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Novel wound management system reduction of surgical site morbidity after ventral hernia repairs: a critical analysis

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Abstract

BACKGROUND: Prophylactic incisional negative-pressure wound therapy use after ventral hernia repairs (VHRs) remains controversial. We assessed the impact of a modified negative-pressure wound therapy system (hybrid-VAC or HVAC) on outcomes of open VHR.

METHODS: A 5-year retrospective analysis of all VHRs performed by a single surgeon at a single institution compared outcomes after HVAC versus standard wound dressings. Multivariable logistic regression compared surgical site infections, surgical site occurrences, morbidity, and reoperation rates.

RESULTS: We evaluated 199 patients (115 HVAC vs 84 standard wound dressing patients). Mean follow-up was 9 months. The HVAC cohort had lower surgical site infections (9% vs 32%, $P < .001$) and surgical site occurrences (17% vs 42%, $P = .001$) rates. Rates of major morbidity (19% vs 31%, $P = .04$) and 90-day reoperation (5% vs 14%, $P = .02$) were lower in the HVAC cohort.

CONCLUSIONS: The HVAC system is associated with optimized outcomes following open VHR. Prospective studies should validate these findings and define the economic implications of this intervention.

Despite being one of the most common general surgery procedures, ventral hernia repairs (VHRs) remain associated with significant postoperative morbidity. Recurrence rates following VHR range from 3% to 43%.[1–5] In addition, surgical site occurrences (SSOs), including wound dehiscence, seroma formation, and surgical site infections (SSIs), may dramatically alter patients' postoperative course and result in potentially serious repercussions. SSIs occur in 18% to 41% of VHR and are associated with markedly increased risk of hernia recurrence and higher hospital costs.[6–8] VHR total annual healthcare costs are upwards of $3.2 billion in the United States, making this disease a significant health care burden.[2]

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A number of technologies have been proposed to reduce the risk of SSIs after VHR, including the use of prophylactic negative-pressure wound therapy (NPWT). NPWT using vacuum-assisted closure (VAC) is a technique often used for management of wounds, burns, ulcers, skin flaps, and grafts. The physiologic and molecular mechanisms by which VAC therapy accelerates wound healing are not fully understood. However, VAC therapy affords several known benefits including improved removal of excessive wound fluid, decreased interstitial edema, and increased microvascular blood flow, as well as maintaining adequate wound drainage and the humid environment necessary for optimal wound healing.[9–11] Despite its benefits, the use of incisional NPWT to reduce surgical site morbidity after VHR remains controversial.[12–14]

Our group developed a modified wound management system (hybrid-VAC or HVAC) with the goal of reducing surgical site morbidity. In light of the potentially significant impact of SSOs and SSIs after VHR, and the current controversies regarding prophylactic NPWT for this population, we aimed to determine the effect of the HVAC on postoperative surgical site morbidity of patients undergoing open VHR. We hypothesized that the prophylactic use of the HVAC would lead to decreased surgical site complications after VHR.

Methods

After obtaining Johns Hopkins Institutional Review Board approval, all consecutive patients who underwent VHR by a single experienced surgeon (F.E.E.) between January 2008 and February 2013 were retrospectively reviewed. Selection criteria were unchanged during this 5-year period and consisted of outpatient referrals. Baseline patient characteristics were collected from electronic medical records including age, sex, body mass index (BMI), race, previous VHR, ventral hernia grade according to the modified hernia grading scale (MHGS),[15] previous mesh placement, history of wound infection, and comorbidities (smoking, diabetes, immunosuppression, chronic obstructive pulmonary disease, renal failure or insufficiency, deep vein thrombosis, and pulmonary embolism). Perioperative data acquisition included American Society of Anesthesiology (ASA) classification, operative time, surgical repair technique, and surgical incision classification according to centers for disease control (CDC) criteria.[16]

Surgical technique

In all cases, preoperative antibiotics were administered within 60 minutes of incision and redosed as appropriate per surgical care improvement project criteria.[17] Prophylactic antibiotics were not administered postoperatively. Patients were shaved using hair clippers when necessary and prepped with 2% chlorhexidine unless there was an enterocutaneous fistula present, in which case Betadine was used. Tight glycemic control was accomplished using standard hospital measures, including diabetes management consultation when necessary.

Our principal goal in VHRs is to restore abdominal wall anatomy and function, using wide mobility of soft tissue flaps and anterior component separation (ACS) to reapproximate and primarily close the fascial defects in the midline. All cases of midline fascial closure were reinforced with synthetic soft polypropylene mesh onlay (Prolene; Ethicon LLC). This was secured firmly to the abdominal wall fascia 10 cm beyond the fascial closure in all directions using permanent monofilament sutures and fibrin sealant (TISSEEL; Baxter, Deerfield, IL). In all cases of ACS, the mesh onlay was extended to the lateral edge of the relaxing incision to restabilize the lateral abdominal wall. In cases where fascial approximation was not possible, a sandwich approach was performed using an acellular dermal matrix (Surgimend; TEI Biosciences, Boston, MA) underlay and a soft synthetic polypropylene mesh (Prolene; Ethicon LLC, USA) overlay without ACS. Surgical principles and techniques were not altered during the study period.

At the completion of VHR, three to four closed suction drains were placed and exited through the lateral abdominal wall. The dermis was approximated using interrupted 3-0 vicryl sutures. For standard wound dressings (SWD), the skin was closed with staples and dry gauze was placed over the closed incision in sterile fashion. For HVAC placement, rectangular strips, or wicks, of reticulated open-cell polyurethane white foam (KCI, San Antonio, TX) were cut to size and inserted through the dermal layer into the subcutaneous space at intervals of 6 to 8 cm along the entirety of the incision (Fig. 1A,B). These wicks measured 5 mm $\times$ 10 mm $\times$ 100 mm in dimensions and the length was varied according to abdominal wall thickness so that the wicks extended 1 cm above the surface of the skin. Exposed areas of skin between the wicks were covered with silver-impregnated nonadherent dressing (Restore Silver Contact Layer; Hollister Inc, Libertyville, IL) extending 3 cm on either side of the incision to protect the skin (Fig. 1C). A piece of reticulated open-cell polyurethane black foam (Granufoam; KCI) was secured with adhesive dressing (Fig. 1D). Negative-pressure VAC therapy was applied at a continuous pressure of -125 mm Hg.

Postoperative management

For patients in the SWD group, the sterile dressing was removed on postoperative day 2 and the incision was left open to air. For patients in the HVAC cohort, the HVAC dressing was removed on postoperative day 3. The wicks were qualitatively assessed. If the wicks were fully saturated, they were replaced and re-examined in 24 to 48 hours. Replacement wicks were made shorter and narrower with each dressing change to encourage closure of the skin gaps and were removed once they were