Discussion

Vacuum-Assisted Closure for Sternal Wounds: A First-Line Therapeutic Management Approach

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This well-written article by Dr. Agarwal and colleagues is an important addition to the literature on the management of infected/dehisced sternal wounds. The authors describe their experience with 103 patients who underwent median sternotomy during a 5-year period (June of 1999 to March of 2004), which included the use of negative-pressure wound therapy as a first-line treatment. Although they report a mortality rate of 28 percent, none of the deaths were directly attributable to this treatment algorithm, which consisted of identification of the problem, thorough débridement, and placement of a vacuum-assisted closure device for a variable amount of time (range, 2 to 79 days; mean, 11 days). Some of these patients went on to pectoralis or omentum flap closure (68 percent). Others were allowed to heal by secondary intention (32 percent).

The authors are correct in emphasizing the severe nature of the problem. While it is true that the initial reports of a 50 percent mortality rate have decreased to as low as 10 percent with aggressive débridement and flap closure, this dreaded complication still has a devastating effect on the patient, the patient's support system, and the physician. The traditional treatment involving frequent and painful dressing changes resulted in a significant burden on resources and psychological taxation to the patient. With the advent of the vacuum-assisted closure therapy and its subsequent gain in popularity in the treatment of post-sternotomy chest wounds, this burden has significantly decreased while patient comfort has increased. This article emphasizes this in through a retrospective review of the largest cohort of patients to be reported on using this method of treatment.

Several issues, however, require further discussion and highlighting. The first involves the condition of the individual patient. The authors' experience is similar to mine in that these patients frequently have several significant underlying comorbidities that can have a dramatic impact on both overall survival and wound healing. One factor not mentioned is the nutritional status of the patient. This patient subpopulation often suffers from malnutrition, which can be assessed by albumin and prealbumin levels. This can adversely affect the rate of wound healing as well as the bulk of flaps that may be used in reconstruction. The use of vacuum-assisted closure in these patients is even more useful, as it provides a temporizing intervention that maintains the health and stability of the wound bed while aggressive nutritional repletion is instituted. I generally look for a prealbumin level of at least 15 (with a positive trend) as evidence of adequate nutrition before proceeding with major flap surgery. Enteral or even parenteral supplementation may be required to achieve this.

The second issue that requires emphasis is that of "radical sternal débridement." Although the therapy is undoubtedly effective in the treatment of these wounds, it does not serve as a substitute for débridement. Although this is, in fact, included in their algorithm for treatment, it deserves special attention in that it truly serves as the cornerstone of therapy. All infected and nonviable bone and cartilage should be débrided aggressively. Affected bone and cartilage often do not respond well to antibiotic therapy. The vascularity to these tis-

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sues is diminished after median sternotomy and internal mammary sacrifice (especially if bilateral), and marginal tissue or infected tissue will serve as a nidus for continued infection, no matter what type of flap reconstruction is used. Inadequate débridement is the most common cause of recurrent infection—a fact that must be underscored in the treatment of these wounds.

The third issue that requires further discussion concerns the respiratory mechanical advantage that the vacuum-assisted closure device confers on the patient. These patients with median sternotomies and open chest wounds suffer from prolonged periods of mechanical ventilation, in part due to skeletal instability and loss of respiratory efficiency. If properly applied, the sponge will act as a "splint" that serves to stabilize the sternum and allows for earlier weaning and subsequent extubation. This will result in an earlier mobilization of the patient while simultaneously preparing the wound bed for surgical closure. On this note, I maintain all of my patients in the cardiac intensive care unit during the initial part of this process. The comorbidities of these patients combined with their predilection to respiratory issues and the need for labor-intensive device changes preclude placement on a normal ward that lacks the oversight and resources required to truly take care of these patients.

The specifics of the application of the therapy were described by the authors. My technique differs somewhat in that I frequently use a combination of the polyvinyl alcohol sponge (the "white" sponge) as well as the open-cell polyurethane foam sponge (the "black" sponge). If the mediastinal membrane is intact, I do not hesitate to place either sponge directly on top of the membrane. If there are exposed vital structures (e.g., heart, grafts), I will use Xeroform Gauze (Integrity Medical Devices, Elwood, N.J.) or Adaptic Dressings (Johnson & Johnson, Englewood, N.J.), rather than Acticoat as an interface. If Acticoat (Smith and Nephew, Largo, Fla.) is used, it must be activated with sterile water (not saline) and full-thickness perforations must be made to allow the transmission of negative pressure through the dressing. Regarding the sponge itself, I use the polyvinyl alcohol sponge in areas of tunneling or undermining and leave enough exposed at its proximal extent to contact the polyurethane sponge, which is placed on top and connected to the unit. I generally cut the foam into large pieces, using as few pieces as possible, so as not to increase the risk of inadvertently leaving a piece of foam in the wound, which can become infected. I then use 75- to 125-mmHg continuous negative-pressure therapy (I use slightly higher pressures if there is a significant amount of polyvinyl alcohol sponge, due to its increased density). Normally, I would transition to an intermittent mode after the volume of exudate/edema diminishes to increase the amount of granulation tissue formation. However, in this particular patient subpopulation, the "splinting" effect, described above, is only realized when continuous negative pressure is applied. Therefore, I maintain the device in the continuous mode.

The duration of treatment ranged between 2 and 79 days in this study. The authors comment that in some cases the therapy is used to prepare the wound for flap reconstruction, while in others, it is used to expedite healing by secondary intention. In either case, it is important to define your endpoint a priori—that is, "what are we trying to accomplish?" If this is not done, the therapy literally can be used for weeks or months, even though there may be no significant gains in wound healing. This is a waste of resources. As stated above, the therapy may be used as a temporizing measure to increase the nutritional status of the patient before definitive flap closure. It also may be used to prepare the wound bed itself through increased granulation tissue formation, decreased bacterial counts, and increased angiogenesis, as stated. A healthy-appearing bed, then, would be the endpoint. If complete wound closure is chosen as the endpoint, care must be taken to follow the wound dimensions objectively to assure that progress is, in fact, being made. I generally look for a decrease in wound surface area/volume by 10 percent per week. If I am not achieving this, changes are instituted (e.g., device settings are adjusted and controllable issues such as nutrition and glucose are corrected).

The authors have chosen the pectoralis and omentum as their "workhorse" flaps for sternal reconstruction. These are excellent choices. However, the latissimus and rectus also must be considered as viable choices for sternal reconstruction after mediastinitis. Of course, the blood supply to these flaps may have been altered by prior surgery, but their use for sternal reconstruction has been well established and de-

serves mention within the context of their proposed algorithm for treatment. The advantages and disadvantages of each are well known to the reader.

Finally, the limitations of this retrospective study must be realized. The authors do not state what their "time to closure" is using the traditional algorithm, what their rate of complications is, or the economic effect of using traditional dressing changes versus negative-pressure wound therapy. Obviously a prospective, randomized trial comparing the traditional method versus the new proposed algorithm would have a greater impact. If a true paradigm shift is to occur, whereby standard treatment algorithms are changed, this should be based on an evidence-based approach. Therefore, while this article represents a significant addition to the literature on this topic, further research, time, and outcomes data are required before the "standard of care" is changed. Regardless, the authors should be complimented on their well-written review of their experience and the conclusions that can be drawn from it.

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