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Different Types and Importance of Negative Pressure Drain:Review Article

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ABSTRACT
Postoperative unimpeded drainage is crucial for preventing hematoma and fluid collection formation as well as postoperative consequences. Aim: To discuss the characteristics and key points of clinical management of types of commonly used negative pressure drainage systems.
Keywords: Negative pressure, Drainage, Complications.

INTRODUCTION

Surgical site infections (SSIs) are a significant postoperative complication. These infections happen within 30 days of surgery for the deep layers, and 30 to 90 days for the superficial layers, when microorganisms penetrate the tissues. Two more categories of SSIs are organ/space and incision. There are two types of incisional SSIs: superficial and deep. SSIs even though they are only allowed at surgical sites. The epidermis and superficial fascia are affected by superficial SSIs, whereas the fascial and muscle layers are infected by deep SSIs. Within 30 or 90 days following surgery, Any tissue below the fascial layer that was engaged in the procedure gets infected by organ/space SSIs [(1)].

The incidence of SSI varies between 0.5 and 15% globally. Increased dead space, hematoma, or tissue that has lost vitality are all consequences of poor surgical methods—increase the risk of infection. It also applied to any other foreign object, such as stitches or drains. Additionally, it has been reported that individuals with high body mass indexes (BMIs), documented histories of drinking, chronic heart conditions, and diabetes are key risk factors for developing SSI[(2)].

Due to the general reduction in immunological activity they produce, delayed wound healing occur. The kind of wound and operations also played a significant influence; for example, a contaminated wound receiving an urgent procedure (such as an emergency caesarean section) is more likely to develop SSI following the procedure than a clean wound experiencing a similar procedure (elective caesarean section) [(1)].

These infections manifest as erythema, discomfort, fever, pus discharge from wounds, and dehiscence. Several strategies have been used to decrease them, including shaving, using chlorhexidine to wash hands, and receiving antibiotics before surgery [(3)].

In surgical wounds following surgery, the use of subcutaneous drains has appeared to be really hopeful, especially in emergency laparotomies. The idea behind it was to eliminate any accumulated in order to reduce the risk of infection and wound complications, remove any fluid or debris and fill in any dead areas in the subcutaneous plane. The drain output is subsequently carefully observed. One method to combat seroma may be to use these drains behind flaps. After that, it can be removed sterilely and covered with pressure dressing. The seroma if gathers once more, the incision should be opened to remove it. Seroma should be evacuated if it returns after two aspirations by releasing the stitch and applying saline gauze to the wound to promote secondary healing [(1)]. By resolving the issues with the clotting factors, hemostasis can be avoided [(4)]. Interrupted sutures or synthetic mesh are the most secure options for high-risk patients. This has shown to be quite helpful coupled with wet surgical gauze, an iodophor dressing, and continual suctioning. In 7 to 10 days, the wound can be stitched up. If the wound cannot be stitched shut, it is instead allowed to granulate before being stitched shut with a skin graft. According to several research, using subcutaneous catheter covered in an antibiotic solution and irrigated with saline works best for filthy wounds [(1)].

Types of surgical drain:

1. **Open or closed**
   - Fluid is drained from open drains (such as corrugated rubber or plastic sheets) into a stoma bag or a gauze pad. They probably make becoming sick more likely.
   - Tubes draining into a bottle or bag provide closed drains. Drains for the chest, abdomen, and joints are a few examples. Infection risk is generally decreased.
2. **Active or passive**
   - Suction is used to sustain active drains (which could be high or low pressure).
   - Passive drains work by using the difference in pressure between bodily cavities and the outside environment rather than suction [(5)].
3. **Silastic or rubber**
   - Silastic drains cause little tissue reactivity and are largely inert.
   - Red rubber drains may cause a strong tissue reaction and occasionally cause a tract to form (this

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may be considered useful – for example, with biliary T-tubes).

Subcutaneous negative pressure drain:

Closed systems called active drains are used to collect liquids into reservoirs. This reservoir can minimize the exposure of hospital workers or other patients to contaminated fluid, reduce the danger of ascending infection, and prevent saturation of bandage material. An artificial pressure gradient is generated by active drains to draw fluid or gas from a wound or bodily cavity. When compared to passive drains, active drains are more effective, the drain exit may be placed in any location, fluid can be removed defying gravity if necessary, and dead space can be collapsed using negative pressure. Active drains' negative pressure might fluctuate or remain constant [(6)]. Continuous negative pressure enhances drain performance and can shorten the drain's installation period. Additionally, ongoing suction reduces the possibility of bacterial growth in static fluid. The volume of fluid or gas being evacuated should best determine the ideal level of intermittent negative pressure. Negative pressure of 80 mm Hg permits fluid evacuation and causes dead space to collapse without causing tissue damage around the drain to be harmed [(7)].

Examples:

Redivac®: A vacuum-driven negative pressure drain that draws liquids into a reservoir bottle is the Redivac® system. While the bottle comes in just one standard size, the drain tubing comes in a variety of sizes. This system's disadvantage is that a new reservoir bottle should be purchased. after it is full. The transparent reservoir makes it possible to measure daily output, but it is fragile and can break if dropped. The retracted green rubber section of the seal reveals a vacuum when viewed from the outside. If the vacuum is lost although the bottle is still full, by attaching the bottle to a suction device, the vacuum can be created again [(8)].

Before removing the drain, the vacuum must be let go in order to prevent pain from the negative pressure holding the tissues in place.

Figure 1: Redivac drain bottle

Drain by Jackson-Pratt®:

The Jackson-Pratt drainage features its bulb and multiple side perforations, the silicone tube can be used to simulate a low negative pressure vacuum while also gathering fluid. It is a system of low negative pressure suction, reducing the danger of bowel perforation or ischaemia by preventing intra-abdominal materials like preventing the omentum or intestines from entering the tube [(8)] .

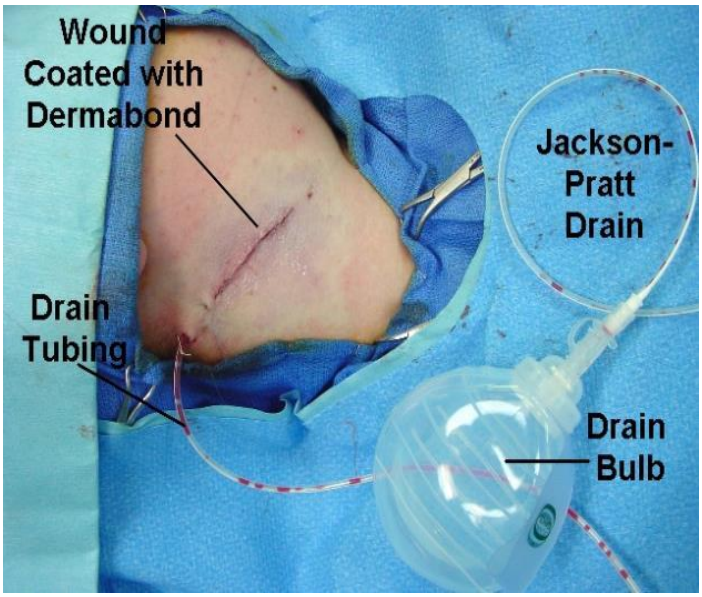

Figure 2: Jackson-Pratt® drain.

Drain J-Vac®

Additional low negative pressure devices is the J-Vac® drain. It has a silicone tube with four small lumens formed by grooves at the end of the body cavity. At the reservoir end, they come together to produce a single lumen. For the patient, the silicone material is less uncomfortable, and its key benefits are that it does not readily become clogged. At the reservoir, the vacuum can be created by omentum without changing the reservoir [(8)].

Devices with vacuum assisted closure (VAC®)

Open wounds in the belly, chest, and limbs can be closed with VAC® devices. When primary laparotomy wound closure is unachievable due to increasing abdominal pressure or in situations where a second opinion laparotomy may be necessary due to a severe abdominal infection, abdominal VAC® dressings are employed. A non-adherent, porous film that serves as protection for the abdominal viscera is covered with polyfilms and a sponge. A negative pressure can be produced by using a vacuum pad [(9)].

Although VAC® dressings are a particular kind of wound dressing, fall under the category of vacuum drains since they function more compared to cavity drains, like surface drains.

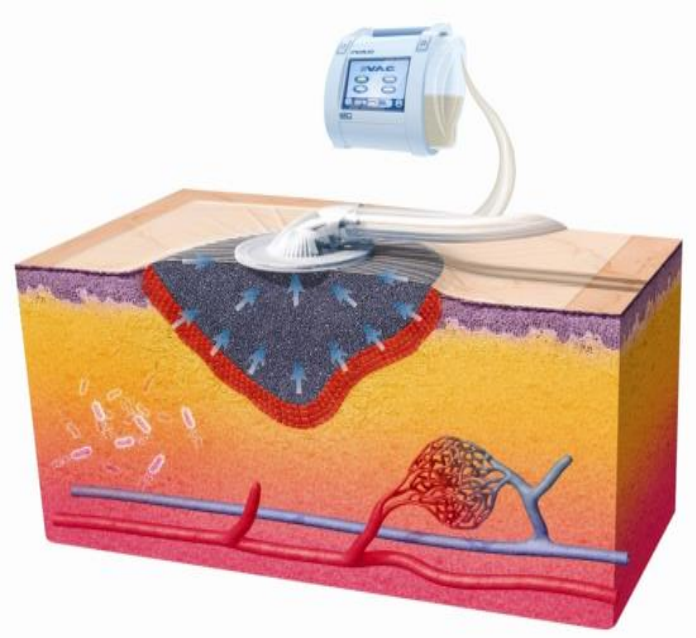

Figure 3: Vacuum assisted closure device [10].

Indication:

- To avoid the buildup in fluid (blood and infected fluids).
- To avoid air from accumulating (Silent space)
- T0 describe the gathered fluid (like detection of anastomotic leakage) [11].

Technique:

1. Add a Drain Catheter:

The drainage catheter features several openings on one end enabling fluid to pass through and a pointed tip (trocar) to penetrate the skin. Knowing anatomy is crucial when inserting the drain to prevent damaging key tissues like arteries or nerves. Place the drain beneath the skin with the trocar pierced, and apply counterpressure above the skin's surface. To prevent unintentional harm, pull the trocar through the skin and tuck the trocar's pointed end with the safety rubber. Trim the perforated catheter to the required length after pulling the catheter until all holes are just within [12].

2.Using sutures to secure the drain catheter

A skin suture is obtained close to the drain site, and a loose square knot is made on it. (i.e., hanging knot). After that, wrap a double knot around the drain catheter and repeat multiple times, throwing the knot the catheter's rear and front [13].

3.Keeping Drain Secure During Microvascular Techniques

vascular repair site should not be crossed by the drain catheter. The drain catheter, which was placed inside a flap, was stabilized with one or two more stitches before fixing the drain as previously mentioned. The extra suture, which was introduced through the skin via the nearest catheter hole and then reinserted through the skin, forms a loose knot on the skin side.. The drain won't be moved by using this way of security. To provide for additional care, it is necessary to demonstrate to the nursing personnel where the anchoring suture was placed [12].

4. Making the Circuit Complete

A clamped plastic tube with a drain is connected to the cut catheter trocar. A bottle of negative pressure in the high-pressure drain, a bulb in the low-pressure drain, and the given reservoir drain are all linked to the opposite end of the plastic tubing. When the clamp-on plastic tubing is loosened skin wound has been dressed and closed [12].

5. Observe the drainage

After surgery, blood is instantly collected by the reservoir. The collections gradually lose their crimson color as time goes on. With occasional blood clots, the fluid subsequently turns yellow. In the event that the reservoir fluid abruptly transforms into milky white or blood with clots, the surgeon must be notified.

6. Taking advantage of the drain tube:

Milking keeps the tube from clogging. Hand hygiene should be done with water and soap before milking. Holding the tube initially with the non-dominant hand at the skin insertion point. Next, carefully squeeze the tube between your index and middle fingers while travelling around the source with your dominant hand. For easy gliding over the tube, use alcohol rub or hand sanitizer. With a finger in the tube, let the fluid flow into the reservoir. While milking, as much fluid as you can out of the tube is preferable than nothing. For each drain, two times every day, the tube must be milked. If milking the tube fails to bring the flow back, Inform the surgeon as you likely signifies that the tube is obstructed internally. Never cut, kink, or detach the drain tubing [12].

7.Taking the Collection Out of the Low-Pressure Bulb:

At least three times each day, or if it is more than 50% filled, the bulb is drained. It is necessary to thoroughly wash the hands with soap and water. and the drain care must be sterile. Remove the stopper at the top of the bulb's emptying port. Over measuring cup, invert source Gently squeeze the bulb fluid into a measuring cup. In a measuring cup, insert the day, time, and volume from the chart. Discard the liquid in the measuring cup in a sink or toilet. Precaution: Never remove the drain tubing from the bulb [12].

8. Making a low-pressure bulb pressurized negatively:

First, use an alcohol swab to clean the port aperture. The bulb should next be carefully squeezed by hand to flatten it as much as possible. Plug the stopper as far as you can into an emptying port with a flattened bulb. Check to see if the bulb is flat before releasing it. As the fluid fills the bulb, it slowly enlarges. The bulb's constant suction forces accumulated fluid out of the body. To improve drainage, attach a plastic tag to the bulb so that it is below where the drain is inserted [6].

9. High-Pressure Reservoir Changing:

cleaning using hand sanitizer or soap and water before starting to change the bottle. Make that the compressed nozzle and clamp are present on the new high-pressure bottle. Lock the bottle's two clamps. that will be taken out. To separate from the bottle's tube, remove the area surrounding the connection and an alcohol swab and unscrew it. Apply a fresh alcohol swab to the tube connector to clean it. Without touching the connector, attach the replacement bottle. Finally, let go of the new bottle's two clamps. The drain is kept ideally at the same hour every day, on a flat surface for measurement. Observe the fluid reading at eye level while drawing a line on a white label to indicate the measurement date. Record the quantity of drainage on the provided chart [(14)].

10. Treatment of the Site of Drain Insertion:

A tiny degree of swelling and discomfort at the drain insertion site persisted for a few days. is typical. In most circumstances, 48 hours after surgery, the patient can take a shower. Allow the shower's soapy water to drip down the drain. Following skin cleansing region, pat it dry and give it some time to dry. If you are unable to take a shower, at least once every day, clean with soap and water, clean the drain location. Cleaning the drain insertion site should come after performing hand hygiene with soap and water.

Daily dressing changes are made at the insertion site. Typically, the dressing is taken off before to taking a shower, and thereafter, infection symptoms are examined. A fresh dressing is then put on. The standard way of the drain site covered with tape and a folded piece of gauze. it down. Over the drain site, another folded piece of gauze is put and taped down[(15)].

Look for symptoms of infection such as pain, swelling that worsens, pus discharge, offensive discharge, or systemic signs like fever at the at the place where the drain was inserted. Inform the surgeon if any of the symptoms are present.

11. Drain removal:

It is standard procedure to check removing the drain when it falls below 30 ml/day and checking the drainage every 24 hours. for two days in a row [(16)]. Perform a last milking process to look for any leftover collections before cutting the suture. Holding the catheter is a suture in place is cut, and the tube is then clamped. Any clots that are still clinging to the catheter's perforated end are carefully removed when it is progressively taken out.

12. Dressing Following Removing drain:

piece of the gauze placed over the skin gaping wound where ,There was a drain, and taped in place. After 24 hours, the dressing can be taken off, and the patient is free to request a shower. The additional dressing is typically not recommended; instead, a week's worth of twice-daily applications of an antibiotic ointment may be provided [(12)].

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