Preventing Surgical Site Infections Related to Abdominal Drains in the Intensive Care Unit

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Surgical site infections are significant contributors to health care–associated infections. Nursing interventions may help decrease the incidence of surgical site infections, particularly in regards to the management of postsurgical abdominal drains. This comprehensive guide, compiled from evidence-based practice literature, is intended for nurses to use to reduce surgical site infections secondary to postsurgical abdominal drains. This article focuses on drain management in intensive care unit patients, who are at risk for infection because of their immunocompromised state. (*Critical Care Nurse*. 2018;38[4]:20-26)

Health care–associated infections (HAIs) result in lengthened hospital stays, increased medical costs, and poorer patient outcomes.[1] Studies of evidence-based practice have shown that nursing interventions help reduce the incidence of HAIs. For example, since 2008 the "Scrub the Hub" campaign has contributed to a 50% reduction in central catheter–associated bloodstream infections (CLABSIs).[2,3]

Although nursing interventions for the prevention of common HAIs such as CLABSIs and catheter-associated urinary tract infections have been explored in depth, few initiatives have focused on nursing interventions for the prevention of surgical site infections (SSIs) related to postsurgical drains. An estimated 60% of SSIs are preventable using evidence-based practices.[4] To prevent SSIs, practitioners must be educated on SSI prevention practices and surveillance. Topics addressed in this article include prophylactic management of *Staphylococcus aureus* infection, postsurgical drain assessment, dressing selection criteria,

CE 1.0 hour, CERP A

This article has been designated for CE contact hour(s). The evaluation tests your knowledge of the following objectives:
1. Assess postsurgical abdominal wounds for infection and effectively communicate findings to health care providers
2. Describe at least 5 nursing interventions that reduce the risk of infections related to postsurgical abdominal drains
3. Identify the appropriate dressing for postsurgical abdominal wounds at various stages of healing

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tips to maintain drain patency, and assessment indicators for discontinuing drainage catheters.

Background

Surgical site infections are currently the most common and costly of all HAIs.[4] According to recent data published by the Centers for Disease Control and Prevention, nearly all US hospitals continue to report SSIs following abdominal procedures.[3] These infections are defined by purulent drainage from the incision or a positive wound culture result in the presence of fever, localized pain, or abscess detected with imaging within 1 to 90 days postoperatively.[4] Abdominal drains are commonly placed to prevent the retention of bodily fluids at an anastomosis, remove tissue fluids such as lymph that accumulate in the peritoneal cavity, or prevent hematoma formation.[5] Although drains are placed to help prevent SSIs following abdominal procedures, the addition of a drain creates a host environment suitable for infection if not managed properly. Nursing interventions to prevent SSIs related to abdominal drains in the intensive care unit (ICU) are imperative because patients in the ICU experience longer stays than other hospitalized patients and are at greater risk for SSI because of their immunocompromised state.

Various forms of postsurgical abdominal drains are available. Drains are categorized as active or passive. Passive drains use gravity and pressure differentials between the wound and the environment outside the body to remove exudate from the wound bed. Passive drains are typically open to air. An example of a passive drain is the Penrose drain, a hollow, compressible tube made of latex or silicone that permits drainage of exudate from surgical sites. Active drains use negative pressure or suction to remove exudate from the wound bed into a reservoir or closed container. The active drains most commonly used in postsurgical abdominal procedures are polyvinylchloride and silicone drains connected to a 100-mL or 400-mL silicone bulb drainage reservoir (eg, the Jackson-Pratt drain, Cardinal Health, Inc). Active drains are frequently selected to prevent abdominal SSIs because of the ease of generating manual suction and because of their antireflux properties, which prevent backflow of fluid to the patient.[6] Active drains require maintenance to ensure their proper use and to prevent SSIs. This article addresses nursing interventions for properly maintaining negative-pressure drains.

Interventions to Prevent SSIs

Standard Precautions

Hand hygiene is the best way to prevent the spread of infection. Hands should be cleansed with soap and water or an alcohol rub solution before and after coming into direct contact with a patient, bodily fluids or secretions, or fomites and before and after using gloves. Gloves must be changed frequently to avoid transfer of pathogens to different areas of the body. If hands are visibly soiled, hands must be washed with soap and water. Appropriate personal protective equipment, such as gloves, gowns, masks, and goggles, should be worn during patient care that places the provider in direct contact with blood and other bodily fluids. Single-use items must be discarded after 1 use, and multiuse medical devices such as stethoscopes, tray tables, patient beds, and the like must be disinfected between uses.[7] Following standard precautions during all patient contact prevents the spread of harmful pathogens such as vancomycin-resistant enterococci, *Clostridium difficile,* and methicillin-resistant *S aureus* (MRSA), which may contribute to SSIs and other infections.

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Prophylactic Suppression of *S aureus*

The most common cause of SSI is *S aureus,* a potentially multidrug-resistant organism prevalent in the ICU environment. *Staphylococcus aureus* is a bacterium that resides on the skin and in the nares. Although *S aureus* may be part of a patient's normal flora, it may also be acquired during the hospital stay, acting as an

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opportunistic pathogen at the surgical or drain site. Evidence has shown that daily baths with cloths impregnated with 2% chlorhexidine gluconate (CHG) reduce multidrug-resistant organisms such as MRSA. Therefore, daily CHG baths help prevent SSI by decreasing the number of *S aureus* colonized on the skin.[8] In many ICUs, daily CHG bath practices are already in place as a means to decrease pathogens that contribute to the incidence of CLABSIs and catheter-associated urinary tract infections. In units where CHG baths are already in place, the importance of a thorough CHG bath for all ICU patients should be reinforced to limit SSIs due to postsurgical abdominal drains.

For patients whose nasal swab cultures are positive for MRSA, it is important to ensure contact isolation precautions are followed to prevent the spread of MRSA to care providers and other patients.[7] These precautions include cleansing the hands with soap and water or with an alcohol hand rub solution before entering and before leaving the room, wearing gown and gloves, and limiting the transfer in and out of the room of objects such as stethoscopes and glucometers that may host the organism.[7] In addition to receiving a daily CHG bath, patients whose cultures are positive for MRSA should also receive the antibiotic mupirocin swabbed in the nares daily for 5 days.[8] Mupirocin has been shown to be effective for eliminating *S aureus* in the nares immediately following application and for maintaining 90% eradication of the organism for up to 2 weeks following administration.[8] Because *S aureus* resides in the nares and on the skin, both sites must be addressed to prevent the transmission and colonization of the potentially harmful bacteria.

Staphylococcus aureus does not cause infection unless the number of organisms exceeds 1 million or a foreign body such as a postsurgical abdominal drain or Foley catheter is present. *Staphylococcus aureus* attaches to the foreign body via adhesions and creates a biofilm. It is therefore important to cleanse not only the skin with daily CHG baths but also to clean postsurgical abdominal drains and other foreign objects to effectively limit the presence of *S aureus* and decrease the patient's risk of acquiring an SSI.[9]

Postsurgical Drain Assessment

When assessing postsurgical abdominal drains, health care providers should address each of these questions: What type of drain was placed? Is the drain open (like a Penrose drain) or closed to air (as with Jackson-Pratt drains)? Where does the drain terminate in the body? How does placement affect the type, color, consistency, and expected odor of the drainage fluid? What is the volume of fluid obtained? Is there a dressing on the drain, and if so, does the dressing contain any drainage fluid? How does the skin look around the drain? Although the answers to many of these assessment questions vary depending on the drain type and its location in the abdominal cavity, healthy skin will have distinctly different characteristics from infected skin around the postsurgical abdominal drain exit site (Table 1).[6] Assessment findings will dictate selection of the appropriate nursing interventions. Additionally, many of these questions may be addressed in a thorough bedside report and during handoff, using knowledge and noting assessment findings identified by the previous nurse.

Table 1 Comparison of healthy and infected skin[6]

Healthy skin	Infected skin
Day 1-4: Skin edges are slightly swollen with mild redness	Purulent drainage
Day 5-13: Granulation tissue present; hard ridges at edge of incision	Positive culture result at the incision site
Week 2-1 year: Scar tissue forms	Pain or tenderness
	Localized swelling
	Redness
	Heat

Selection of the Postsurgical Drain Dressing

Standard postprocedural care includes the maintenance of a sterile dressing at the site for 24 to 48 hours.[10,11] If the dressing becomes saturated or loose, the dressing should be changed using sterile technique.[10] Before replacing the sterile dressing, cleanse the site around the surgical drain exit site with a swab containing CHG 2% (ChloraPrep, BD) to eliminate *S aureus* and other multidrug-resistant organisms.[12] It is important to select a dressing that keeps the wound surface clean and slightly moist, such as transparent film that allows gas exchange between the skin and environment (Table 2).[13] Place a sterile dressing over the top.[13] If a large amount of exudate is present, notify the provider because the drain may need to be sutured or evaluated for proper placement and functioning.

Table 2 Wound dressings[12]

Postoperative time, h	Wound	Exudate	Dressing	Examples[a]
0-48	Red	Any	Transparent film/adhesive semipermeable Sterile	Bioclusive, BlisterFilm, CarraFilm, Omniderm, Opsite, Polyskin, Tegaderm
>48	Red	None	Open air	Not applicable
		Minimal	Transparent Sterile	Bioclusive, BlisterFilm, CarraFilm, Omniderm, Opsite, Polyskin, Tegaderm
>48	Yellow	Moderate-large	Absorptive	ABD pads, Covaderm, Curity Abdominal Pads, Multipad
>48	Black	Any	Consult wound care specialist	Not applicable

[a] Manufacturers: Bioclusive, Acelity; BlisterFilm, Covidien/Kendall; CarraFilm, Carrington; Covaderm, DeRoyal Industries, Inc; Curity Abdominal Pads, Covidien/Kendall; Multipad, DeRoyal Industries, Inc; Omniderm, Omikron Scientific; Opsite, Smith & Nephew; Polyskin, Covidien/Kendall; Tegaderm, 3M.

After the drain has been in place for 48 hours, the dressing selected depends on the wound tissue color and amount of exudate produced at the wound bed. If there is no exudate after 48 hours, the dressing may be removed and the drain site left open to air. If exudate and redness are present at the wound bed, the area should be gently cleansed, leaving granulation tissue undisturbed. Use a transparent film or adhesive semipermeable dressing to cover the wound bed, and cover it with a sterile dressing (Table 2). Perform dressing changes only if the dressing is saturated to avoid disruption of new tissue formation.[13]

In a wound with yellow tissue, exudate is commonly present. Before the dressing change, consider obtaining an order and supplies for a wound culture if infection is suspected. Once the dressing has been removed, a wound culture specimen may be collected. After collecting the specimen, cleanse exudate away from the wound bed with sterile saline or water. For low to moderate drainage and superficial or partial-thickness wounds, apply a hydrocolloid dressing (Table 2). Hydrocolloid dressings prevent gas exchange with the environment by using a protective barrier that wicks exudate from the wound bed while allowing protection from secondary infection. For large exudates and partial- or full-thickness wounds, apply absorptive dressings (Table 2). Avoid dressing changes until the dressing becomes saturated. If eschar is noted, debridement and consultation with a wound care nurse may be necessary.[13]

Some surgeons have begun placing small disks that provide continuous CHG exposure (Biopatch, Ethicon) at drain exit sites as additional means to reduce the incidence of SSI.[14] Although many health care providers apply these disks as prophylaxis against SSI at drain exit sites, research on the efficacy of CHG-impregnated disks at postsurgical abdominal drain sites is limited.[14] Further research on the efficacy of these disks is needed to determine if they will be recommended to reduce SSIs among patients with abdominal drains.

Maintaining Drain Patency

Postsurgical abdominal drains are placed near an anastomosis at risk for leakage to evacuate postsurgical fluid. Evacuation of the fluid before collection aims to decrease the incidence of leakage from an at-risk anastomosis, thereby preventing infection.[12] Thus, the efficacy of the drain is dependent on the drain's ability to remove retained fluid in the abdominal cavity. Techniques for maintaining patency include performing sterile flushes, ensuring continuous pressure from negative-pressure devices such as Jackson-Pratt drains, stripping the tubing, and preventing kinks in the drainage tubing.

If there is no exudate after 48 hours, the dressing may be removed and the drain site left open to air.

Flushing the Drainage Catheter

Flushing the drainage catheter is indicted if drain output has ceased or a significant decrease in output is noted.[15] Flushing should be performed with 3 to 5 mL (depending on the site) of 0.9% sodium chloride to assess

for clogs.[15] Always obtain an order to flush before flushing the catheter. Many closed drainage systems contain needleless connector ports or stopcocks on the drainage tubing for flushing the drainage system. Before attaching the sterile syringe to the needleless connector, cleanse the connection port with an alcohol swab for 15 to 30 seconds using mechanical friction.[16] Once the port has been cleaned, attach the syringe and flush with one-third of the syringe volume.[16] If resistance is met, leakage around the drainage catheter is noted, or the patient reports pain, stop flushing the catheter and notify the provider; radiographic imaging may be needed to assess the drain for proper placement and functioning.[15] If flushing proceeds without resistance, instill another one-third of the saline volume, pause, and then deliver the remaining saline.[16] It is important to apply positive pressure only; do not aspirate with the syringe for any reason. After flushing, remove the syringe from the needleless connector and cleanse the needleless connector.[16] Ensure that drainage fluid is noted after flushing the catheter. For negative-pressure drains, ensure negative pressure is maintained by emptying the collection chamber before complete filling, thereby preventing potential clots or occlusions from developing because of loss of suction.[6] This procedure is outlined in a video available on the Memorial Sloan Kettering Cancer Center website.[16]

Maintaining Negative Pressure of Collection Bulbs

Negative-pressure drains, or drains in which the pressure in the collection chamber is greater than the pressure in the body cavity, depend on bulb or reservoir compression to generate suction force. In a study by Carruthers et al,[17] drain pressures were measured in collection bulbs of various sizes. The study revealed smaller drainage bulbs (100 mL) had greater peak suction pressures at -117.6 mm Hg than did larger drainage bulbs (400 mL), which had peak suction pressures of -71.4 mm Hg. These pressures were generated by squeezing the drainage bulb with a fist to the point of full compression.[17]

Carruthers et al[17] also explored the suction generated among drains of all sizes by different modes of compression. They compared suction pressure following drainage bulb compression using the squeeze method (compressing the sides of the bulb along its longest axis) and using the bottom-toward-top method (pushing the bottom of the drain toward the top) (see Figure). Compressing the sides of the bulb by squeezing it with the fist generated significant negative pressure, whereas compressing the bottom of the drain toward the top did not result in any measurable suction (see Figure). Therefore, when applying compression to the bulb drain, the drain should be fully compressed by squeezing with a fist to generate negative pressure.[17]

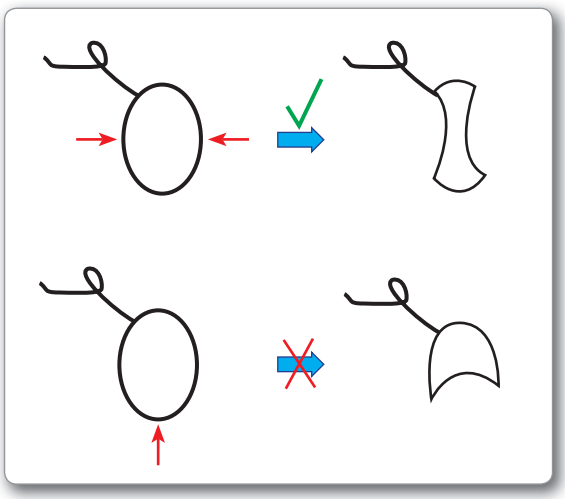

Figure Compression using the squeeze method (top) versus bottom-toward-top compression (bottom) on a negative-pressure drainage bulb.

Stripping the Drainage Tubing

Many surgeons also promote "stripping the tubing," which allows for clot disruption in the drainage tubing by mechanical friction. Stripping is performed by gripping the drainage tubing between the thumb and forefinger at the site closest to the exit site of the patient. This hand remains in place to stabilize the drain to prevent accidental drain removal during the stripping process. Grip the tubing between the thumb and forefinger of the other hand just distal to the stabilization hand on the drainage tubing. Move the distal thumb and forefinger down the drainage tubing while maintaining pressure until reaching the collection chamber.[18] If it is difficult to slide the hand down the tubing, place an alcohol swab around the tubing before placing the second hand to facilitate motion down the tubing.[19] This motion is akin to the motion used when curling a ribbon. Repeat as needed for clot disruption. This procedure is outlined in a video available on YouTube.[19]

Although stripping the tubing has been shown to help disrupt and prevent clots, stripping the tubing may cause potential complications. In a study that included 3 types of surgical drains (Hemovac, Zimmer Biomet; Reliavac, C. R. Bard, Inc; and Jackson-Pratt, Cardinal Health), investigators found that stripping the tubing resulted in a transient increase in negative pressure.[20] Repeated stripping may result in complications or trauma to the internal drainage site because elevated pressures may disrupt healing wound tissue.[20] This finding suggests that although stripping the tubing is an accepted practice, nurses should limit stripping to times when clot presence is suspected or upon provider request to prevent potential trauma to healing wound tissue.

Preventing Kinks

Preventing kinks in the drainage tubing is also important for preventing SSIs because kinks form easily and may cause complications if not identified. The recommendations presented in this section are widely accepted as common practice. Three types of ICU patients are at risk for developing kinks in the drainage tubing: those who are sedated, those with generalized weakness, and those who are mobile. Sedated patients and patients with generalized weakness are turned every 2 hours to relieve pressure points.[21] During this process, kinks may develop in the tubing and may not be discovered until the full body assessment. A similar event may occur in mobile patients who are able to ambulate or move frequently in bed. For these patients, the collection container may be pinned to the gown and a loop may be created at the exit site before applying the dressing, ensuring that the collection chamber is below the site of drainage (for gravity drains).[6] Because all patients in the ICU are mobile, whether passively or actively, be sure to check the drainage tubing for kinks each time a patient is turned or after a patient has ambulated.

Maintaining patency of the surgical drain is imperative for the prevention of SSIs related to stasis of wound exudates at the surgical site. Additional resources are available in a video about caring for wound drainage systems posted on YouTube.[22]

Drainage Assessment

Emptying the Drainage Reservoir

The drainage reservoir for a negative-pressure system should be emptied before filling or at least once per shift. For closed drains, obtain a small measuring device and an alcohol swab. Grab the reservoir and remove the emptying cap. Flip the reservoir upside down and squeeze the contents into a clear container.[18] Measure the contents of the drainage and take note of the consistency, color, and odor. Significant increase in output, darkening color, or increasing odor are concerning findings to discuss with the provider.[14] Before recapping, swab the lip of the securement port with alcohol, squeeze the drainage reservoir with a fist (see Figure), and recap the device.[18]

A significant increase in drain output, darkening color, or increasing odor are concerning findings to discuss with the provider.

Indications to Discontinue the Drainage Catheter

Monitor the amount of drainage and compare it with earlier drainage. If the amount of drainage has decreased for several days (and a blockage in the drainage catheter has been ruled out by flushing), the color of the output lightens, and the clarity of the drainage improves, communicate these assessment findings to the provider for possible discontinuation of the drainage catheter.[17] Removal of surgical drains as soon as indicated is one of the best ways to prevent infection because bacteria no longer have a direct conduit to the patient's skin or body.[23]

Conclusion

To effectively decrease the patient's risk of developing an SSI related to abdominal drains, a thorough assessment, routine drain maintenance, and communication with the provider regarding indications for discontinuing the drainage catheter should be performed. Although many of these actions occur during the shift assessment, drain maintenance is a continual process that requires vigilance by the nurse, even among immobile patients in the ICU. By following the guidelines discussed in this article, critical care nurses can ensure that even the most immunocompromised ICU patients remain free of SSIs related to postsurgical abdominal drains. CCN

Financial Disclosures
None reported.

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See also

To learn more about surgical site infections, read "Improving Surveillance and Prevention of Surgical Site Infection in Pediatric Cardiac Surgery" by Cannon et al in the *American Journal of Critical Care,* March 2016;25:e30-e37. Available at **www.ajcconline.org**.

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