risk of a postoperative wound infection. There are two methods to insert a vacuum-type drain. The first method is used with drains that have a sharp trocar attached to the tube. The surgeon uses the trocar with some drains attached to pierce the skin from the inside of the wound at the desired site and pulls the attached tube out through the stab wound. The surgeon places the inner end of the tube at the required site and detaches the trocar. The surgeon may secure the drain to the skin with a stay-stitch. After the wound is closed, the scrub person connects the tube to the reservoir. Suction may be attached to the reservoir to facilitate wound drainage.

The second method for drain insertion is used when a trocar is not attached to the drainage tube. In this case, the surgeon uses a forceps to pierce the abdominal wall from the inside of the wound and pushes the forceps through the subcutaneous tissue. He or she then incises the overlying skin with a scalpel. The surgeon opens the tip of the forceps to grasp the end of the drain tube and pulls the drain into the wound to the desired location. The surgeon may secure the tube to the patient’s skin with a stay-stitch. The scrub person connects the tube to the reservoir after the wound is closed.

Vacuum drains are classified according to the degree of pressure used. Typical bottled vacuum drains (eg, Redi-vac) use high negative pressure. Bulb-shaped suction devices (eg, Jackson-Pratt) and collapsible four-channel vacuum drains (eg, J Vac, Blake) use low negative pressure.

HIGH-NEGATIVE-PRESSURE DRAINS
High-pressure bottled vacuum drains have the advantages of being sealed, closed-circuit systems that allow for easy monitoring and safe disposal of the drainage. These systems consist of a clear, plastic reservoir with a rubber cap that has indicator wings to monitor the presence of vacuum pressure and an opening in which to connect the drainage tube. When a vacuum is present in the system, the wings on the rubber cap are close together; the wings are apart if the vacuum is lost. The end of the drainage tube that is inserted into the wound has multiple openings on its inner side through which fluid can be evacuated from the wound. The wound should be closed before the clamps on the drain are opened; otherwise the vacuum will be lost as the tube sucks in atmospheric air.

Although the patient’s condition and type of surgical procedure indicate appropriate monitoring times and documentation of drainage volumes, the amount of drainage typically is measured two to four hours after surgery and every six hours thereafter. Occasionally, the surgeon may decide to clamp the tube for a couple of hours if it drains too much (eg, more than 100 mL an hour). This may occur after some procedures,
such as joint replacements. Once every 24 hours, the nurse should mark the drainage reservoir bottle and record the volume of drainage collected in 24 hours.

Reinstating Vacuum Pressure
When the vacuum is lost, the drain will not function, so the tube has to be connected to a new bottle or the vacuum must be reinstated by one of the following methods. A clinician removes the bottle from the drainage tube and loosens the plastic attachment. In method #1 (ie, the suction-tube method), the clinician connects the plastic tube of the suction machine to the white plastic attachment of the vacuum bottle and turns on the suction machine (Figure 1). In method #2 (ie, the reverse Yankauer suction method), the clinician inserts the tip of a Yankauer suction catheter into the suction machine tube. The clinician then holds the connection end of the Yankauer suction catheter tightly against the white plastic attachment of the vacuum bottle and turns on the suction machine. In both methods, when the rubber cap shows evidence of enough vacuum pressure in the bottle, the clinician clamps the plastic attachment on the drainage tube to retain the vacuum pressure, then the clinician disconnects the suction machine tubing.

LOW-NEGATIVE-PRESSURE DRAINS
Low-pressure vacuum drains have a plastic bulb-shaped reservoir and a silicone drainage tube, with multiple side holes at the end that is inserted into the wound. When the bulb is compressed, air is forced out, which creates negative pressure in the system. Low-negative-pressure drains work gently to evacuate excess fluid and air.

It is easy to educate the patient so that he or she can care for a bulb-type, low-pressure vacuum drain at home without help. Removing the plug from the exit valve allows the bulb to inflate. The amount of drainage is easily quantified with the measurement marks on the side of the bulb. The patient empties the contents into a disposable container or cup by squeezing the bulb reservoir, then the patient squeezes the bulb again and replaces the cap, thus recreating the negative pressure. The patient can also be instructed on

Figure 1. One method to reinstate the pressure in a high-pressure bottled vacuum drain is to attach the plastic tube (arrow) to the suction unit and then release and close the valve when appropriate.

Figure 2. A four-channel vacuum drain ready for insertion.
how to remove the drain at home without assistance, if necessary.

A four-channel vacuum drain is a type of low-pressure drain; the primary difference is the size and shape of the reservoir.\(^{14}\) The drain tube is soft and flexible,\(^ {15}\) and the reservoir is foldable with two outlets (Figure 2). One outlet is used for connecting to two drains and another outlet is used for emptying the contents. The drainage tube has four tiny lumina that join to form a single lumen. The advantage of a four-channel vacuum drain is that it is unlikely to become occluded by the omentum because of the tiny size of the holes. The disadvantage is that the holes may not be large enough to evacuate larger particles of tissue or blood clots.

After the surgeon inserts the drain by using one of the two methods previously described, the scrub person connects the drain tube to the outlet adaptor. The scrub person folds or bends the reservoir into a U shape by pressing both thumbs on the marked areas in the middle part of the reservoir, which releases the locking system (Figure 3). The scrub person removes the plug from the exit valve and repeats the procedure by bending the reservoir to create vacuum pressure. The scrub person then reseals the reservoir with the plug. The scrub person may have to repeat this process several times until all the air is removed from the reservoir. On the postoperative nursing unit, the nurse monitors drain output and empties the reservoir when required. A vacuum is easily visible by the undistended or unfolded appearance of the reservoir. The bag will appear larger when the vacuum is lost.

**DRAIN REMOVAL**

The negative pressure in the reservoir should be released by removing the plug from the exit valve, and the bulb or reservoir should be disconnected before the drain is removed. After cutting the stay-stitch, if there is one, the nurse or patient smoothly pulls out the drain. Drain removal can be painful for some patients, so the patient may wish to take an oral analgesic before removing the drain. After removing the drain, the nurse or patient should clean the drain-tube site with antiseptic and a small dry cotton swab. If the site is oozing, then the nurse can apply a gauze dressing. If there is a large quantity of drainage, then the nurse can apply a stoma bag.

**COMPLICATIONS OF VACUUM DRAINS**

Although drains serve an important function, there are potential complications with their use. Some of these complications include the following:

- **Breakage**—Drains are made of strong silicone or polyvinyl chloride plastic and, therefore, are not likely to break, but breakage can occur.\(^ {16}\) Laparoscopy may be required if part of a drain breaks off inside the patient’s abdomen during removal.\(^ {17}\)
Difficulty in removal—If a drain remains inserted for a long period of time, it may become difficult to remove. On occasion, the drain has been stitched to the wound during closure of deeper layers. The nurse should report any difficulty encountered during drain removal to the surgeon. The wound may need to be temporarily opened to remove the drain.

Inadvertent removal—Drains may get tangled in the patient’s other lines (eg, IV tubing, electrocardiogram leads) or become tangled in clothing or linen and accidentally be pulled out. This might cause bleeding or pain.

Infection—Although one purpose of surgical drains is to evacuate excessive fluid accumulation to prevent bacterial proliferation, drains can increase the risk of infection via retrograde bacterial migration. Typically, drains are removed when they are draining a negligible amount (eg, less than 25 mL per day; less than 1 mL per hour) to minimize this risk.

Occlusion—Drain tubes can become occluded by blood clot, tissue, or the omentum. This can lead to the formation of a hematoma and subsequent discomfort and increased risk for infection.

Pain—Drain sites can be painful and may prevent the patient from lying on the side where the drain is inserted. Furthermore, some patients are apprehensive about moving with a drain in place after surgery; lack of movement can potentially increase the risk of postoperative immobility complications (eg, venous thrombosis).

Unsightly scar—A drain site is left to heal by secondary intention so the site may form a puckering scar. When possible, the surgeon may place the drain in a skin crease to help improve cosmesis.18

Visceral perforation—Drains left in place for a long period of time can erode into the bowel and lead to visceral perforation.19

SUMMARY
Perioperative nurses need to know the surgical uses of high- and low-pressure vacuum drainage systems as well as potential complications of surgical drain use. Understanding how to create the negative pressure vacuum will help nurses provide better drain care and better patient education. Knowing how to recreate the negative pressure in a high-pressure reservoir is particularly useful when an underfilled high-pressure vacuum drain bottle loses its vacuum pressure. Low-pressure vacuum drains have the advantages of easy emptying and easy recreation of the gentle, negative low-pressure vacuum, and they are easy for patients to manage at home.

Editor’s note: Redi-vac™ is a trademark of Atrium Medical, Hudson, NH. Jackson-Pratt® is a registered trademark of Cardinal Health, Dublin, OH. J Vac® and Blake® are registered trademarks of Ethicon, St Louis, MO.

References


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CONTINUING EDUCATION PROGRAM

Surgical Vacuum Drains: Types, Uses, and Complications

PURPOSE
To educate perioperative nurses about the use of surgical vacuum drains.

OBJECTIVES
1. Differentiate between passive and active drains.
2. Identify uses of surgical drains.
3. Discuss how drains are inserted.
4. Explain how to reinstate vacuum pressure.
5. Describe low-pressure vacuum drains.
6. Identify complications associated with drain use.

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QUESTIONS
1. Passive drains
   a. use negative pressure to remove accumulated fluid from a wound.
   b. depend on the higher pressure inside the wound in conjunction with capillary action and gravity to draw fluid out of a wound.
   c. use the sodium-potassium pump to exchange sodium ions across the cell membrane with potassium, which draws fluid out of the wound.

2. The collection reservoir of an active drain exchanges negative pressure for fluid, so if the vacuum is lost, the drain becomes ineffective.
   a. true
   b. false

3. The most common use of drains is to
   a. introduce medication such as antibiotics into the surgical wound after surgery.
   b. decrease postoperative pain.
   c. prevent the accumulation of fluid or air postoperatively.
   d. monitor pressure inside the wound.

4. Use of a prophylactic drain is routinely recommended after clean surgical procedures.
   a. true
   b. false

5. When a surgeon inserts a drain with an attached trocar, he or she pierces the skin from the outside of the wound at the desired site and pulls the attached tube in through the stab wound.
   a. true
   b. false
6. When a surgeon inserts a drain without an attached trocar, the surgeon
   1. uses a forceps to pierce the abdominal wall from the inside of the wound.
   2. pushes the forceps through the subcutaneous tissue.
   3. incises the overlying skin with a scalpel.
   4. grasps the end of drain tube with the forceps and pulls it into the wound.
   5. secures the tube to the patient’s skin with a stay-stitch.
      a. 2 and 3
      b. 1, 4, and 5
      c. 2, 3, 4, and 5
      d. 1, 2, 3, 4, and 5

7. If vacuum pressure is lost in a high-pressure bottled vacuum drain, the vacuum can be reinstated by using the ________________ method.
   1. reverse Yankauer suction
   2. suction camshaft
   3. suction tube
   4. inversion suction
      a. 1 and 3
      b. 2 and 4
      c. 1, 2, and 3
      d. 1, 2, 3, and 4

8. The advantages of bulb-type, low-pressure vacuum drains include that
   1. they can easily be cared for by the patient at home without help.
   2. the amount of drainage is easy to quantify.
   3. the patient can be instructed on how to remove the drain without assistance at home.
   4. they work gently to evacuate excess fluid and air.
      a. 1 and 2
      b. 3 and 4
      c. 1, 2, and 3
      d. 1, 2, 3, and 4

9. The advantage of a four-channel vacuum drain is that it
   a. can evacuate larger particles of tissue or blood clots.
   b. can be used in multiloculated cavities.
   c. is unlikely to become occluded by the omentum.
   d. has a higher negative-pressure vacuum.

10. Potential complications of drain use include
    1. breakage or occlusion.
    2. difficult or inadvertent removal.
    3. electrolyte imbalance.
    4. infection.
    5. pain or unsightly scar.
    6. visceral perforation.
       a. 1, 3, and 5
       b. 2, 3, 4, and 6
       c. 1, 2, 4, 5, and 6
       d. 1, 2, 3, 4, 5, and 6
This evaluation is used to determine the extent to which this continuing education program met your learning needs. Rate the items as described below.

OBJECTIVES
To what extent were the following objectives of this continuing education program achieved?

1. Differentiate between passive and active drains. Low 1. 2. 3. 4. 5. High
2. Identify uses of surgical drains. Low 1. 2. 3. 4. 5. High
3. Discuss how drains are inserted. Low 1. 2. 3. 4. 5. High
4. Explain how to reinstate vacuum pressure. Low 1. 2. 3. 4. 5. High
5. Describe low-pressure vacuum drains. Low 1. 2. 3. 4. 5. High
6. Identify complications associated with drain use. Low 1. 2. 3. 4. 5. High

CONTENT
7. To what extent did this article increase your knowledge of the subject matter? Low 1. 2. 3. 4. 5. High
8. To what extent were your individual objectives met? Low 1. 2. 3. 4. 5. High
9. Will you be able to use the information from this article in your work setting? 1. Yes 2. No

10. Will you change your practice as a result of reading this article? (If yes, answer question #10A. If no, answer question #10B.)

10A. How will you change your practice (Select all that apply)
1. I will provide education to my team regarding why the change is needed.
2. I will work with management to change and/or implement a policy and procedure.
3. I will plan an informational meeting with physicians to seek their input and acceptance of the need for the change.
4. I will implement the change and evaluate the effect of the change at regular intervals until the change is incorporated as best practice.
5. Other: __________________________

10B. If you will not change your practice as a result of reading this article, why? (Select all that apply)
1. The content of the article is not relevant to my practice.
2. I do not have enough time to teach others about the purpose of the needed change.
3. I do not have management support to make a change.
4. Other: __________________________

11. Our accrediting body requires that we verify the time you needed to complete the 1.2 continuing education contact hour (72-minute) program: ___