

Utilizing Instilling Negative Pressure Wound Therapy with Vashe Wound Solution for an Infected Sternal Dehiscence: A Case Report

Linnea T. Mauro¹, Courtney M. Janowski¹, Mariah J. Janowski¹, Adalberto C. Gonzalez¹, Eugene J. Sidoti¹, Luis G. Fernandez^{2,3,4,5,6,7,8,9}, Paul J. Kim¹⁰, Marc R. Matthews^{11*}

¹Valleywise Medical Center, Department of Surgery, Phoenix, Arizona

²Department of Surgery, Division of Trauma Surgery/Surgical Critical Care, University of Texas Health Science Center, Tyler, Texas

³The University of Texas, Tyler School of Medicine Endowed Chair in Trauma Surgery, Tyler, Texas

⁴Trauma Wound Care, UT Health East, Tyler, Texas

⁵Department of Surgery, University of Texas Medical Branch, Galveston, Texas

⁶Medicine and Nursing, University of Texas, Arlington, Texas

⁷Department of Medical Education Health Science Center, Tyler, Texas

⁸Department of Physician Assistant Studies, School of Health Professions, University of North Texas, Fort Worth, Texas

⁹ACS National Committee on Trauma, Chicago, USA

¹⁰Plastic Surgery, Department of Surgery, University of Texas Southwestern, Dallas, Texas

¹¹University of Arizona & Creighton University Schools of Medicine, The Arizona Burn Center, Phoenix, Arizona

Email: *marc_matthews@dmgaz.org

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Abstract

Utilization of negative pressure wound therapy with instillation (NPWTi) for sternal dehiscence wounds secondary to sternal wound infection after surgery has become an accepted therapy. NPWTi accelerates wound healing through macrostrain, microstrain, and cyclic fluid instillation. Wounds benefit from additional superficial infection control with the removal of microorganisms, the release of proinflammatory mediators, stimulation of angiogenesis, as well as mechanical debridement. However, very few cases of utilizing NPWTi in the treatment of sternal wound infections have been reported in the literature. This case study describes the use of NPWTi with hypochlorous acid for the treatment of a sternal wound infection.

Keywords

Negative Pressure Wound Therapy with Instillation, NPWT, NPWTi, NPWT with Dwell, Hypochlorous Acid, Vashe Wound Solution, Sternal Dehiscence

1. Introduction

Sternal wound infection following open cardiac surgery is a rare but potential-

ly fatal complication with an incidence ranging between 0.2% and 3% [1]. Multiple risk factors have been identified in association with sternal dehiscence leading to mediastinitis including, but not limited to, postoperative bleeding with re-exploration, diabetes, prolonged mechanical ventilation, and internal mammary artery grafting [2] [3]. Prior to 2006, common options for managing deep sternal wound infections included sternal debridement and rewiring, mediastinal irrigation, local wound care, and revision with omental and musculoskeletal flaps [4].

After 2006, the use of negative pressure wound therapy (NPWT) became more commonly utilized for sternal wound infections, and it has become a first option therapy immediately after dehiscence [4]. Studies have shown that utilizing NPWT in the treatment of sternal wound infections have led to shorter hospital stays, faster rates of healing, and reduced over-all infection rates compared to conventional therapy [5] [6]. The use of closed incision negative pressure (Prevena™ Incision Management System, 3M, Minneapolis, MN) applied over a closed sternum applied immediately post-coronary artery bypass grafting, has shown a tremendous decrease in sternal infections, decrease length of stay, and less cost to the healthcare system [6] [7] [8].

The use of NPWTi for open extremity and torso soft tissue wounds has been reported in the treatment of many types of wounds [9]-[14]. The application of NPWTi has been reported to decrease the bioburden in wound beds, decrease length of hospitalization, and decrease overall healthcare costs [9] [10] [11] [12] [13] [15]. Instilling through open abdomen NPWT devices (ABTEHRA ADVANCE™ Open Abdomen Dressing, 3M, Minneapolis, MN) has been described without concomitant hypothermia [16] [17] [18]. In a series of reports, the authors (MM, LF) have instilled hypochlorous acid (Vashe Wound Solution, Urgo Medical North America, Fort Worth, TX) in the septic abdomen due to its reported antimicrobial effect and found no adverse outcomes [19] [20] [21] [22].

The utilization of NPWTi for dehisced sternal wounds has only been reported once in the literature [8]. The authors have failed to find any current reports of hypochlorous acid cleanser used to treat sternal wound dehiscence, use for instillation into the pericardial sac, or as the instillation in NPWTi, in this setting. Irrigation with hypochlorous acid into the chest cavity was previously described utilizing EUSOL, a basic, hypochlorous acid containing irrigating solution during the beginning of the 20th century [Lyndon Smith] and during the First World War [Frazier and Bates] [23] [24]. Recently, Fernandez used a hypochlorous acid cleanser to lavage a pericardium during a massive chest trauma after multiple stab wounds to the anterior torso and subsequent cardiac apices with no clinical sequelae [25].

We present a case study of NPWTi (V.A.C. VERAFLOR Cleanse Choice, 3M, Minneapolis, MN) using hypochlorous acid cleanser (Vashe Wound Solution, UrgoMed, Ft Worth, TX) as the instillation solution to promote infection clearance and wound bed granulation in a dehisced sternal wound prior to sternal bone resection and pectoralis musculoskeletal flap and skin closure. The institu-

tional review board (IRB) at Valleywise Health Medical Center (formerly known as Maricopa Integrated Health System) has determined that this case report (CR2021-018) is exempt from IRB review based on Code of Federal Regulations (CFRs) Title 25, Part 46—Protection of Human Subjects and the human data presented is in accordance with the Declaration of Helsinki. There was no funding provided or obtained for the writing and development of this scientific paper.

2. Case Description

A 64-year-old female presented to her local medical center with a past medical history significant for coronary artery disease, hypertension, and atrial fibrillation. She was noted to have recently undergone a median sternotomy for mitral valve replacement, patent foramen oval closure, and coronary artery bypass graft using her left internal mammary artery to a left anterior descending artery. Three months following this surgery, she underwent a re-sternotomy for a perivalvular leak repair, tricuspid valve repair for regurgitation with left atrial appendage closure.

The patient's postoperative course was complicated by a sternal wound dehiscence with an associated methicillin-resistant *Staphylococcus aureus* infection. She subsequently underwent a second sternal debridement and closure followed by traditional NPWT and intravenous antibiotic treatment which failed to resolve the sternal infection. In addition, the sternum remained unstable to palpation and with movement while the skin over the sternum had reopened. Purulent drainage began to be expressed from the open sternal wound. The patient was transferred from an outside wound clinic to the author's (MM) medical facility for further care. The patient's traditional NPWT device (**Figure 1**) was switched to a NPWTi (**Figure 2**). A hypochlorous acid solution was used with a total volume of instillate of 50 mL per dwell cycle. The dwell time was 10 minutes into the open sternal wound which tracked into the pericardial sac followed by negative pressure at -75 mmHg applied for 15 minutes. These NPWTi settings were applied for 5 days.

During the 5 day NPWTi treatment period, the wound appeared to show mechanical debridement with large macrodomes of granulation tissue by day three NPWT exchange (**Figure 3**) and a modest decrease in necrotic fibrinous exudate (**Figure 4**). By day five there was a large increase in anterior chest/sternal granulation tissue and a large decrease in fibrinous exudate (**Figure 5**). The patient underwent a manubrium-sparing partial sternectomy with left pectoralis muscle local rotation advancement flap with primary closure on day five (**Figure 6(a)** and **Figure 6(b)**). Her postoperative course was uneventful, and she was discharged on postoperative day two. She was evaluated in the clinic one month following her final closure and was found to have a stable sternum and no wound infection. Subsequently, the patient was contacted by telephone for check-up and her recovery at two years continues to be uneventful.

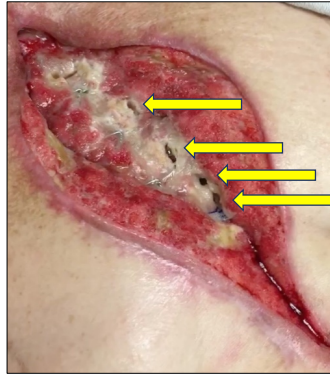


Figure 1. Photograph of an infected, dehiscenced sternal wound upon first presentation despite debridement and attempted closure and negative pressure wound therapy from another medical center. Note the widening of the two sternal edges with deep inspiration (yellow arrows) despite recent debridement and the presence of sternal wire within the wound bed.



Figure 2. Photograph of a NPWTi with hypochlorous acid with an instilling over the infected sternum.



Figure 3. Photograph of removal for exchange of the sternal NPWT V.A.C. VERAFLOR Cleanse Choice device at bedside. Note the two-layer foam with the contact layer with the large fenestrated foam against the sternum and the cover layer elevated with the acrylic drape and surrounding ostomy paste.



Figure 4. Photograph of anterior sternal wound revealing macrodome granulation tissue development and a modest reduction of fibrinous exudate tissue on day three.



Figure 5. Photograph of the dehisced sternal wound with improved granulation tissue and less fibrinous exudate after five days with the use of NPWTi with hypochlorous acid.

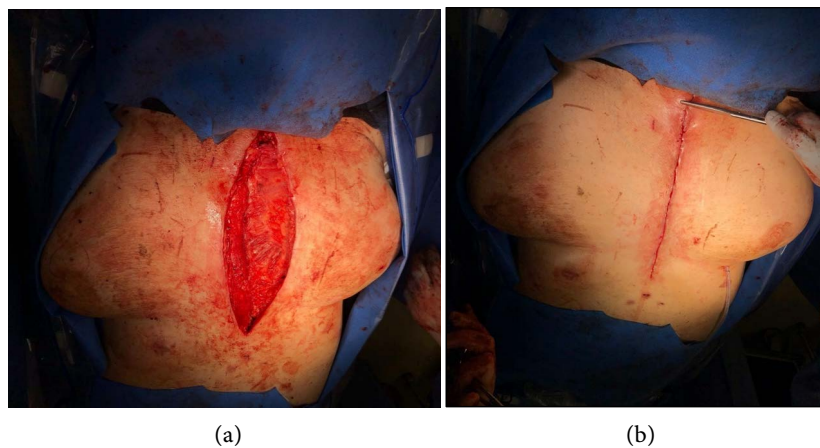


Figure 6. (a) Photograph of left pectoralis advancement flap closure after sternal debridement. (b) Photograph of midline sternal closure of the anterior chest wall.

3. Discussion

This case study demonstrates the effective and safe use of NPWTi in conjunction with hypochlorous acid in treatment of sternal wound infection and dehiscence. While it is widely accepted that use of NPWT is associated with improved positive outcomes for sternal wound dehiscence and infections compared to conventional treatment methods, there is only one, rare description demonstrating the use NPWTi for sternal wound infections [8] and none demonstrating the use of hypochlorous acid cleanser as the irrigant.

Sternal wound infections are a potentially fatal complication following open cardiac surgery. Over the years, the treatment and management techniques have evolved as new products have become available. Prior to NPWT devices being utilized for sternal wound closure, there were a variety of techniques utilized, including primary wound re-opening, debridement, closed-chest irrigation, and muscle flap reconstruction. Many studies have been performed demonstrating the benefits of traditional NPWT utilization for sternal wound infections. Outcomes include shorter hospital stay, lower rates of reinfection, and even lower rates of in-house mortality [7]. Only one case study was found describing the use of NPWTi for sternal wounds as an effective treatment of *Mycoplasma hominis* mediastinitis [8].

We present the use of hypochlorous wound solution when using the NPWTi because it has been shown to be effective in killing all prokaryotic organisms with sustained contact [22] [26]. Hypochlorous acid, has been utilized in many wound care as an irrigant and for debridement to assist in wound bed preparation. It has been reported in vitro to be effective against a variety of pathogens including bacteria, viruses, and fungi as well as biofilm including but not limited to methicillin-resistant staphylococcus aureus (MRSA), vancomycin-resistant enterococcus faecalis (VRE), and candida albicans. [26] Differing from sodium hypochlorite solution, hypochlorous acid has a pH of 4.5 - 5.5 making it a more stable solution and non-cytotoxic to surrounding healthy tissue including the myocardium [9] [22].

4. Limitations

The following case report has no specific limitations other than it is a single case report with the objective of disseminating information to the clinical specialist. While one could perform a large case series review or a randomized trial with and without NPWTi for sternal dehiscence, the author's (MM) medical facility does not provide a cardiothoracic surgery service line, therefore, it would be difficult to complete such a series or trial.

5. Conclusion

We present a case demonstrating that hypochlorous acid-based wound cleanser is a safe and effective agent in conjuncture with NPWTi for the treatment of sternal wounds with an open pericardium and over the myocardium. Future stu-

dies should include larger case series and controlled trials to see if hypochlorous acid cleansers are more efficacious than standard normal saline as an irrigant. In addition, studies should assess the use of NPWT with irrigation in the preparation for a sternal debridement and closure.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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