Section A-Research paper

Surgical Drains for Wound Healing After Gynecological Surgeries

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Abstract

Background: Wound complications lead to extended stays in hospital, worse quality of life, and increased treatment costs. In gynecological cancer, wound complications have been shown to be associated with increased readmission rates and postoperative mortality, and delays in chemotherapeutic treatment after abdominal surgery .Because the risk for wound complications, many techniques have been investigated to reduce these complications. Reduction in operative time, use of perioperative prophylactic antibiotics, irrigation of the operative site, adequate hemostasis, avoidance of dead space, and meticulous surgical technique have been shown to help reduce the risk for postoperative wound complications . The premise behind these techniques is to reduce the presence of bacteria and decrease the amount of subcutaneous tissue dead space.

Keywords: Surgical Drains, Wound Healing, Gynecological Surgeries

Introduction

Wound healing remains a challenging clinical problem and correct, efficient wound management is essential. Much effort has been focused on wound care with an emphasis on new therapeutic approaches and the development of technologies for acute and chronic wound management. Wound healing involves multiple cell populations, the extracellular matrix and the action of soluble mediators such as growth factors and cytokines. **(1).**

Although the process of healing is continuous, it may be arbitrarily divided into four phases: (i) coagulation and haemostasis; (ii) inflammation; (iii) proliferation; and (iv) wound remodeling with scar tissue formation. The correct approach to wound management may effectively influence the clinical outcome. **(1).**

The human body can sustain a variety of injuries including penetrating trauma, burn trauma and blunt trauma. All of these insults set into motion an orderly sequence of events that are involved in the healing response, characterized by the movement of specialized cells into the wound site. Platelets and inflammatory cells are the first cells to arrive at the site of injury and they provide key functions and "signals" needed for the influx of connective tissue cells and a new blood supply. These chemical signals are known as cytokines or growth factors. **(1).**

History now gives credit for the invention of the rubber drainage tube to chassaignac of france after his publication in 1859. In 1865, **Eugene koeberle** introduced a glass tubular drain which was modified by Keith and Wells into a cylindrical glass tube open at both ends and having side holes **(2).**

New materials for drain were introduced. In **1880'sNeuber** used an absorbable tubular drain of decalcified ox bone**.** Other drains used included catgut, gutta-percha Molded rubber drains, gauze enclosed in a rubber sheath and horsehair **(3).**

In 1880's, **Mikulicz** drain or "tampon" was introduced, It was constructed by placing a fenestrated sheet of rubber in the area to be drained and filling it with lengthy strips of gauze. The rubber dam was folder over the gauze and both were brought out through the wound. The gauze was gradually removed over a 48 hour period allowing the dam to collapse before its removal the following day **(4).**

In 1890 Penrose used tubular and capillary drain as well as combination of each. He placed gauze inside of glass tubes and rubber sheets aiming at prevention of accumulation of fluid in the peritoneum. After less

than three decades of widespread use, **Howard Kelly** believed that, drainage is a marker of imperfect surgery. Also **Halsted** believed that meticulous surgical technique and obliteration of dead space eliminated the need for drains in nonseptic instances. As prophylactic drainage produces necrosis of the contact tissues towards organisms **(5).**

Before the end of 19's century, the last innovation in drainage was the advent of the suction drain in England. In **1898 Heaton** placed a smaller perforated catheter inside the glass drain and attached water activated suction **(5).**

The use of drains began to decline gradually and the experience gained during world war I would have a major further marked reduction of their use **(6).**

The indications for the use of drains diminished to their therapeutic use in the presence of free purulent material in considerable quantity and the presence of an abscess sac "The indications for suction drain were used in deep or large abscess cavities when gravity drainage could not be achieved **(6).**

Clinical applications of drains

Drains are useful for helping to remove purulent material from wounds in the subcutaneous tissues. Passive Penrose drains are best are often used for this purpose and can work well when placed properly. Passive drains need to exit at the most dependent part of the wound or abscess pocket and must be covered at all times.Active drains such as the Jackson-Pratt can be used although they can be more uncomfortable when used in areas over tendons and joints**.(7).**

Drains are placed just prior to abdominal closure. Location is not as important since these are active drains, so they do not need to be placed so that they exit at the most dependent site. **.(7).**

Open abdominal drainage (OAD) is also an option for abdominal drainage. With this technique a portion of the abdominal incision is left open (a length that is about the size of a gloved hand), and sterile wraps are placed over the wound. The frequency of wrap changes depends on amount of fluid drained and external soiling. These are far more labor intense than an active suction drain such as the Jackson-Pratt as bandage changes require significant sedation or general anesthesia to prevent evisceration. A good alternative to open abdominal drainage for patients with significant abdominal contamination is using NPWT.(**8).**

- **Classification of surgical drains:**

Drain can be classified based on various factor:

Table (**I**) classification of drains:

Based on factor	**Type**	
Mechanism	Passive	Active
Nature	Tube	Sheet\flat
Disposition	Open	Closed
Location	Internal	External
Property	Inert	Irritant

(9).

- **Passive drains:**

These are drain that act by the mechanism of capillary action, gravity or the fluctuation of intra-cavity pressure. Corrugated rubber drain, Penrose drain, sump drain are examples of this type. These drains are used when drainage fluid is too viscous to pass through tubular drains **(10).**

- **Active drains:**

These are tube drains that are aided by active suction which could be low continuous, low intermittent or high suction drainage. Jackson-Pratt drains, Surgivac drain, Redivac drain are examples. Reliable measurement of effluent can be done. There decreased risk of wound infection, minimal tissue trauma and no skin excoriation. However, regular activation of reservoir is often required **(11) .**

Specific active drains

In small animal simple tube drains attached to intermittent or continuous suction are frequently used for deep wounds, suctioning of the pleural space or under full thickness grafts. Continued use of high negative pressure may cause injury to tissues and if the system is suddenly disrupted, reflux of fluid may occur increasing the risk of infection. The internal drain tubing in closed suction drains is often multi-fenestrated. (**12)** .

The external drain tubing can be connected to a variety of devices including a homemade suction device created using a three-way stopcock and 30mL syringe. The connected syringe may be withdrawn to the desired negative pressure and held with a small pin or needle across the plunger. Alternatively, the tubing from a butterfly catheter can be placed into a wound as a drain and the needle can be inserted into a blood collection tube (10mL), which will have the negative pressure to pull fluid out and be the container to store it. **(12).**

A bulb (grenade) with the air evacuated can be connected to a closed suction drain and used to create negative pressure (Jackson-Pratt drains). A more active negative pressure wound therapy (NPWT) system (e.g. VAC system –Vacuum Assisted Closure) can also be used in both small animals and equine patients. **(13).**

NPWT is used to help evacuate wound fluid from a wound bed as well as to help stimulate and create a healthy granulation bed in a large wound. This process involves creation of negative (subatmospheric) pressure via continuous or intermittent suction over a wound bed. The wound to be treated by suction is prepared for aseptic surgery and the wound and its edges are cleaned and debrided. Ideally, no necrotic tissue should be left behind. A sponge (open cell sterile polyurethane foam) is cut to slightly overlap the wound size. **(13).**

The continuous suction device is attached to the sponge. The entire sponge and the suction device are covered by a special occlusive film, which provides an airtight seal between the wound and the normal skin. A bandage is applied to protect the device and maintain external pressure. When suction is applied, the wound exudate is evacuated and it accumulates in a container. It is recommended to use continuous suction in our veterinary patients as changes in suction have been reported to cause discomfort in people. **(13).**

The continuous negative-pressure setting most commonly used during NPWT is –125 mm Hg. Initial animal studies showed improved blood flow and granulation tissue formation with intermittent suction (5 minutes on, 2 minutes off); however, human patients reported more discomfort when suction was applied intermittently than when it was continuous. Veterinary patients tend to tolerate continuous suction well and do not require pain medication specifically for NPWT. NPWT dressings are changed every 48-72 hours under sedation or anaesthesia as removing the sponge can be painful. **(13).**

The mechanisms of action of NPWT are that it decreases interstitial edema, increases tissue blood flow, accelerates granulation tissue formation, increases bacterial clearance, and hastens wound closure by providing mechanical tension on skin to promote mechanical creep of skin. Complications of NPWT use include loss of the airtight seal, which can cause wound fluid to accumulate over the wound bed and the surrounding skin, which can cause significant local dermatitis. **(14)**

If the NPWT is left on for too long granulation tissue can grow into the pores of the foam, which will make removal of the foam painful for the patient and will cause bleeding and removal of healthy granulation tissue. Contraindications for NPWT use include limited ability to debride wounds (the NPWT device will not remove devitalized or necrotic tissue), malignancy (application over neoplastic cells can increase blood flow and stimulate cellular proliferation within the wound bed) and bleeding, care must be taken near exposed arteries and veins. It is possible for the foam to erode through exposed vessels, resulting in extensive blood loss. Coagulopathies or active bleeding are also contraindications to NPWT use. **(14)**

Table (II) the major difference between active and passive drains

	Active	**Passive**
Function	Work by active suction	Depend on pressure differentials
Pressure gradient	Negative pressure (low ,moderate and high)	Positive pressure
Drain exit site	Dependant position not necessary	Dependant position necessary for best function
Drain site dressing	Minimal or not required	Bulky to absorb fluid output
Measurement of effluent	Reliable and accurate	Difficult to quantify
Fluid recollection	Unlikely because negative pressure improve tissue apposition	Likely because of limited effect on the dead space
Retrograde infection	Lower incidence	High incidence
Obstruction of drain	More common	Less common
Radiographic studies	Easy to perform	Difficult except in special circumstances like T-tube
Pressure necrosis	High incidence	Low incidence

- **(9)**
- **. Tube drain:**

These are hollow tubes of varying materials brought out through a body orifice or stab wound. when they are connected to a bag, they become closed but when left alone they remain open drains multiple holes on the end are necessary and essential in case one hole becomes blocked **(10).**

- **Sheet drain:**

These are drains mad in sheet of gutters or parallel tubes through which fluid passes. corrugated rubber drain, which the fluid tracks through the gutters to the surface, is one commonly used example of this type of drain **(10).**

- **Flat drain:**

These are drains that are made flat with 3/4 or full-length multiple perforations which can be connected to a tubing system, thus, convert it to a close system or left opened. The inner wall of the flat segment usually has internal ribs to prevent it from collapsing or kinking. They are often used for various surgeries, including plastic and reconstructive surgery. **(9).**

- **Open drain:**

These drain empty directly to the exterior into the overlying wound dressing or stoma bag.

Corrugated rubber drain, Penrose gauze wick drain and glove finger drain are examples of this type of drain they are mostly used in superficial wounds and cavities.

Drained fluid collects in gauze pad or stoma bag which can easily be changed.

It's simple and easy to apply. However, it's often difficult to measure the effluent. High rate of wound infection, trauma to the skin from repeated changing of dressings, skin excoriation and erythema due to irritation by the effluent has been noted **(15).**

Closed drains:

These are hollow tubes of varying materials brought out through a body orifice or stab wound and are connected to closed system of sterile drainage bag. Under water seal drainage system is an example. This drain is mostly used in deep cavities the risk of skin excoriations and surgical wound infection is less.
Effluent can easily be collected and measured. However, reflux of the content of a contaminated reservoir has been noted **(15).**

- **External drains :**

These are that are brought out through the body wall to the exterior. The fluid discharge is channeled from the deepest part of the cavity to the exterior. This can be passive or active drain **(9).**

- **Internal drain :**

These are drains that are placed internally within luminal organs to create a route or to connect tow luminal organs.
They divert retained fluid from primary drainage site or area to distal body passage or cavity in order to bypass an obstruction.
They are used in:

1. Neurosurgery for internal drainage of hydrocephalus.
2. Gastrointestinal surgery where other tube Celestine tube and could be to palliate malignant obstruction of the esophagus **(15)**

- **Inert drains:**

This group of drains is non-irritative to the tissue and so ideally do not provoke tissue fibrosis. Examples include polyvin
l chloride, silastic and silicone drains. **(9).**
(9).

Figure (1) penrose drain

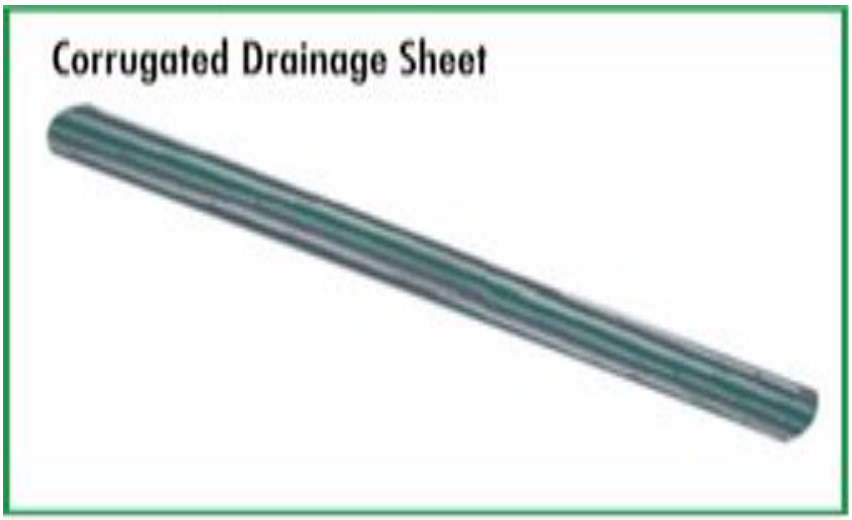
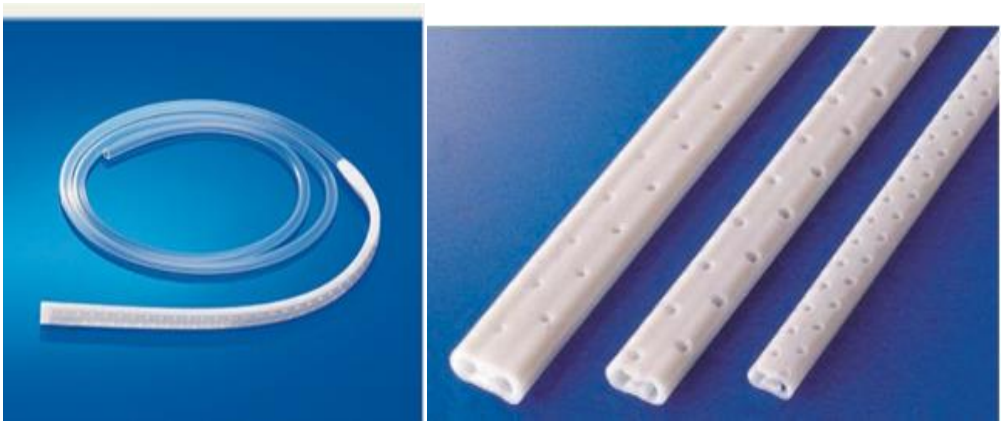


Figure (2) sheet of corrugated rubber drain

Figure(**3**) redivac drain

Fig (**4**) close tube drain

Figure (5) tube drain open
(9).



Fig(6) flate drain

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- **Therapeutic:** - drain permits the exit of gases and liquid and could be used to treat conditions like hydrocephalus, urinary retention, and abscess cavity **(16).**
- **Palliation**: - It could be used as a palliative measure to bypass a Luminal obstruction **(17).**
- **Diagnostic: -** T-tube cholangiogram as apost cholecystectomy diagnosis of retained stones in the common bile duct'**(18).**
- **Prophylactic**: To prevent postoperative complication that could arise from fluid accumulation in a wound cavity **(19).**
- **Monitoring: -** For instance, monitoring progress by Nasogastric tube in a patient with upper gastro intestinal bleeding monitoring of urinary output **(10).**
- **Access route:** - for percutaneous therapy e.g useful in percutaneous nephrolithotomy **(20).**

Complication of drain

- **Tissue reaction** particularly when irritant drains are used may be enormous and detrimental. Careful selection and Use of non-irritant drains should prevent its complication **(10).**
- **Source of contamination: -** the fact that a drain is a conduit allows opposite traffic within it, thus, increasing the possibility of surgical site infection. However, strict aseptic and proper drain care, if observed will limit rate of surgical site infection. Occasionally, antibiotic cover may be necessary particularly in susceptible drains **(10).**
- **Delayed return of function**: - limitation of movement inpatient with surgical drain may cause a delayed return of function. Early mobilization is paramount in this case (**17).**
- **Retained foreign body: -**
- This may be possible when the drain disintegrates following enzymatic action, trauma or undue traction, Proper selection of drain, adequate care and prompt removal after use will suffice. **(9).**

- **Tissue necrosis: -** from pressure of very hard or stiff drain may be prevented by the use of soft drain **(9).**
- **Bowel herniation:** -May occur through the weak drain site particularly when it was complicated by infection. Proper drain Insertion technique and meticulous care will prevent this complication occasionally, the drain site may need to be closed by one or 2 sutures to prevent herniation **(15).**
- **Hemorrhage: -** Occurs during insertion or from repeated injury of the surrounding tissue, especially during mobilization and change of dressing. A stiff drain may also precipitate bleeding if it erodes into a large vessel. If this continuous, the drain should be removed under vision and hemostasis secured **(9).**

- **Prolonged healing time: -** A drain is a foreign body therefore its Presence in the tissue may delay or prolonged wound healing. Every drain must be removed when it's no longer needed **(9).**
- **Drain entrapment and loss: -** The drain may become entrapped when fibrous adhesions develop around it. **(9).**
- **Fluid, electrolytes and protein loss:-** this may occur, particularly when the output is high **(21).**
- **Erosion of viscera: -** particularly drains that are placed within the peritoneal cavity without a well-defined abscess cavity. This should be avoided as much as possible **(9).**
- **Migration of the drain: -** A drain may migrate into the tissue or fall off proper anchoring and care should prevent it from migrating. Radiologic investigations may occasionally be needed to locate internally migrated drains **(21).**

Conflicts of Interest: The authors declare no conflict of interest.

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