

# MEDIASTINITIS: The Never Event for Modern Day Cardiac Surgery

By: V. Seenu Reddy, MD, MBA, FACS

Mediastinitis is a potentially lethal and often devastating illness that can have multiple causes. Although primary mediastinitis is observed clinically, it is usually due to processes involving the tracheobronchial tree or alimentary canal, most typically from an esophageal perforation. The more commonly seen mediastinitis is in the post-sternotomy setting, and is variably referred to as a deep sternal wound infection. It is one of the most feared and morbid complications in patients undergoing cardiac surgery via sternotomy. The overall incidence of post-sternotomy mediastinitis is exceedingly low, and has been reported to be between 1% and 3%. The complication, when it occurs, however, is associated with significant mortality and morbidity, usually reported to occur in between 20% and 45% of patients.<sup>1,2</sup> On July 31, 2008, the Centers for Medicare & Medicaid Services (CMS) announced new payment and coverage policies to improve safety for hospitalized patients.<sup>3</sup> Embedded within this announcement was the declaration that surgical infections which manifested post coronary artery bypass grafting (CABG) surgery would be classified as a “hospital-acquired condition” that would no longer justify reimbursement.

Currently, there is no overarching consensus regarding the appropriate surgical or medical treatment of mediastinitis following open-heart surgery—other than early drainage. A broad range of wound management and wound healing strategies have been established for the treatment of post-sternotomy mediastinitis. Conventional forms of treatment usually involve

- surgical revision with open dressings or closed irrigation;
- reconstruction with vascularized soft tissue flaps such as omentum; and
- bilateral pectoralis major muscle advancement.

These approaches have procedure-related morbidity associated with them that occur relatively frequently in the face of conventional treatments. It should be further noted that the long-term clinical outcomes using these approaches and strategies have been sub-optimal. Use of Negative Pressure Wound Therapy for Vacuum assisted closure (V.A.C.) is a novel open wound treatment modality and its underlying mechanism has shown the potential for shortened wound healing times and the ability to manage patients in the outpatient setting.<sup>4,5</sup> This wound therapy technique is based on the application of localized negative pressure to the wound via a special porous sponge. Using this approach of negative pressure to the sternal wound, clinicians may note several advantages over more conventional surgical wound treatments. Further innovative advances have allowed concomitant instillation of topical wound solutions in conjunction with NPWT (i-NPWT V.A.C.® VERAFLU Therapy) and a recommended clinical pathway for its use in the adjunctive management of wounds has been published.<sup>6,7</sup>

Rather than therapy however, the consensus is that deep sternal wound infections and resultant mediastinitis should be prevented rather than treated. The preferred “prevention algorithm” includes

- identification of the highest risk patients through stratification and delineation of risk factors;
- meticulous intra-operative surgical techniques to minimize the intra-operative risk; and
- consideration of novel sternal closure mechanisms to reduce sternal movement and dehiscence.

In addition, various closure techniques along with consideration for closed incision management have become more prevalent. Finally, the careful postoperative management of the patient, including glycemic control, additional sternal precautions, appropriate use of postoperative antibiotics and nutritional support as needed are all recognized adjuncts for the prevention of this feared complication.

The early stratification of the at-risk patient begins with the consultation for the primary operation. In select patients, sternotomy may be avoided all together by using alternative surgical approaches such as thoracotomy or more minimally invasive strategies such as mini-sternotomy. In addition, those patients identified as high risk preoperatively should have optimization of their secondary risk factors addressed as best as possible prior to any intervention. Factors such as improved glycemic control and optimization of pulmonary disease is crucial. Numerous studies<sup>8</sup> have documented that an elevated HbA1C preoperatively may result in higher rates of postoperative wound infections. Moreover, for the sternotomy patient, poorly controlled chronic obstructive pulmonary disease (COPD) and ongoing tobacco abuse may potentiate postoperative pneumonia and increased coughing which would markedly increase the rate of sternal non-union and sternal dehiscence leading to possible mediastinitis. Smoking cessation and glycemic control in the preoperative period should be undertaken whenever possible. In addition, if patients are on steroid therapy for comorbid conditions, a dose-reduction strategy—under the supervision of the prescribing physician—should be considered as high dose and chronic steroid therapy place the patient at higher risk during the intraoperative period.

Using a meticulous operative technique<sup>9</sup> is the second step to preventing mediastinitis. Many publications have suggested using lower electrocautery settings and novel plasma and radio frequency (RF) energy-based devices to limit thermal injury to tissues at the time of sternotomy. In addition, minimizing disruption of the bone marrow and limiting the use of bone wax may also encourage improved sternal union and reduce the presence of foreign material for bacterial inoculation and growth. Some centers have advocated the use of special vancomycin-laden putty and other treatments to

prevent infection during sternal healing although the data is not conclusive on this treatment approach. Limiting the use of bilateral mammary harvesting to healthier patients with lower body mass index (BMI) and lower total risk factors may also prevent wound healing complications. During mammary harvesting for bypass surgery, many surgeons have recommended a more skeletonized pedicle to minimize disruption of the blood supply to the sternum.

During closure of the sternum, attention to appropriate sternal fixation is required. Those patients with poor bone quality, high BMI, or risk factors such as diabetes and severe COPD are at higher risk of sternal non-union, sternal disruption and the later development of mediastinitis. The use of sternal plating systems or other devices to ensure a more secure sternal closure may prevent later sternal disruption and infection. There are many commercially available systems for consideration and soft tissue handling and tension-free skin closure are other adjunctive measures that may be of benefit in this setting.

Finally, the development of superficial infections—which could lead to deeper sternal infection—should

be considered in all high-risk patients as part of the routine course of management of the closed incision as a means to minimize wound dehiscence. In those patients that have risk factors such as poorly controlled diabetes, hypertension, obesity, requirement for postoperative vasopressors or ongoing steroid use, the application of a closed incision negative pressure wound therapy (ci-NPWT) may enhance wound integrity and healing and mitigate wound breakdown. In addition to the application of systems such as the PREVENA™ Incision Management System, the postoperative management should include absolute minimization of sternal load bearing, nutritional supplementation if the patient has a low albumin and aggressive glycemic control during the inpatient admission.

Mediastinitis is a feared and highly morbid condition. Fortunately, the rates are lower today than in the past due to the recognition of how to deal with high-risk patients and due to the greater attention to prevention. By using a multimodal approach that takes into consideration the preoperative characteristics of the high-risk patient, and by careful intraoperative and postoperative management, we may indeed one day make the entity a “never event.”



### Dr. V. Seenu Reddy

Dr. V. Seenu Reddy did his undergraduate work at Amherst College, graduating magna cum laude and obtained his Medical Degree with Honors from The University of Alabama. He completed a residency in General Surgery and a Research Fellowship in Cardiac Surgery at Vanderbilt University. His Cardiothoracic training was at Emory University in Atlanta, GA, where he obtained additional expertise in Endovascular and Minimally Invasive Surgery. Dr. Reddy also obtained an MBA with Honors from Vanderbilt University Owen School of Management in 2000.

He was on the faculty of the University of Texas, San Antonio as Director of Emerging Technology, Director of Thoracic Aortic Surgery and Associate Professor of Surgery. He is Board Certified in Surgery and Thoracic Surgery. In the community, Dr. Reddy

is active with the American Heart Association, serves as a Director of the Nashville Academy of Med, and is President of the Nashville Surgical Society. He also serves his specialty through Task Forces in the Southern Thoracic Surgical Association, and Society of Thoracic Surgeons. He has previously served as Clinical Associate Professor of Surgery at Vanderbilt and continues to serve on the faculty for their Perfusion School. Dr. Reddy is actively engaged in research and has over 12 book chapters, over 20 abstracts and 25 publications in peer reviewed journals and has presented at regional and national meetings. He is also a reviewer for The Annals of Thoracic Surgery. He is a consultant to a variety of startup health care companies. At TriStar Centennial, he serves as Co-Director of the Structural Heart Program and Director of Cardiac Surgical Outreach.

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