The function of a drain is to remove unwanted fluid (e.g. purulent exudate, urine, serous fluid, or bile) or gas (e.g. pneumothorax) from a wound or body cavity. The use of drains appropriately can accelerate the healing process, however inappropriate usage may slow healing (e.g. via the introduction of infection) and potentially increase morbidity or mortality. Drains are not a substitute for inadequate wound cleaning, debridement or lavage. In most clean procedures, dead space can and should be closed with fine sutures and an appropriate closure, rather than rely on a drain. “Dead space” is an abnormal space within a wound due to disruption of interstitial connective tissues into which blood or serum accumulates. The fluid accumulation in this space is a great medium for bacterial growth.

Indications for drain use
The three main indications for drain placement include elimination of dead space, evacuation of collections of fluid or gas, and to prevent anticipated accumulation of fluid or gas. Other indications include instances when foreign material or tissue of questionable viability is present in a wound, or when massive contamination is deemed inevitable, such as with a wound in the anal area.

Types of drains
Drains may be passive or active. Passive drains rely on gravity, capillary action, natural pressure gradients or overflow to control gas/fluid outflow. An example of a passive drain commonly used is a penrose drain. These drains must be placed so that they exit in a dependent position for effective function. Active drains create and rely on negative pressure (suction) to promote outflow of gas or fluid. An example of an active drain is a Jackson-Pratt drain. The ideal drain is soft (comfortable for the patient), inert, radio-opaque and non-reactive. The mere presence of a drain (or any foreign material) within a wound reduces the number of bacteria necessary to cause a clinical infection by a factor of 10,000. Therefore, active drains are preferred for most wounds in veterinary patients because these closed systems significantly decrease the likelihood of ascending infections. Active drains also allow more precise quantification of drainage fluid, and provide a minimally invasive opportunity to the clinician to perform cytological examination of the draining fluid on a regular basis.

Drain placement
In order to properly place a drain several measures need to be taken. The hair surrounding the wound and the proposed area of drain placements should be liberally clipped and the site of drain placement and drain exit should be aseptically prepared. Anaesthesia may be either local or general, depending on the status of the patient and the type of drain to be placed. Consider placing a Penrose drain in a small laceration or abscess versus placing a chest drain in a sick animal with chylothorax. In sterile wounds the drain should be placed under aseptic conditions. Additionally the drain should be covered in a sterile primary bandage layer before placing secondary and tertiary layers. Bandages should be changed before wound fluid ‘strikes through’ to the outer layers of the bandage. This is especially important when using passive drains such as Penrose drains. Penrose drains should not be placed and then left to drain to the environment without a bandage on top. This allows potentially infected material to contaminate the hospital (and possible owners home) and allows for ascending nosocomial infections not to mention the mess that they can make.

Drains should be placed into the space requiring the most drainage. On occasions several drains are needed to evacuate a large area or several different tissue layers. Passive drains must exit through the skin at the most ventral or dependent aspect of the wound or dead space. Drains can cause some mechanical damage and therefore they should not be placed near nerves, major blood vessels and suture lines. Drains can erode through vascular walls within a few days and cause life-threatening blood loss. Drains should exit through a separate incision away from the primary suture line. It is important to secure the drains with individual sutures at the exit point to prevent loss into or out of the wound. Penrose drains can be tacked at the proximal aspect if desired but this is usually not necessary to keep them in place. This tacking suture should be easily distinguishable from the primary wound sutures and the drain should not be attached to subcutaneous or deeper sutures, which are inaccessible without completely opening the wound again. The drain should be long enough both for easy removal and to prevent disappearance into the wound. Drains need to be protected from the patient and environment. This is usually accomplished by using an Elizabethan collar on the pet and a bandage to cover the drain and/or to secure it to the body (such as in the case of a grenade from a Jackson Pratt drain).

Drain management
The amount of drainage dictates the frequency of bandage changes or when the drainage containers need emptying. The volume of drainage such as via a Jackson-Pratt drain should be recorded and totalled daily. This gives an objective measure of whether fluid...
accumulation is decreasing or increasing and can help to gauge whether treatment for the patient is having the desired effect. Gloves should always be worn when handling a drain. The drain exit site should be cleaned at every bandage change. If a passive drain is used, it is advisable to protect the adjacent skin from irritation by a thin layer of Vaseline or triple antibiotic ointment. Drains should not be back-flushed. Back-flushing will cause introduction of microorganisms into the wound.

As a general rule drains should be removed as quickly as possible; the average time is 2-4 days, which coincides with the debridement period of wound healing. Exceptions to this rule include instances where blood is being evacuated from a small cavity, which may allow the drain to be removed after about 24 hours. When treating known bacterial infections the drain should be left in place for 48-72 hours or longer if needed. If a large amount of dead space is present (e.g. following removal of a large lipoma), the drain may need to be left in place for up to 2 weeks.

The best indicator for removal of a drain is an abrupt decrease in the volume of fluid being removed and a change in its characteristics to serous, non-odorous but slightly turbid fluid. It is important to remember that a drain is a foreign material to the patient’s body, so the body will produce a certain amount of fluid just due to the presence of the drain. As a general rule 1-2 ml/kg of fluid will be produced by the body in reaction to the presence of a drain. It is rare for drains to completely stop being productive. Be careful not to remove a drain to soon as seoma formation can occur in wounds if drains are pulled too early. At the time of drain removal, the exit site is prepared aseptically, the retention sutures are cut and removed, and the drain can be removed – usually without sedation unless the patient is intractable. It is important to ensure that no contaminated drain is pulled through the wound bed (see further notes on contraindications for through and through drains). The drain exit incisions are generally left to heal via second intention. They will sometimes continue to drain a small amount of fluid so bandaging the area or covering it with an absorptive dressing can be helpful to prevent this fluid from contaminating the environment or dirtying the owners couch or carpet.

Drain complications
Foreign body response and ascending infection are the most common complications of drain placement. This can be serious in the case of multi-resistant pathogens e.g. MRSA and MRSP. If a portion of the drain is accidently left in the wound, the wound will continue to drain (and an infection could persist) until it is removed. Cultures should be obtained and cytology should be considered if the character of the wound fluid changes to become more purulent or the volume of drainage increases dramatically. Kinking of the drains occasionally occurs, which will cause ineffective drainage. Suture dehiscence or damage to vessels and nerves may occur (particularly if placement is blind), and rigid drains may cause pain and discomfort. Incisional hernias may occur if the drain hole is too large or the drain is placed in the primary incision. Premature removal (either by the veterinarian or patient) could cause a recurrence of the seoma or abscess and may necessitate replacement of the drain. It is vital that the drain is covered at all times, connected to the body and that the patient is wearing an Elizabethan collar while the drain is in place to prevent trauma and self-removal of the drain.

Specific passive drains
Gauze drains are prepared from gauze rolls or gauze sponges – they may be soaked in antibiotic or antiseptic. They are applied as packing in profusely bleeding cavities (e.g. after nasal septum or nasal mass removal) or in an abscess that cannot be drained even at its lowest point. They are cheap and easy to place, although the adherence of fibrin clots to the gauze usually results in a certain amount of bleeding at removal.

Penrose drains are the most commonly used passive drain in small animal practice. They are made from thin latex material and are soft, pliable, easily sterilised, readily available and economical. Penrose drains cause little foreign body reaction. They are available in widths from ¼ inch to 2 inch wide and in lengths from 12 to 36 inches. They can be shortened as needed. Most drainage occurs extra-luminally and is driven by gravity or capillary action. Penrose drains work because of available surface area of the drain itself and should not be fenestrated as this reduces their surface area. Fenestrations also weaken the drain and may result in breakage and subsequent incomplete removal if adhesions between the drain and soft tissue develop. Penrose drains should only have a ventral exit and NOT have a dorsal exit (i.e. snorkel, “through and through” placement technique). A dorsal exit does not help with drainage and will only serve to allow contaminants into the wound. A ventral exit point for the drain is sufficient. An exception is the inguinal or axillary regions where a single incision may act as a one-way valve and draw air into the wound as the animal moves creating subcutaneous emphysema. In these instances, a dorsal incision should be created to allow air to escape. In these cases it may also be preferable to use a suction drain such as a Jackson-Pratt drain.

Penrose drains can be used successfully in wounds that cannot be completely debrided with the presence of residual foreign material, wounds that contain massively contaminated tissue, wound with unquestionably viable tissue, and fluid filled dead spaces. Penrose drains should not be used with suction (they collapse), and they cannot be used in the abdominal cavity (they become quickly walled off and allow ingress of bacteria) or the thoracic cavity (they allow air to pass into the thorax!!!). Penrose drains should be covered with a sterile absorbent dressing to absorb fluid and prevent wound contamination. Bandages should ideally be changed just before they strike through, and the exit site should be cleaned daily.
Tube drains differ in form and material; with and without side holes. They can be relatively stiff single tubes of red rubber, plastic (e.g. polypropylene) or Silastic (Silicon). Silicon is less reactive than plastic, which is less reactive than red rubber. Tube drains function mainly by intraluminal and some extraluminal flow. They can be fenestrated to improve access to the lumen and can be used in an open or closed fashion. Tube drains can be successfully used for draining wounds as well as the abdomen, urinary bladder and thorax. Some may be connected to a suction apparatus to evacuate fluids without collapsing and to allow irrigation. One disadvantage of tube drains is that they are easily obstructed so they may become ineffective until they are back-flushed (which is less than ideal) to make them patent again, and this obstruction may occur frequently.

Specific active drains

Clinical applications of drains

Drains are useful for helping to remove purulent material from wounds in the subcutaneous tissues of dogs and cats. 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.

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Drainage of the abdomen may be indicated in cases such as septic peritonitis and bile peritonitis. In cases of septic peritonitis in small animals, the mortality rate is 30-50%. This is an expensive disease to treat optimally. These animals require intensive 24-hour care. They quickly lose protein rich fluid in their effusion leading to hypoalbuminemia and electrolyte imbalances. Post-operative nutrition is integral in management as is repeat fluid cytology, repeat blood testing and fluid therapy.

For abdominal drainage a PVC or silastic drain (e.g. Jackson-Pratt) is most appropriate, although recent studies have shown success with using NPWT for patients with septic peritonitis as well. A Penrose drain is not appropriate for abdominal drainage. As
mentioned previously, Penrose drains tend to get clogged easily and quickly with omentum, and it is very difficult to maintain a sterile environment using a passive drain. Usually 1-5 Jackson Pratt drains (depending on the size of the patient and the amount of contamination) are placed in small animal patients with septic peritonitis. 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.

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 eversionation. A good alternative to open abdominal drainage for patients with significant abdominal contamination is using NPWT.

A completely closed system must be maintained when draining the thorax, and this creates unique challenges when using thoracic drains. In dogs removal of fluid from the thorax is best achieved using an active drainage system. Multifenestrated PVC drains surgically placed, or thoracic trocars percutaneously placed, are suitable for this purpose. Red rubber tubes are also an option, although depending on the viscosity of the fluid to be drained these may clog too quickly (such as in the case of a pyothorax). A closed suction device is applied to the catheter and maintained until drainage subsides. Depending on the volume of fluid needing to be removed, intermittent drainage of chest tubes is also acceptable. Thoracic drains are usually quite large in diameter (10-32 French, depending on patient size) and need to be secured to the patient with either a purse string suture followed by a fingertrap-type suture pattern, or three or more, interrupted sutures through the patient’s skin and around the tube. The thoracic tube should also have a C-clamp (to prevent pneumothorax in case the end is bitten off or otherwise removed) and a Christmas tree, and three-way stopcock to allow easy removal of air or fluid. It is vital that all personnel working with and emptying the thoracic drain are familiar with how a three-way stopcock works.

Further reading