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A NARRATIVE REVIEW

The Role of Vacuum Assisted Closure in Acute Care Practice on Low-Output Abdominal Fistula: A Narrative Review

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Abstract

Low-output enterocutaneous fistulas (ECFs) are challenging postoperative complications that can lead to significant morbidity due to nutritional depletion, infection, and prolonged hospitalization. Vacuum-assisted closure (VAC) therapy, also referred to as negative pressure wound therapy (NPWT), has shown promise as a valuable adjunct in the acute care setting. This narrative review explores the role of VAC therapy in the management of low-output abdominal fistulas, focusing on its physiological mechanisms, technical considerations, and clinical outcomes. Evidence suggests that VAC therapy enhances granulation tissue formation, controls effluent, and facilitates spontaneous closure in up to 70 - 100% of appropriately selected cases of low-output fistulas. Closure often occurs within two to eight weeks when VAC is applied properly. Despite concerns about potential complications such as bleeding or fistula worsening, VAC remains a safe and effective strategy, particularly when traditional wound care methods fail. While the current literature is largely composed of case series and observational reports, the cumulative experience supports VAC as a frontline therapy in the acute management of low-output ECFs upon conservative measure failure. More clinical trials are needed to establish standardized treatment protocols.

Keywords

Enterocutaneous fistulas, Low out-put, Narrative review, Outcomes.

Introduction

Enterocutaneous fistulas (ECFs) pose significant management challenges, with high morbidity due to fluid/electrolyte losses, malnutrition, and sepsis. Reported mortality rates range from 6 % to 33 % in various series [1]. Abdominal fistulas most often follow surgical complications e.g., anastomotic leak or severe inflammatory processes such as Crohn's disease or infection that lead to bowel wall breakdown [2].

ECFs are commonly classified by output volume: low-output fistulas drain < 200 mL of enteric fluid per day, moderate-output 200 - 500 mL/day, and high-output > 500 mL/day [1]. Low-output fistulas tend to have a better chance of spontaneous closure under conservative management, whereas high-output fistulas often require more intensive interventions. Indeed, roughly one-third of fistulas will close spontaneously with optimal medical management, e.g., sepsis control, nutritional support, and local wound care, especially if they have low output, a longer tract, and no distal obstruction [3]. However, many fistulas persist despite conservative measures, necessitating innovative approaches to promote healing.

Vacuum-assisted closure (VAC) therapy, also known as negative pressure wound therapy (NPWT), has emerged as a valuable tool in the acute management of abdominal fistulas. VAC therapy involves applying sub-atmospheric pressure to a wound via a foam dressing connected to a vacuum device. First introduced in the 1990s for treating complex wounds, NPWT was initially contraindicated in fistulas due to concerns that it might maintain the fistula opening or even cause new fistulas [1]. Today, VAC therapy is widely used as part of a multimodal strategy for ECFs, although clinical trial data are lacking, and no formal international guidelines yet

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specifically endorse its use in small bowel fistulas [3]. This narrative review examines the role of VAC therapy in acute care of low-output abdominal fistulas in adults, focusing on its mechanism of action in fistula healing, practical application techniques, clinical relevance in acute care, indications and outcomes in low-output cases, and critical discussion of benefits, safety, and limitations.

Low-output Enterocutaneous Fistulas

ECFs commonly arise postoperatively due to anastomotic leakage or iatrogenic bowel injury, with non-anastomotic perforations and dehiscence accounting for the majority. Infectious causes such as typhus and Crohn's disease contribute significantly, especially in developing countries. Radiotherapy and ablative therapies may induce delayed fistulization via vascular and connective tissue damage. Chemotherapy and targeted therapies, notably bevacizumab and tyrosine kinase inhibitors, are associated with bowel perforation through ischemic, thromboembolic, and antiangiogenic mechanisms [4].

The primary goals in acute management of ECF are often summarized as controlling sepsis, protecting the skin, managing fistula effluent, and optimizing the patient's fluid/nutritional status. Under ideal conditions, a low-output fistula can close spontaneously. Favorable factors for spontaneous closure include a small fistula defect (< 1 cm), a long and unobstructed fistula tract, absence of distal bowel blockage, no foreign bodies or active disease in the tract, and an output under ~500 mL/day [4]. By contrast, large or short tract fistulas, distal obstruction, or ongoing infection are unlikely to heal without intervention [4]. Traditional wound care for an open fistula has involved pouching systems or dressings to contain the effluent and protect the surrounding skin from corrosive intestinal fluids. However, ordinary dressing often requires frequent changes and does not actively promote wound healing. Prior to NPWT, managing an ECF was highly challenging and associated with mortality up to 44 % in some series [5].

Mechanism of Vacuum-Assisted Closure in Fistula Healing and Application

VAC therapy promotes fistula healing through multiple mechanisms of action that address both the wound environment and the fistula output. A key benefit of NPWT in fistulas is continuous suction of intestinal effluent away from the wound. The negative pressure actively drains the fistula output, preventing the accumulation of fluids that would otherwise irritate the wound and macerate the surrounding skin [6]. The subatmospheric pressure exerted by VAC foam dressings induces mechanical deformation in the wound tissue, stimulating cellular proliferation and angiogenesis. In acute wounds and fistula tracts, this leads to rapid granulation tissue growth that can help close dead space and cover exposed areas. NPWT has been shown to enhance the granulation of the wound bed and support the formation of a healthy tissue matrix around the fistula [4]. Studies have noted that VAC dressings decrease local inflammation in infected abdominal wounds and help control bacterial contamination by continuously clearing fluid and debris [4].

Proper application of VAC therapy in the setting of an abdominal fistula is critical to success. As with any wound therapy, the area must be prepared. This includes debriding devitalized tissue and draining any abscesses adjacent to the fistula. A protective interface is often placed over any exposed viscera before applying foam; for example, a non-adherent contact layer can be laid on bowel surfaces to prevent the foam from directly adhering to the gut [7]. A major technical consideration is handling the fistula output under the VAC dressing. For low-output fistulas, the small volume of effluent can often be simply absorbed and evacuated by the foam dressing itself. The foam is cut to fit around the fistula, and the suction tubing will pull fluid through the foam into the canister. Additional isolation techniques can be used in cases where the fistula opening is sizable or in an open abdomen. Trevino et al. described a "ring and silo" technique, where the fistula was encircled by a ring barrier and covered with a silo-like drape that funneled output into a collection bag, and the VAC was applied around this structure [8]. In low-output cases, such elaborate setups may not be necessary. Another aspect of the VAC application is the level of negative pressure used. Standard NPWT for wounds often uses around -125 mmHg continuous suction. In fistula management, less can be more for low-output fistulas, as excessive suction might stimulate more fistula output or trauma. Some authors have reported better fistula outcomes with lower suction pressures (- 50 to - 80 mmHg) for low-output fistulas [7].

Indications for Vacuum-Assisted Closure in Low-Output Fistulas

The ideal scenario for employing VAC therapy is an adult patient with an abdominal fistula that has relatively low output (e.g., < 200 mL/day) and is in the acute phase post-fistula development. These are often post-operative patients where surgical re-intervention is risky in the acute setting due to inflammation or adhesions. VAC is indicated to manage the open wound or dehisced surgical incision that harbors the fistula, with the goals of protecting the skin and encouraging the fistula to close on its own. It is particularly useful if the fistula opening is small and not epithelialized; in such cases, NPWT has a high chance of inducing closure [9]. Low-output jejunal or ileal fistulas, fistulas in the context of an open abdomen, and fistulas arising from an anastomotic leak are all scenarios where VAC can

be applied. Overall, VAC therapy has become a go-to indication in the acute management of low-output fistulas when conventional dressings fail to contain the situation or when a proactive approach to promote healing is desired.

Outcomes of Vacuum-Assisted Closure Therapy in Low-Output Fistulas

Clinical outcomes with VAC therapy in abdominal fistulas have been reported in numerous case series and observational studies over the past two decades. While no randomized controlled trials exist, the aggregate experience suggests that VAC can significantly improve spontaneous closure rates in suitable fistulas and at least simplify the care of those who do not close. Key outcome metrics include fistula closure rate, time to closure, and overall patient morbidity.

Spontaneous Closure Rates

Reported closure rates vary with patient populations and fistula types. In general, low-output fistulas are much better than high-output ones. For example, an early study by Gunn et al. treated 15 adult patients with ECF using NPWT dressings; overall, 73 % of fistulas closed with VAC therapy, and significantly, all fistulas that had no visible bowel mucosa at the skin healed (11/11 cases) [9]. Only those with exposed mucosa failed to close, underscoring that tissue factor. In a multicenter study of enteroatmospheric fistulas in open abdomens, Bobkiewicz et al. reported that low-output fistulas had a 76.9 % spontaneous closure rate under NPWT [6]. Another series from Italy by Pepe et al. focusing on VAC in fistulas found that 100 % (4/4) of their enterocutaneous fistulas, which were all low-output, closed spontaneously. In contrast, 1 out of 4 enteroatmospheric fistulas closed, and the others were converted into lower-output fistulas for later management [1]. Low-output fistulas, without adverse factors, are clearly at the higher end of this range, with many reports approach closure rates of 70–100% in that subgroup [1,9].

Time to Closure

When closure is achieved with VAC therapy, it often occurs relatively quickly, within weeks, once the system is in place. Gunn et al. reported a mean time to fistula closure of only 14 days in the patients who healed with NPWT [9]. This is remarkably short, likely reflecting that small superficial fistulas can epithelialize under VAC in just a few weeks. Other studies have found longer durations; for example, Bobkiewicz's multicenter study noted a mean time of 47 days for fistula closure with NPWT [6]. D'Hondt et al. reported that the onset of fistulization in elective surgical management was 51 days. The difference is due to the complexity of the patient's open abdomen with large wounds; it takes longer for sufficient granulation to achieve closure. Pepe et al.'s series found that an average of 36 days of VAC therapy was required to reach fistula closure [1]. Thus, one can expect 2 weeks to 2 months of NPWT to get closure, with low-output straightforward cases often closing in the shorter end of that spectrum.

Safety, Benefits, and Limitations

VAC therapy in fistula management offers distinct benefits but also has limitations and potential risks that must be acknowledged. The benefits of VAC for low-output fistulas include improved rates of spontaneous closure, superior management of wound and skin conditions, and reduced nursing burden, i.e., fewer dressing changes, less spillage, and possibly avoidance of immediate high-risk surgery. Patients often experience better comfort once the fistula is controlled; they can be mobilized and participate in nutrition/rehabilitation with less fear of incessant leakage. Additionally, VAC tends to reduce the overall time to fistula closure compared to passive dressings [9]. Psychologically, having the fistula under control with a vacuum device can alleviate patients' distress from an uncontrolled, draining wound [10].

Despite its utility, VAC therapy has certain limitations, including if the fistula has a large epithelialized tract or a prolapsing mucosa, NPWT will not induce closure [9]. The negative pressure cannot cause the mucosa to re-approximate; surgical fistula revision will eventually be needed in these cases. Furthermore, applying VAC can theoretically create additional fistulas or enlarge the existing ones [6]. Another limitation is that since granulation tissue is vascular and fragile, VAC dressings can adhere to it, potentially resulting in hemorrhage. Lastly, the current evidence for VAC in fistulas comes from case series, case reports, and a few comparative cohort studies, all subject to bias. However, when used judiciously, VAC therapy is a powerful adjunct in the acute care of low-output abdominal fistulas.

Conclusion

In conclusion, vacuum-assisted closure is a proven and effective therapy for enterocutaneous fistulas. In the acute care of low-output abdominal fistulas, VAC is a bridge to recovery and achieving positive results. Over the past two decades, accumulating evidence from case series, clinical reports, and expert experience has demonstrated that VAC can significantly improve spontaneous fistula closure rates, often achieving closure in the majority of low-output cases. Indications for its use center on situations where the fistula output is manageable and immediate surgery is undesirable or high-risk. Low-output fistulas have the inherent potential to heal and are ideal candidates. As reviewed, outcomes in such cases are generally favorable, with many patients avoiding further surgery. VAC has broadened the therapeutic window, allowing time and conditions for healing that previously might not have been possible. The lack of randomized trials means our knowledge is

based on observational evidence and clinical reasoning, necessitating further investigation. Future research should aim to provide higher-level evidence, perhaps comparing VAC therapy to conventional dressing management in fistula patients.

Author Contributions

"Conceptualization, M,A. . Methodology, L.A..; Validation, E.A. and L.A..; Investigation, L.A .; Resources, E.A.; Writing – Original Draft Preparation, L.A. Writing – Review & Editing, E.A.; Visualization, E.A.; Supervision, M.A.; Project Administration, L.A; Funding Acquisition, M.A.".

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Conflicts of Interest

The authors declare no conflict of interest.

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