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An Overview on Surgical Drains

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Abstract:

Background: Surgical drains are medical devices inserted into wounds, operative sites, or body cavities to facilitate the removal of fluid, blood, pus, or air. Their primary objective is to prevent fluid accumulation that may predispose to infection, impaired wound healing, or formation of hematomas and seromas. Drains may be classified into active drains (e.g., Jackson-Pratt, Hemovac) that rely on suction, and passive drains (e.g., Penrose drain) that depend on gravity or capillary action. Despite their wide use, the decision to insert a drain remains individualized, as indiscriminate use may increase infection risk or cause tissue irritation.

Keywords: Surgical drains, Active drains, Passive drains, Postoperative complications, Hematoma, Seroma, Infection prevention, Jackson-Pratt, Penrose drain, Wound healing.

Introduction:

The use of surgical drains represents an important aspect of postoperative management across a variety of surgical specialties. Their role is to evacuate unwanted collections, reduce tension at the operative site, and promote healing. Over the years, advancements in surgical techniques and perioperative care have questioned the routine use of drains, particularly in clean surgeries, where the risks may outweigh the benefits **(1).**

While drains can reduce the incidence of fluid collections such as seromas and hematomas, they may also increase the risk of retrograde infection and patient discomfort. Therefore, their application should be based on sound clinical judgment, balancing the anticipated benefits against potential risks **(2).**

Recent evidence suggests that selective rather than routine drainage leads to improved outcomes, particularly in procedures such as abdominal, breast, and orthopedic surgeries. Surgeons are encouraged to adopt evidence-based strategies, tailoring drain usage to the specific surgical context and patient risk profile **(3, 4).**

Suction drains are appliances used to collect blood, pus, or body fluids. They are active drains that maintain a negative pressure gradient. The collection reservoir of an active drain collects fluid by exchanging negative pressure, and the drain may become ineffective if the vacuum is lost. The type of drainage system is based on the needs of a patient, type of surgery, type of wound, expected amount of drainage, and surgeon preference **(5).**

Indications

Suction drains are used in different types of surgery. The primary purpose of a suction drain is **(6)**:

- To prevent the collection of fluid (blood and infected fluids).
- To prevent the accumulation of air (dead space).
- To characterize collected fluid (like identification of anastomotic leakage).

Equipment

Two commonly used suction drains are a low negative pressure bulb vacuum used to drain small amounts of fluid and a high negative pressure bottle drain used for more significant draining amounts of fluid. Its compressed green nozzle ascertains the negative pressure on the bottle **(7).**

A radiopaque silicone catheter with multiple perforations on one end and a sharp trocar on another end is accompanied by the device **(7).**

Principles for Abdominal Drainage

The issue of abdominal drainage has undergone great development. The advantages and disadvantages of drainage, questions of when, how, and what to drain during operations are considered. However, there is some consensus. In elective or minor uncomplicated abdominal surgeries (appendectomy, cholecystectomy), most authors are inclined to recommend not draining the abdominal cavity. Drainage is always recommended for potentially complicated surgical procedures where complications may be expected. Drainage should never be conducted by the surgical wound - due to the weakening of the wound and the possibility of postoperative herniation at the site of the drain and the risk of possible infection of the surgical wound. In places where we do not see, the drain is placed by hand. Direct drainage of the drain with the anastomosis should be avoided **(8).**

When draining the peritoneal cavity, it is necessary to be aware of the most common places of fluid accumulation. In the vertical position, the lowest stored area of the abdominal cavity is the Douglas space, in the horizontal position the subphrenic space on both sides and also the Douglas space **(9).**

The Most Important Criteria for Drain Selection

Drainage efficiency (performance), biostability and biocompatibility are the most important criteria. Rubber hoses are nowadays rejected due to poor biostability and surface structure deficit. The only exception is their use in Tdrainage. As a result of secondary structural changes in the drainage material, which are caused enzymatically, there is a progressive rigidity of the material with increasing storage time in the body. Prolonged intra-abdominal drainage with rubber drains can lead to intestinal erosions. PVC materials should be excluded due to insufficient biocompatibility **(10).**

Drainage Efficiency

The total flow of the drainage system is the sum of all the individual streams that flow through the openings in the wall of the collecting channel. The flow in the collecting channel is turbulent, and beliefs are formed. An important parameter is the relationship of the sum of the areas of all side holes of the drain (f) to the cross sectional area of the collecting channel (b). Mainly drainage with a large f:b ratio did not initially show any pressure drop. The side openings in the rear part of the collecting channel suck the most, proportionally more than the openings in the front part. In the experiment, the authors tested and evaluated 14 different drainage systems and the following conclusions were drawn **(10):**

1. The larger the diameter of the drain, the larger the volume flow. The volume flow is the same in each cross section of the tube **(11).**
2. Drainages with a square cross-section at the beginning of the stream show approximately the same volume flow when compared to drains of circular cross-section with the same cross-sectional area size **(11)**.
3. For suction drainage, a certain wall resistance against collapse must be ensured **(11)**.
4. With the same geometry, the larger the volume flow, the more side holes of the same size are located on the drain **(11)**.
5. As the ratio of the sum of the areas of the side openings to the cross section of the collecting channel increases, the drainage capacity increases **(12).**

Complications

- Clot formation causes a sudden drop in fluid flow or fluid leak around the insertion site. Try milking the plastic tube. If it does not work, inform the surgeon **(13)**.

- It can get obstructed by small tissue fragments. The reduced collection may be misleading. When no fluid is collecting, check for occlusion or obstructed by adjacent tissue **(13)**.

- The catheter can fall out when it slips off the suture. If it happens, keep a pad at the drain insertion site and secure with adhesive tape. Inform the surgeon **(13).**

Clinical Significance

The performance of a closed-suction system can be optimized by increasing intracavitary tube length, decreasing extra cavitary tube length, increasing tube diameter, increasing the pressure differential, use a perforated catheter, squeezing a low-pressure bulb side-to-side, and milking drain tubing frequently. Whenever indicated, always use closed drain systems and keep drains as short as possible to minimize the risk of retrograde infections. Place the perforated catheter near but never in direct contact with the anastomotic site to prevent drain-induced erosions or leaks. Routine use of prophylactic drainage in colorectal anastomosis shows no benefit in reducing postoperative complications but reduces mortality **(14).**

Patients with large volumes of fluid from the surgical site usually continue to do so after drain removal. They would benefit by keeping the drain for a prolonged period. Surgical site surface area is also a deciding factor to consider when pulling a drain. Drains used for prophylaxis in surgery, such as pancreatic surgery, are removed early to prevent postoperative complications **(15).**

Surgical Drains in Laparoscopic cholecystectomy

Thirty-one years after Langenbuch performed the first cholecystectomy in 1919, a cholecystectomy performed without drains was called the "ideal technique" in Germany. Although many subsequent studies support this statement, the use of drains following cholecystectomy remains controversial. Although there is no supporting scientific evidence, it would not be a mistake to call the routine use of drains after abdominal operations a traditional practice. In view of the higher probability of preventing surgical complications, such as leaks and bleeding or of early detection with a drain, the frequency of drain use can be better understood **(15).**

Other studies claim that closed drainage systems are not useful after abdominal operations, such as cholecystectomy, colorectal resection, and pancreatic resection and suggest that drain use increases the likelihood of intra-abdominal and wound site infections and hence the duration of hospitalization with worsening lung function **(16).**

The real reason for placing a drain in the subhepatic area after cholecystectomy is the fear of biliary leakage or bleeding, which can lead to peritonitis. This makes drain use a more effective option in the presence of an aberrant biliary tract, suspicion of clipping the cystic canal, or when dissection is difficult enough to cause bleeding **(17).**

Bile leak and bile duct injury are the two most feared complications of LC for acute cholecystitis. The reported incidence for bile leak after LC for acute cholecystitis is approximately 2–3%. Studies from the era of open cholecystectomy showed that most patients who underwent laparotomy for post cholecystectomy bile peritonitis had drains placed, suggesting that drain placement does not detect this complication effectively. Drains are also not effective to treat bile leak in elective LC **(18).**

However, large series from the era of open cholecystectomy showed that most patients, who underwent laparotomy for post cholecystectomy bile peritonitis, had drains placed, suggesting that drain placement does not detect this complication effectively. Drains also are not effective to treat bile leak or bleeding in elective LC **(19).**

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