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Clinical Application and Nursing Management of Suction Drains in Postoperative Patient Care

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Abstract

Background: Suction drains are a fundamental component of postoperative care across surgical specialties, designed to evacuate fluid collections (e.g., blood, serous fluid, pus) and reduce complications like seroma, hematoma, and infection. They also serve a diagnostic role, providing early warning of hemorrhage or anastomotic leak.

Aim: This review aims to detail the clinical applications, technical considerations, and comprehensive nursing management of suction drains in postoperative patients, emphasizing an evidence-based and interprofessional approach.

Methods: A synthesis of current literature and clinical guidelines is presented, covering the indications, contraindications, and equipment (closed vs. open systems). The technique for drain placement, maintenance (including stripping, emptying, and site care), and monitoring protocols are described. Complications and strategies to enhance team-based outcomes are discussed.

Results: Suction drains are indicated for managing dead space, monitoring anastomoses, and controlling output after extensive dissections or in septic cavities. Closed systems (e.g., Jackson-Pratt) are preferred for sterility and output measurement. Effective management requires meticulous technique for placement, regular monitoring of output character/volume, and diligent site care to prevent infection. Complications include occlusion, infection, displacement, and tissue erosion. Evidence suggests prophylactic drain use is not universally beneficial and should be selective.

Conclusion: While suction drains are valuable surgical adjuncts, their use must be judicious. Optimal outcomes depend on proper selection, correct technique, vigilant interprofessional monitoring, and timely removal to maximize benefits and minimize risks.

Keywords: Suction drain, Postoperative care, Jackson-Pratt drain, Wound drainage, Surgical site infection, Interprofessional team.

Introduction

Suction drains represent a foundational component of postoperative management, serving both therapeutic and diagnostic purposes across a wide range of surgical specialties. Their primary function is the efficient evacuation of accumulated fluid—such as serous fluid, blood, lymph, bile, or purulent material—from subcutaneous planes, intraabdominal cavities, retroperitoneal compartments, musculoskeletal spaces, and regions affected by abscesses or hematomas. By removing this excess fluid, suction drains help mitigate conditions that would otherwise predispose patients to infection, delayed wound healing, tissue separation, or other complications. Their clinical utility extends beyond simple fluid removal; they also provide an indirect window into postoperative physiology. The character, volume, and progression of drainage can alert clinicians to early signs of hemorrhage, anastomotic leakage, pancreatic fistula, bile leak, or recurrent abscess formation, thereby enabling timely intervention and reducing morbidity. Drains are most frequently deployed in surgical procedures where significant dead space is created or where the anticipated inflammatory and healing responses might lead to the accumulation of

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exudative fluid. Such scenarios often occur after extensive tissue dissection, oncologic resections, reconstructive surgeries, or procedures involving grafts and flaps. By maintaining close apposition of tissue planes, suction drains play a pivotal role in promoting tissue integration and vascular ingrowth, elements crucial to the survival and stability of skin grafts, reconstruction sites, and anastomoses. Their importance is particularly evident in complex hepatobiliary and pancreatic surgeries, where efficient drainage reduces the risk of postoperative fistulas—such as pancreaticojejunostomy or biliary leaks—which carry substantial morbidity and can lead to prolonged hospitalization, sepsis, and the need for reoperation.[1]

Suction drains can be broadly categorized into closed and open drainage systems, with selection informed by surgical goals, anatomical considerations, contamination risk, and clinician preference. Closed systems—such as Jackson-Pratt, Blake, and pigtail drains—incorporate a conduit connected to a sealed collection reservoir. These systems can depend on passive gravity drainage or may employ active negative pressure generated by self-contained bulbs or external suction devices. They have the advantage of reducing infection risk by limiting exposure of the wound to the external environment. Additionally, more sophisticated negative-pressure systems, such as wound vacuum-assisted closure (VAC) devices, provide continuous or intermittent suction that enhances fluid removal, decreases edema, and mechanically stabilizes wound edges, thereby promoting granulation tissue formation and accelerating healing.[2] Open systems—exemplified by Penrose drains—operate by capillary action and gravity, allowing fluid to exit freely into an absorbent dressing. These drains are particularly useful in superficial wounds or in cases where gentle, low-pressure drainage is required. Open drains are generally avoided near newly constructed anastomoses or deep cavities due to their potential to facilitate retrograde contamination. In contrast, active suction systems, while highly efficient, must be used with caution in situations where excessive negative pressure could compromise fragile tissues, disrupt anastomotic integrity, or impede early wound healing. In such cases, passive drainage may be safer, reducing the risk of promoting fistula formation or vascular compromise.[3]

Suction drains are commonly managed both in hospital settings and, when appropriate, in the home or rehabilitation environment. Their usage has become routine following many major surgeries, given their perceived benefits. However, emerging evidence has challenged the long-held assumption that prophylactic drain placement universally reduces postoperative complications. Studies have increasingly demonstrated that empiric drain placement does not always result in improved outcomes and may, in some cases, prolong hospital stays, increase costs, or contribute to drain-related complications.[4][5]

Fig. 1: Suction Drains.

These complications may include infection due to retrograde bacterial inoculation, mechanical injury during placement, or accidental displacement or breakage of the drain apparatus, which may necessitate repositioning, intervention, or replacement.[9] Furthermore, data evaluating routine drainage after major abdominal, colorectal, hepatobiliary, and orthopedic surgeries have produced equivocal results, with several investigations suggesting no clear reduction in surgical site infections, fluid collections, or anastomotic complications.[6][7][8] Given these findings, contemporary surgical practice increasingly emphasizes a selective, evidence-based approach to drain placement rather than routine use. Clinical judgment, patient-specific factors, and intraoperative findings must all guide the decision-making process. While suction drains remain indispensable tools in many scenarios, their benefits must always be weighed against potential risks. As research evolves, the role of these devices continues to be refined, underscoring the importance of understanding their mechanisms, indications, and limitations in modern postoperative care.

Indications

Suction drains are employed in a wide spectrum of surgical disciplines as an adjunctive measure to mitigate the adverse consequences of postoperative fluid accumulation and to optimize wound healing. Their principal indication arises in clinical contexts where there is a high likelihood of exudative fluid, blood, lymph, bile, or inflammatory effusions collecting within surgically created spaces. Such accumulations, if not effectively evacuated, predispose to seroma and hematoma formation, infection, delayed wound healing, and in some cases

mechanical compromise of adjacent structures. By maintaining controlled egress of fluid and, where relevant, air, suction drains assist in preserving tissue apposition, reducing tension, and providing a means of early detection of complications, thereby improving overall surgical outcomes. In major operations involving extensive tissue dissection, particularly within the abdominal, thoracic, pelvic, and musculoskeletal compartments, the risk of postoperative fluid collection is considerable. Large raw surfaces exude serum and lymph, while small vessels may ooze blood despite meticulous hemostasis. In these settings, suction drains are strategically positioned within the operative bed to continuously remove accumulating fluid and prevent the formation of clinically significant seromas or hematomas. Unchecked, such collections may serve as a nidus for infection, cause pain, impair mobility, and necessitate subsequent invasive procedures for drainage. The use of suction systems provides a controlled and monitored route of egress, allowing both therapeutic decompression and diagnostic assessment of drainage character over time [3][4][5].

Closely related to this indication is the management of dead space. Dead space arises when tissue planes are not completely re-approximated, or when cavities remain following excision of diseased tissue, tumor, or devitalized structures. These potential spaces are readily filled with fluid under the influence of gravity and capillary leakage. Suction drains help obliterate dead space by continuously evacuating accumulated fluid, thereby enabling the collapse of tissue planes onto one another and promoting adherence and fibrosis. This is particularly critical in complex reconstructive procedures and grafting operations, where sustained tissue contact is essential to graft survival, flap viability, and structural integrity of the reconstruction. A major area in which suction drains have been traditionally integrated into perioperative strategy is hepatopancreatobiliary surgery. Following pancreatic resections, biliary anastomoses, or combined procedures, the risk of postoperative fistula formation is significant. Drains placed in proximity to pancreatic or biliary anastomoses provide several benefits: they evacuate enzyme-rich or bile-containing fluid, reduce local inflammation and pressure, and enable early recognition of a leak through changes in drainage volume, appearance, or biochemical composition. By facilitating timely diagnosis and intervention, these drains may reduce the severity of pancreatic or biliary fistulas and the downstream risk of sepsis, hemorrhage, or intra-abdominal abscess formation [10][11][12].

In the setting of trauma and intra-abdominal or retroperitoneal sepsis, suction drains assume a central role in both source control and ongoing management. Traumatic injuries to solid organs, bowel, or mesentery, as well as surgically drained abscess cavities, often leave behind spaces that continue to produce serous, sanguineous, or purulent effusions. Failure to adequately drain these collections can lead to persistent infection, abscess re-formation, or progression to generalized peritonitis. By maintaining continuous or intermittent negative pressure within these spaces, suction drains help remove contaminated fluid, decrease bacterial burden, and support the effects of systemic antimicrobial therapy.[10][11][12] They are thus an integral component of comprehensive management strategies for complex intra-abdominal sepsis and post-traumatic collections. Suction drainage is also frequently indicated when infectious or inflammatory processes have been surgically debrided. After excision of necrotic or infected tissue, the residual cavity remains at risk for reaccumulation of exudate and bacterial proliferation. Drains placed within these spaces facilitate evacuation of residual pus or inflammatory fluid, thereby lowering the likelihood of recurrent infection and supporting wound healing. In such circumstances, drainage not only serves a mechanical function, but also allows continuous assessment of the local infectious milieu, guiding the duration and selection of antimicrobial therapy. Cardiothoracic surgery represents another domain in which suction drains are routinely utilized. After procedures such as coronary artery bypass grafting, valve replacement, or pulmonary resections, chest drains connected to suction are placed to evacuate blood, air, and serous fluid from the pleural and mediastinal spaces. Effective drainage in this context is essential for preventing hemothorax, residual pneumothorax, pleural effusions, and cardiac tamponade. Inadequate evacuation may compromise respiratory mechanics, impair gas exchange, and precipitate life-threatening hemodynamic instability. Suction-assisted chest drainage thus plays a pivotal role in maintaining lung expansion, preserving cardiac function, and reducing postoperative pulmonary and cardiovascular complications [10][11][12].

In the realm of cosmetic and reconstructive surgery, suction drains are commonly used following procedures such as abdominoplasty, breast reduction, mastectomy with reconstruction, and extensive flap mobilization. These operations often involve large areas of subcutaneous dissection, predisposing to significant seroma formation. Seromas in these settings can distort aesthetic results, increase tension on incisions, predispose to wound dehiscence, and heighten infection risk. Prophylactic placement of drains mitigates these risks by promoting continuous removal of serous fluid, supporting contour preservation, and facilitating a smoother postoperative course. An additional important indication for suction drains is their role in anastomotic monitoring. When positioned adjacent to a fresh gastrointestinal, biliary, or pancreatic anastomosis, an indwelling drain provides a real-time indicator of local integrity. The emergence of bile,

pancreatic juice, enteric contents, or blood within the drainage system may signal an anastomotic leak or hemorrhage, prompting expedited evaluation and intervention. This early warning function is particularly valuable in high-risk reconstructions, where delayed recognition of an anastomotic complication can lead to rapid clinical deterioration. Following extensive lymph node dissections, such as lymphadenectomy in oncologic surgery, suction drains are frequently employed to manage lymphatic leakage and serous exudation. The disruption of lymphatic channels and vascular structures during these procedures predisposes to lymphocele formation and persistent serous drainage. By placing drains within the dissected basin, surgeons can reduce the volume of fluid accumulation, decrease tissue tension, and minimize the risk of infection, wound breakdown, and delayed healing. In all of these contexts, the fundamental rationale for suction drain use is the controlled removal of blood, serum, lymph, air, bile, or purulent material that may escape into surgical fields during and after operative interventions. Their judicious application contributes to the prevention of fluid-related complications, supports proper wound healing dynamics, limits infectious sequelae, and enhances the safety and effectiveness of both routine and complex surgical procedures [10][11][12].

Contraindications

Although suction drains are widely utilized and often beneficial in postoperative management, their use is not universally appropriate. Careful assessment of patient-specific factors, underlying pathology, and local tissue conditions is essential, as certain clinical scenarios render drain placement either relatively or absolutely contraindicated. In these contexts, inappropriate use of suction drainage may not only fail to confer benefit but may actively worsen outcomes. One important consideration is the presence of active infection or uncontrolled sepsis, particularly at or near the proposed insertion site. While drains are frequently used as part of source control in abscess management, introducing or maintaining a suction drain in tissue with uncontrolled infection can, in some circumstances, facilitate microbial spread or serve as a conduit for ascending contamination. If the drain tract becomes colonized, or if external components are not meticulously handled, pathogens can be introduced into deeper tissues, exacerbating local infection or leading to secondary wound contamination. In such cases, the decision to place or maintain a suction drain must be weighed against alternative methods of infection control and the overall sepsis management strategy. Tissue quality is another critical determinant. Patients with markedly compromised tissue integrity—such as those suffering from extensive burns, severe soft tissue trauma, chronic steroid use, radiation damage, or critical ischemia—may not tolerate drain placement well. The creation of a drain tract and the continuous mechanical forces exerted by negative pressure may further compromise already fragile tissues. This can result in localized necrosis, skin breakdown at the exit site, or dehiscence of surgically approximate planes. In such circumstances, the physiologic cost of drain placement may exceed its potential benefits, and alternative approaches to fluid management or wound care should be considered [10][11][12].

Coagulopathy represents a further contraindication or strong precaution. Patients with severe thrombocytopenia, inherited coagulation disorders, or those receiving anticoagulation therapy are at increased risk of developing significant bleeding or hematoma at the time of drain insertion and in the immediate postoperative period. The process of tunneling a drain through tissue planes can disrupt small vessels, and in a coagulopathic milieu, relatively minor injuries may result in substantial hemorrhage. Additionally, active negative-pressure dressings placed over major vessels in patients with coagulopathy or malignancy pose a relative contraindication, as suction may precipitate bleeding, erode into vascular structures, or contribute to tumor spreading in the setting of cancer. Body habitus and anatomical constraints can also limit the effectiveness and safety of suction drainage. In individuals with obesity and marked subcutaneous adiposity, it may be technically challenging to position drains accurately within the desired space. The long subcutaneous path increases the risk of kinking, displacement, or obstruction, and the dead space in adipose tissue may not be effectively collapsed by standard suction. These factors predispose inadequate drainage, persistent collections, and increased infection risk. Similarly, certain confined anatomical locations—such as deep pelvic recesses or narrow retroperitoneal compartments—may not allow optimal drain placement. In such settings, the inability to maintain appropriate positioning and patency may render a drain functionally ineffective, undermining its purpose and exposing the patient to risk without clear benefit. Patients with severe, uncontrolled ascites represent another group in whom suction drains must be used with caution, if at all. The placement of a drain in the presence of large-volume free fluid can lead to continuous high-output drainage, worsening intravascular volume depletion, precipitating electrolyte imbalances, and increasing the risk of renal dysfunction. Repeated or excessive removal of ascitic fluid can destabilize hemodynamics and may interfere with the management of the underlying hepatic or systemic disease. In such situations, more controlled methods of fluid removal, such as therapeutic paracentesis under careful volume and albumin replacement protocols, may be preferable [10][12].

Preexisting fistulas in proximity to a proposed drain site represent an additional concern. Introducing a suction drain through or adjacent to a fistulous tract may enlarge the tract, perpetuate abnormal communication between organs or between viscera and skin, and increase the volume of output. In some cases, this can delay or prevent spontaneous fistula closure. It is often more appropriate to address the fistula definitively—whether medically, endoscopically, or surgically—before considering placement of any additional drainage devices in the region. Systemic conditions that impair wound healing must also be factored into the decision-making process. Poorly controlled diabetes mellitus, severe peripheral vascular disease, chronic immunosuppressive therapy, malnutrition, and advanced systemic illness can all compromise the capacity of tissues to respond to surgical insult and drain placement. In these patients, the risk of wound infection, dehiscence, and poor tissue approximation is already heightened; the presence of a drain, particularly if it becomes contaminated, can further increase the likelihood of local and systemic complications. In some instances, minimizing foreign bodies and portals of entry—such as drains—may be the safer course. Beyond physiological and anatomical considerations, patient-centered factors may also function as practical contraindications. Some individuals experience significant anxiety, discomfort, or psychological distress related to external devices. Others may have limited capacity to manage drains safely at home due to cognitive impairment, lack of caregiver support, or environmental limitations. In such cases, the feasibility of safe outpatient drain care is questionable, and alternative strategies for fluid management, such as shorter-term inpatient observation or different surgical techniques that minimize dead space, may be preferable. Ultimately, the decision to place a suction drain must be individualized, balancing potential benefits against the specific risks imposed by infection status, tissue quality, coagulation profile, anatomy, systemic disease, and patient factors. A nuanced appreciation of these contraindications is essential to ensure that suction drainage is employed judiciously, safely, and only when its advantages clearly outweigh its hazards [10][11][12].

Equipment

The apparatus used for suction drainage in surgical practice encompasses a range of devices engineered to efficiently evacuate fluid from operative fields while minimizing contamination and maintaining patient safety. The equipment differs substantially between closed and open systems, reflecting their distinct design principles, levels of control, and clinical applications. Understanding the structural components and functional nuances of each system is essential for appropriate selection, troubleshooting, and optimization of postoperative management. Closed suction drainage systems are specifically constructed to provide effective fluid removal within a sealed, sterile circuit. Their design minimizes exposure of the wound environment to external pathogens and allows precise monitoring of output characteristics over time. At the core of these systems is the drain tube itself. This tubing is typically composed of biocompatible materials such as silicone, chosen for its flexibility, inertness, and reduced tissue reactivity. The configuration of the tube may be round or flat, with dimensions expressed in French units for round drains and in millimeters for flat variants. These size gradations allow tailoring of the device to the anatomical location, expected viscosity and volume of fluid, and the nature of surrounding tissues. The internal architecture of the tube is also variable. Some closed drains are designed as channel drains, incorporating multiple longitudinal channels that promote efficient fluid collection along the drain's surface. Others use perforated tubing, with multiple fenestrations distributed along the intraluminal segment to enhance drainage from a larger surface area. This perforation pattern improves the capture of fluid from surrounding tissues and reduces the likelihood of localized pooling. To facilitate accurate placement into deeper surgical planes, the drain tubing is often mounted on a trocar, which enables controlled passage through tissues and precise positioning within the operative bed [10][13].

An integral component of closed suction systems is the collection chamber. This chamber, usually transparent and graduated, serves as the reservoir into which fluid is evacuated. The transparency permits direct visual inspection of fluid color, clarity, and presence of air or debris, while the calibrations provide quantitative measurement of output volume over defined intervals. These features allow clinicians to track trends, detect early bleeding or leaks, and adjust care plans accordingly. The sealed nature of the chamber maintains sterility and reduces the risk of retrograde contamination. The creation of negative pressure is a defining feature of active closed suction systems. In widely used devices such as the Jackson-Pratt drain, suction is generated manually compressing a bulb-shaped reservoir and then sealing it, resulting in a controlled vacuum that draws fluid from the wound through the tubing into the bulb. More advanced vacuum-assisted systems incorporate mechanical or electronic pumps that deliver continuous or intermittent negative pressure, often standardized around levels such as 125 mm Hg. These negative-pressure wound therapy systems frequently employ sterile or antibiotic-impregnated foam dressings placed within or over the wound, covered by an occlusive adhesive barrier that maintains an airtight seal. Tubing connects this dressing to the vacuum unit, allowing the controlled application of suction across the wound surface, promoting fluid removal, wound contraction, and granulation tissue formation.[10][13]

Connecting all of these components is a network of flexible suction tubing and valves. The tubing links the intrabody drain segment with the collection chamber and any external suction source. Valves are strategically incorporated to modulate the strength and direction of flow, prevent backflow of fluid or air toward the wound, and maintain the integrity of the closed system. In some low-resource or improvised settings, closed suction systems can be assembled using standard medical tubing, syringes, and simple vacuum-generation techniques, provided that sterility and one-way flow are ensured.[10][13] Open suction drainage systems, by contrast, are simpler in construction and rely primarily on passive mechanisms. They are generally not sealed from the environment and therefore do not provide the same degree of control or protection against contamination as closed systems. The archetypal open drain is the Penrose drain, typically manufactured from materials such as latex, silastic, or polypropylene. It functions as a soft, pliable conduit laid within a wound or cavity, through which fluid exits by gravity and capillary action. Penrose drains are available in various widths, and their length can be tailored by cutting to fit the clinical situation. Their flexibility and ease of placement make them useful in superficial or localized collections where controlled suction is not required. Because open drains do not incorporate a contained collection reservoir, the effluent is instead captured by external absorbent dressings applied over the exit site. These dressings may consist of gauze, pads, or more advanced absorbent materials, and they must be changed regularly to maintain hygiene, monitor output, and prevent skin maceration around the drain site. The efficiency of fluid removal depends on the capillary action of the drain material and the absorptive capacity and frequency of change of the dressings. The absence of an enclosed collection system means that the volume and characteristics of the drainage are estimated visually rather than measured precisely, which can limit the diagnostic utility compared with closed systems. The concept of wicking is central to the function of open drains. Materials such as latex or polypropylene act as a wick, drawing fluid along their surface from the deeper wound cavity toward the external environment. This passive flow is driven by capillary forces and gravity rather than active negative pressure. While this simplicity is advantageous in certain superficial or contaminated wounds, it also means that drainage is less predictable and more susceptible to environmental contamination. The open nature of these systems can permit retrograde bacterial migration if not managed meticulously, which is why open drains are typically avoided in clean surgical fields or deep sterile spaces.[10][13]

The selection between closed and open suction drainage equipment is influenced by multiple factors, including the type and magnitude of surgery, anticipated volume and nature of fluid, risk of infection, need for precise monitoring, and the anatomical location of the wound. Closed suction systems are often favored in major operations, deep or complex cavities, and settings where meticulous output measurement and infection control are priorities. They offer superior control, sterility, and diagnostic value but require careful maintenance and technical familiarity. Open drains, while less sophisticated, retain value in specific situations, particularly where passive egress of fluid from superficial or contaminated wounds is sufficient and where simplicity is advantageous. Ultimately, the equipment used for suction drainage is not merely a collection of hardware but an integrated system that must be matched thoughtfully to the clinical context. The characteristics of the drain tube, collection components, negative-pressure sources, and dressings all interact to determine the efficacy and safety of drainage. An in-depth understanding of these elements allows clinicians and surgical teams to select, deploy, and manage suction drains in a manner that maximizes therapeutic benefit while minimizing complications.[10][13]

Personnel

The effective use of suction drains in surgical and postoperative care requires coordinated involvement from a multidisciplinary healthcare team, each member contributing specialized knowledge and clinical skills that together ensure optimal patient outcomes. Because suction drains play an essential role in preventing postoperative fluid accumulation, monitoring complications, and supporting wound healing, the expertise of multiple professionals is required from the moment a drain is considered to the point of its removal. This interprofessional collaboration helps minimize risks, improve patient education, and ensure the continuity and safety of care. The surgeon is the principal decision-maker regarding the use of suction drains. Their responsibilities begin in the preoperative phase, where they determine whether a drain is necessary based on the surgical procedure, extent of dissection, potential for dead space formation, and expected fluid accumulation. During the operation itself, the surgeon selects the most appropriate drain type—whether a closed suction system like a Jackson-Pratt or Blake drain, or an open system such as a Penrose—and determines the precise anatomic location for insertion. These decisions require an in-depth understanding of wound healing dynamics, tissue biomechanics, and potential risks. Surgeons must also employ meticulous technique in placing the drain to avoid tissue injury, inadvertent entry into vascular structures, or improper angulation that could decrease drainage efficiency or increase postoperative complications. Their role extends into postoperative monitoring by interpreting drainage output as part of

broader clinical assessment, guiding adjustments or escalation of care when drainage patterns suggest complications such as hemorrhage or anastomotic leakage [11][12][13].

Nurses—including surgical, postoperative, and wound care nurses—play a central and continuous role in the management of suction drains. In the immediate postoperative setting, they inspect the drain's patency, evaluate the quantity and quality of the output, and ensure the negative-pressure system is functioning effectively without leaks, blockages, or loss of suction. Nurses also secure the drain to prevent tension or accidental dislodgement and maintain sterile technique in handling the tubing and collection device. Postoperative nurses monitor early signs of infection, skin irritation, or device malfunction and provide timely communication to the surgeon regarding abnormal findings. Another indispensable aspect of nursing care is patient education. Nurses instruct patients and families on how to empty and measure drainage, how to maintain the cleanliness of the exit site, and what symptoms warrant urgent medical attention. Wound care nurses, in particular, contribute expertise in managing the skin around the drain site, preventing maceration, and performing dressing changes that protect the wound environment. The anesthesiologist's role is most critical intraoperatively, ensuring that the patient remains hemodynamically stable as the surgeon places the suction drain. Because postoperative bleeding or fluid leakage can manifest subtly during surgery, anesthesiologists must continuously monitor vital signs for physiologic changes that may indicate complications related to drain placement. Their vigilance supports patient safety and allows for rapid intervention if issues such as hemorrhage or acute fluid shifts occur during the procedure. Surgical technologists also play a vital role in the operating room by facilitating proper drain placement. They prepare the sterile field, ensure that all drain components—including tubing, trocars, collection reservoirs, and dressings—are available, sterile, and functioning. Technologists assist the surgeon by handing off instruments, maintaining aseptic technique, and helping secure the drain to prevent migration. Their contribution helps maintain procedural efficiency and reduces the likelihood of contamination or device malfunction [10][13].

Radiologists become involved when imaging is required to evaluate the drain's placement or function or when percutaneous drain placement is indicated. In cases of deep fluid collections, abscesses, or suspected drain displacement, imaging modalities such as ultrasound or computed tomography provide critical real-time information. Radiologists interpret these studies to assess whether the drain is positioned correctly, whether drainage is adequate, or whether undrained pockets of fluid remain. In some cases, radiologists may perform image-guided percutaneous drainage, either as a primary intervention or to supplement surgical drainage, particularly in retroperitoneal, intraabdominal, or difficult-to-access cavities. Their involvement contributes to precise diagnosis and enhances the overall safety and efficacy of drainage therapy. Together, the coordinated efforts of this multidisciplinary team form the backbone of successful suction drain management. From the decision to place a drain to ongoing monitoring and eventual removal, each professional contributes essential expertise, ensuring that complications are minimized and postoperative recovery is optimized [13].

Technique or Treatment

The placement and management of suction drains require careful attention to sterile technique, anatomical orientation, and device function to ensure safe and effective postoperative drainage. In most cases, the drain is introduced through a dedicated skin puncture site located a few centimeters away from the primary surgical incision rather than exiting directly through the wound. This separate exit site helps preserve the integrity of the main incision, reduces the risk of dehiscence, and offers a more favorable angle for fluid evacuation. The drain tubing commonly incorporates a sharp, trocar-tipped end for passage through the skin and soft tissues, while the intrabody segment contains multiple perforations or channels that facilitate efficient fluid collection from the operative field.[14] To introduce the drain using the trocar, the surgeon first makes a small stab incision in a prepared, sterile area at an appropriate distance from the operative wound. The trocar with attached tubing is then advanced from the exterior through the stab incision into the operative cavity, taking care to direct it toward the area most likely to collect fluid. Once the perforated portion of the tubing is fully situated within the desired anatomical space, the external segment is pulled through, and the trocar is removed and discarded. As an alternative to trocar-guided placement, especially in more delicate settings, the surgeon may use blunt dissection or surgical forceps to guide the tubing into position under direct visualization, thereby minimizing the risk of inadvertent injury to underlying structures. In all cases, the tubing is trimmed externally to an appropriate length to reduce excess slack and minimize the risk of kinking or accidental traction.[14]

After the drain has been correctly positioned, it is secured at the skin level with a nonabsorbable suture to prevent displacement. The suture is typically placed in a purse-string or anchoring fashion around the tube, with additional loops if necessary, to achieve firm fixation without compressing the lumen. This anchoring suture is then covered with a sterile dressing, and particular care is taken to ensure that the drain exit site is well sealed and supported. A tight seal around the insertion point is essential to prevent leakage of fluid onto the skin

surface and to maintain the effectiveness of suction for both fluid and, when applicable, air evacuation. During placement, the surgeon must be meticulous in avoiding contact between the drain and critical anatomical structures. In particular, proximity to vascular, biliary, or intestinal anastomoses must be considered, as excessive suction or mechanical friction may predispose to erosion, leakage, or fistula formation. When drains are placed beneath tissue flaps, they should be immobilized in such a way as to maintain consistent contact between the flap and its bed, encouraging adherence and reducing dead space. In some flap procedures, an anchoring suture may be applied at or near the most proximal drainage fenestration, and this detail should be clearly communicated to the interprofessional team managing the patient postoperatively.[15][16] Once the operative site has been closed and dressings have been applied, the external segment of the drain is connected to an appropriate collection device, such as a bulb reservoir, bottle, or specialized vacuum canister. The choice of device depends on the type of drain, the amount and nature of expected effluent, and the surgeon's preference. Following connection, nursing staff and clinicians begin monitoring the drainage closely. Initially, the fluid is often sanguineous as postoperative oozing from raw surfaces predominates. Over time, this usually transitions to serosanguineous and then serous fluid as healing progresses. Any abrupt increase in output, sudden reappearance of bright red blood, or change in character to bilious, feculent, or purulent material should be promptly reported to the surgeon, as these changes may signify hemorrhage, anastomotic leak, or infectious complications [15][16].

Maintaining drain patency is a central element of postoperative management. One commonly employed technique is manual "stripping" or "milking" of the tubing to prevent clogging by fibrin, clots, or debris. After performing hand hygiene, the clinician stabilizes the tubing near the skin entry site with the non-dominant hand, then uses the thumb and forefinger of the dominant hand to gently compress and slide along the tube toward the reservoir. This maneuver can be facilitated by applying an alcohol-based hand rub to reduce friction and allow smoother gliding along the tubing. The goal is not necessarily to completely empty the tube of fluid but to dislodge and advance any obstructing material into the collection chamber, thereby restoring or maintaining free flow. Any difficulty performing stripping, or persistent obstruction despite these measures, should be communicated to the surgical team.[17] The collection reservoir, such as a Jackson-Pratt bulb, must be emptied regularly, typically when it is half to two-thirds full or according to institutional protocols. Each time the reservoir is emptied, the volume and character of the effluent are recorded, providing valuable clinical data on postoperative progress. Strict aseptic technique is required whenever the system is handled. To empty a bulb reservoir, the stopper at the emptying port is opened without disconnecting the tubing, the bulb is inverted, and its contents are expressed into a designated receptacle, such as a basin or toilet. After emptying, if negative pressure is to be re-established, the clinician compresses the bulb fully with one hand, then seals the stopper while the bulb remains collapsed. Upon releasing the hand, the bulb attempts to reexpand, generating negative pressure that draws fluid from the wound into the reservoir. To minimize tension on the drain and reduce the risk of dislodgement, the bulb is often secured to the patient's clothing or gown with a safety pin. If the reservoir loses its ability to maintain suction because of wear, cracking, or valve malfunction, it must be replaced. Replacement is performed by first clamping the drain tubing, cleansing the connector with an alcohol swab, detaching the old reservoir, attaching the new one under sterile conditions, and then unclamping the tubing to restore suction. Throughout this process, maintaining sterility and avoiding contamination of the connector are paramount.[10][13][17]

Care of the skin and soft tissues at the drain insertion site is another vital component of the technique. The dress surrounding the drain should generally be changed at least once daily or more frequently if soiled, with many clinicians timing changes to coincide with the patient's shower when permitted. A typical dressing consists of sterile drain gauze placed around the tube and secured with sterile tape, ensuring that the area is clean, dry, and supported. The drain site should be examined at least twice daily for signs of infection such as erythema, warmth, edema, purulent discharge, or increasing tenderness. Excessive leakage around the tube, new onset of pain, or malodor are also concerning findings that warrant prompt evaluation and communication with the surgical team.[17] Drains are generally removed once the volume of output has declined to a minimal and acceptable level, as determined by the surgeon's protocol and the nature of the operation. Before removal, the tubing may be stripped one final time to evacuate residual fluid. The sutures anchoring the tube to the skin are then carefully cut. To reduce discomfort and free any adhesions that may have formed between the tubing and surrounding tissue, the tube is often gently rotated or twisted before being withdrawn. Removal is performed with smooth, steady traction, avoiding abrupt pulls. For specialized devices such as pigtail catheters, it is important to disengage or straighten the pigtail by releasing securing strings or deflating retention mechanisms in accordance with the manufacturer's instructions.[18][19] After removal, the tip of the drain is inspected for completeness, and any debris, clots, or unusual material may be sent for

laboratory evaluation if requested. The exit site is then covered with a sterile pressure dressing, which is changed as needed until the tract seals and healing is complete. Throughout this process, close coordination among surgeons, nurses, and other members of the interprofessional team is essential to ensure that suction drains are placed correctly, function effectively, and are removed at the appropriate time, thereby maximizing their therapeutic benefit while minimizing the risk of complications.[14][15][16][17][18][19]

Complications

Although suction drains serve an important role in postoperative management by reducing fluid accumulation, promoting tissue apposition, and facilitating early detection of complications, their use is not without potential adverse effects. One of the most frequently encountered issues is clogging or obstruction of the drain lumen. Accumulated fibrin, clotted blood, necrotic tissue, or thick purulent material can obstruct the tubing, leading to reduced or absent output. When a drain becomes partially or completely occluded, the intended negative pressure mechanism fails, allowing fluid to accumulate within the operative field. This may result in localized swelling, seroma formation, or increased tension on tissue planes. As pressure builds, fluid may leak externally around the insertion site, causing skin maceration, excoriation, and irritation of the surrounding tissues. Mechanical stripping of the drain or irrigating under sterile conditions may help restore patency, but persistent obstruction may require removal or replacement of the drain.[20] Alongside mechanical issues, suction drains also pose a risk of infection. Although designed to remove fluid and prevent collections that serve as potential bacterial reservoirs, drains can paradoxically act as conduits for pathogen entry. The drain tract creates a direct communication between the external environment and deeper tissues, and improper handling, inadequate dressing care, or prolonged use can increase the risk of microbial colonization. Localized infections may present with erythema, tenderness, and purulent drainage at the insertion site, while more severe cases may progress to cellulitis, abscess formation, or even systemic infection in the form of bacteremia or sepsis. Meticulous sterile technique during insertion, routine dressing changes, and patient education on drain hygiene remain critical components of infection prevention.[21]

Drain displacement is another complication, particularly in mobile patients or those with large body habitus. Excessive tension on the tubing, accidental pulling, or inadequate anchoring sutures may cause partial or complete dislodgement of the drain. A drain that migrates externally loses its effectiveness, whereas one that migrates internally may compress vital structures or no longer adequately drain the intended cavity. In rare cases, portions of the drain may break off, leaving fragments within the body cavity. Such retained foreign bodies may provoke chronic inflammation, abscess formation, or fibrotic encapsulation, and they typically require surgical retrieval. For these reasons, secure fixation and careful monitoring of the drain's position are essential. Foreign body reactions can also occur when drains are left in situ for extended periods. Chronic irritation from silicone, latex, or other drain materials may trigger granuloma formation or fibrotic tissue ingrowth around the tubing. This can complicate drain removal and potentially cause tissue tearing or bleeding during extraction. Additionally, prolonged negative pressure exposure may impede wound epithelialization and slow the natural healing process. In some surgical contexts, especially involving delicate anastomoses or friable tissue, strong suction may increase the risk of fistula formation by exerting excessive traction or pressure on healing tissues. This is particularly important when drains are placed near bowel, biliary, or pancreatic anastomoses, where fistulas have significant clinical consequences.[20][21]

Despite these concerns, evidence indicates that many complications can be minimized with proper postoperative care. For instance, research has shown no significant increase in surgical site infections in patients permitted to shower with indwelling drains, highlighting the importance of adequate hygiene, patient education, and appropriate dressing protection. Routine monitoring for changes in fluid quality or output volume allows early detection of bleeding, anastomotic leakage, or infection—conditions where the drain serves as an early warning system.[22] Effective drain management is inherently interprofessional. Nurses serve a central role in daily drain assessment, including evaluating patency, measuring output, maintaining dressing integrity, and identifying early signs of complications. They also play a crucial role in patient education, teaching patients and family caregivers how to empty reservoirs, clean the drain site, recognize symptoms requiring urgent evaluation, and maintain proper hygiene once discharged. Surgeons and surgical teams provide oversight regarding the appropriate time for drain removal, interpret drainage characteristics, and intervene when complications arise. Pharmacists may assist in antimicrobial stewardship when infection is suspected, while wound care specialists support the management of persistent drainage or skin breakdown. Ultimately, the safe and effective use of suction drains depends on diligent monitoring, timely intervention, and seamless communication among the interprofessional care team. This comprehensive approach helps mitigate risks, ensures continued drain efficacy, and promotes optimal postoperative recovery for patients.[23][24]

Clinical Significance

Suction drains serve as an essential adjunct in postoperative care, yet their optimal use requires

careful attention to both technical factors and clinical decision-making. Improving the efficiency of a closed-suction drainage system begins with understanding the mechanical variables that influence drainage performance. Increasing the intracavitary length of the drainage tube ensures that the perforated segment lies fully within the fluid collection space, enhancing its contact with the accumulating effluent. Conversely, minimizing the length of tubing outside the body reduces dead space, tension, and the potential for kinking or accidental dislodgement. Larger tube diameters permit more efficient evacuation of viscous fluids such as clotted blood or purulent material. Enhancing the pressure differential, often by ensuring that the reservoir maintains negative pressure, further promotes fluid removal. Perforated or channeled catheters improve surface area for drainage, and manually squeezing low-pressure bulbs or milking the tubing at regular intervals helps maintain patency by preventing clog formation.[1] Closed drainage systems confer an additional benefit: by minimizing communication between the internal wound environment and the external surroundings, they significantly reduce the likelihood of retrograde bacterial migration—an important consideration in preventing surgical site infections. Short extracavitary tubing lengths enhance this protective effect, limiting the distance that organisms must travel to reach deeper tissues. Another critical preventive measure involves avoiding direct contact between the drain and freshly constructed anastomoses. Placement of tubing directly over an anastomotic line may induce pressure necrosis or mechanical erosion, increasing the risk of anastomotic leaks and fistula formation. Proper placement, therefore, is integral to preserving the integrity of surgical reconstructions.[25][26][27]

Despite widespread use, the role of prophylactic drains in clean-contaminated abdominal surgery remains controversial. Several studies have sought to determine whether routine drain placement reduces postoperative surgical site infections, but the findings are inconsistent. In a large cohort of 2,833 individuals, 187 developed surgical site infections, yet no significant difference emerged between those who received drains and those who did not, suggesting that prophylactic drain placement may not confer added protection in such cases.[28] Similar uncertainty surrounds the use of drains in complicated appendicitis. Evidence regarding their utility in preventing abscess formation is inconclusive, and some studies indicate that drains may inadvertently prolong hospitalization without offering measurable clinical benefit.[29][30][31] These findings underscore the importance of individualized decision-making rather than reliance on routine drainage practices. As a general principle, drains should be removed as early as clinically feasible to minimize the risk of complications such as ascending infection, tissue erosion, foreign body reaction, or delayed wound healing. Prolonged drain use has been associated with longer hospital stays and an increased burden on postoperative care resources.[4] The question of optimal drain type has also been the focus of comparative research. In pancreatic surgery, a field in which postoperative fistulas and fluid collections are particularly concerning—a study of 320 patients evaluated infection rates and postoperative outcomes between open and closed suction drain designs. The investigation found no significant differences in fluid contamination, postoperative fistula rate, or other clinical parameters, suggesting that drain configuration alone does not dictate postoperative infection risk in this context.[32] Likewise, comparisons between closed suction drains maintained under negative pressure and those relying on gravity drainage have yielded no demonstrable differences in key postoperative outcomes, including fistula formation, surgical site infection, or time to drain removal.[33][34] These findings collectively imply that drain efficacy is influenced more by clinical technique, patient-specific factors, and wound biology than by the specific drainage method chosen. Overall, the clinical significance of suction drains lies not only in their ability to evacuate fluid but also in the judicious use of evidence-based practices that maximize benefit and minimize harm. Effective drain management requires thoughtful placement, vigilant monitoring, timely removal, and an individualized approach to each surgical scenario. While drains provide invaluable diagnostic and therapeutic support in selected cases, growing evidence cautions against their routine prophylactic use in many abdominal and reconstructive procedures. Ongoing research continues to refine the indications for drains and supports a trend toward more selective, patient-centered drainage strategies [33][34].

Enhancing Healthcare Team Outcomes

Effective utilization of suction drains is fundamentally dependent on the coordinated efforts of an interprofessional healthcare team. Optimal outcomes arise when each professional understands their distinct responsibilities and how these integrate into a unified care plan. Clinicians, typically surgeons or proceduralists, bear primary responsibility for determining whether a drain is indicated, selecting the most appropriate type and size, and placing it using sound surgical technique. Their decisions are informed by the underlying pathology, anticipated volume and nature of postoperative fluid, and individual patient risk factors. Following placement, they interpret changes in drainage volume and character in the broader clinical context, using these data to identify complications such as hemorrhage, anastomotic leakage, infection, or inadequate source control, and to decide when removal is appropriate.

Nurses are central to day-to-day drain management and are often the first to detect early deviations from expected postoperative course. They monitor the insertion site for erythema, swelling, tenderness, or increased drainage, assess the integrity and function of the system, maintain dressings, and ensure that negative pressure is consistently maintained where indicated. They also provide essential education to patients and families, particularly when discharge with a drain in situ is anticipated. Instruction in safe emptying techniques, measurement and documentation of output, hygiene practices, and recognition of warning signs equips patients to participate actively in their own care and reduces preventable complications. Pharmacists contribute by optimizing antimicrobial regimens when infection is suspected or confirmed, reviewing medication profiles for agents that may impair wound healing or increase bleeding risk, and adjusting therapies accordingly. In complex cases, wound care specialists and advanced practice nurses may be involved in troubleshooting persistent drainage, skin breakdown, or device malfunction. Social workers and case managers may also assist in arranging home health services for patients requiring ongoing drain care after discharge. Interprofessional collaboration, supported by structured communication tools and consistent documentation, ensures timely identification and management of drain-related issues. Regular discussion of drain status during rounds, explicit documentation of removal criteria, and shared understanding of care goals collectively enhance patient safety, reduce length of stay, and improve overall satisfaction with care [33][34].

Nursing, Allied Health, and Interprofessional Team Interventions

Nursing and allied health professionals are pivotal in implementing real-time interventions that support safe and effective use of suction drains. Because they are in closest and most frequent contact with the patient, these team members often serve as the first line of surveillance for evolving complications. Prompt communication with the treating provider is essential when signs of local or systemic compromise emerge. Erythema, warmth, or maceration around the drain site, increasing pain, or the appearance of purulent discharge are early indicators of localized infection and must be reported without delay so that cultures, imaging, or antibiotic therapy can be initiated as appropriate. Similarly, systemic manifestations such as fever, chills, tachycardia, or malaise may signal sepsis, uncontrolled fluid collection, or other serious complications and warrant immediate escalation. Timely recognition of drain malfunction is another critical intervention area. Changes in the quantity or quality of output—such as sudden cessation of drainage, a sharp increase in volume, the onset of bright red blood, or conversion to bilious or feculent material—can indicate obstruction, hemorrhage, anastomotic leakage, or displacement. Nursing staff and allied health professionals must be trained to recognize these patterns and to understand their potential implications so that they can alert the provider and initiate appropriate interim measures, such as verifying that the reservoir is properly compressed, the tubing is not kinked, and the system connections remain intact. In addition, interventions frequently include patient and caregiver education tailored to the patient's functional and cognitive status. This may involve teaching proper hand hygiene before contact with the drain, demonstrating how to empty and measure drainage, and explaining when to seek urgent medical attention. Physical and occupational therapists may assist with strategies to mobilize safely while protecting the drain from traction or dislodgement. Collectively, these interventions reduce the risk of complications, promote early detection of adverse changes, and support smoother transitions from hospital to home or rehabilitation settings [33][34].

Nursing, Allied Health, and Interprofessional Team Monitoring

Monitoring of suction drains is a continuous, shared responsibility among the interprofessional team and is central to their safe and effective use. This monitoring encompasses both mechanical and clinical dimensions. From a mechanical standpoint, staff must confirm that the drain remains correctly positioned, with the external portion securely anchored and free of kinks or excessive tension. Routine inspection of the insertion site ensures that the tubing has not migrated inward or outward, which could compromise drainage or risk tissue injury. Regular stripping or milking of the tubing, when ordered and appropriate, helps maintain patency by dislodging fibrin, clots, or debris that might otherwise obstruct flow. Equally important is consistent surveillance of the drainage reservoir. Nurses and allied health personnel are responsible for emptying the collection device at prescribed intervals or when it nears capacity, using strict aseptic technique. Each emptying is an opportunity for structured assessment and documentation: the volume of effluent is measured and recorded, and its color, clarity, and viscosity are observed. Trends over time—such as gradual reduction in output, stabilization of serous characteristics, or abrupt changes in appearance—provide valuable clinical information that informs decisions regarding drain continuation or removal. When high-output drainage is present, the interprofessional team must also monitor the patient's fluid balance, replacing significant losses with appropriate intravenous or oral fluids and, when needed, electrolytes to prevent hypovolemia or metabolic disturbances. Monitoring extends beyond the device itself to the patient's overall condition. Vital signs, pain patterns, laboratory values, and physical examination findings are interpreted in conjunction with drain data to form a comprehensive

picture of postoperative recovery. For example, persistent tachycardia or leukocytosis in the setting of cloudy, foul-smelling drainage may indicate infection or an inadequately drained collection. In such cases, further imaging, surgical reassessment, or modification of antimicrobial therapy may be warranted. Through systematic, coordinated monitoring, the interprofessional team can identify complications at an early stage, intervene before they escalate, and determine the optimal timing for drain removal. This meticulous approach reduces morbidity, enhances healing, and supports high-quality, patient-centered surgical care [33][34].

Conclusion:

In conclusion, suction drains are important but not infallible tools in postoperative management. Their primary value lies in evacuating fluid to reduce dead space and providing an early indicator of complications like bleeding or anastomotic leak. However, contemporary evidence challenges routine prophylactic use, advocating instead for a selective approach based on specific surgical and patient factors. Successful drain management is a multidisciplinary endeavor. It requires precise surgical placement, diligent nursing care—including regular output measurement, patency maintenance, and meticulous exit-site hygiene—and clear communication across the care team. Drains should be removed as soon as output is minimal to reduce complication risks. Ultimately, the effective and safe application of suction drains hinges on a balanced, evidence-based strategy that prioritizes patient-specific needs over routine practice, ensuring this common intervention delivers maximum benefit with minimal harm.

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