Acute and Chronic Mediastinal Infections

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- Mediastinal infections = mediastinitis.
- Acute mediastinitis:
- usually secondary to infections (operations requiring sternotomy or arising from perforation of the aerodigestive tract).
- Acute mediastinitis due to the spread of oropharyngeal infections, =descending mediastinitis, represents a less common but extremely lethal form of this disease.
- Chronic infections : uncommon; a minor amount of change in the presentation, diagnosis, and management of this disease has evolved.
- (Most fungal disease)(few are secondary to mycobacterial organisms).
- Chronic fungal or tubercular infections maybe self-limiting but may progress into the clinical entity of chronic fibrosing mediastinitis.

Postoperative Sternal Infection and Mediastinitis

- The incidence of mediastinitis after cardiac surgical between **1%and 4%.**
- causes and risk factors:
- diabetes, chronic obstructive pulmonary disease , congestive heart failure, use of internal mammary artery grafts (unilateral or bilateral), smoking, reoperation, lower ejection fraction, prolonged ventilation, obesity, high body mass index (BMI), immunosuppressive therapy, older age, use of bone wax, preoperative renal failure, duration of operation, prolonged cardiopulmonary bypass and aortic cross-clamp times, off-center sternotomy, improper stabilization of the sternum, poor hemostasis, use of pacing

- wires, need for repeated blood transfusions in the early postoperative period, use of electrocautery, presence of infection elsewhere, extended intensive care unit stay and overall hospitalization, readmission to the hospital.
- ***Theories for mechanism of infection*** :
- 1. local osteomyelitis at the sternotomy
- 2. Sternal instability contributes to the superficial wound dehiscence and that this serves as a portal of ingress for infections.
- 3.Inadequate drainage in the retrosternal space serves as a culture medium for the source of mediastinal infection.
- 4.Concomitant infections, such as a nosocomial pneumonia

- ***Bacterial pathogens*** :usually Staphylococcus aureus and Staphylococcus epidermidis, (50% to 80%).
- skin flora at the time of operation.
- Perioperative contamination :
- leg incision used to harvest a saphenous vein graft.
  Postoperative contamination:
- Gram-negative (Pseudomonas, Serratia, and Klebsiella).
- increased nosocomial infections and prolonged antibiotic use in the postoperative care of more complex and challenging cardiac patients.
- ***Mixed infections account for up to 40% of cases***.
- ***Fungal mediastinitis*** :infrequent cause of post sternotomy mediastinitis .
- should be considered in the setting of failed therapy or prolonged antibiotic use.
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Diagnosis

mortality mediastinitis after CABG: **10% to 50%.**

first-year survival rate after coronary artery bypass graft was 78% with mediastinitis and 95% without, with a threefold increase in mortality rate at 4 years' follow-up.

Clinical Manifestations

- Clinically, postoperative mediastinitis should be suspected in the infected sternotomy wound.
- occur **early** or **late** in the clinical course.
- Classic signs :
- erythema, purulent discharge, and sternal instability.
- A history of pain with breathing or difficulty lying in the lateral decubitus position is indicative of the two halves of the sternum moving against each other.
- It has been suggested that sternal instability as assessed by bi manual alternating sternal compression is the most helpful diagnostic maneuver.
- Fever, sepsis, or leukocytosis, especially without an obvious source may, be a presentation.

Radiographic studies

- are not routinely used,
- particularly in the acute early postoperative period.
- ***computed tomography (CT)*** scanning(in the late presentation) or in the evaluation of unresolving sepsis due to an untreated source of mediastinitis.(An undrained fluid collection or air–fluid level). >30 days after surgery
- ***nuclear imaging studies***

Treatment

- has evolved tremendously in recent years.
- Despite the large number of series evaluating the risk factors for post sternotomy mediastinitis, the majority of these reports do not include ananalysis of its management. ***Conventional therapy—defined as opening and debriding***

- ***serially packing the wound, and eventually closing the wound primarily***

- ***debridement and primary closure*** has involved the use of retrosternal high-negative-pressure catheters, (Redon catheters)

- ***flap closure techniques*** in the treatment of poststernotomy mediastinitis is frequently acceptedas (the standard therapy for these deep sternal wound infections). mortality ratesof <10%
- ***mediastinal irrigation with either saline or antibiotic solution to the debridement and primary closure***

- . Dilute povidone-iodine or antibiotic irrigation was used until mediastinal fluid cultures dictated its cessation.
- simple debridement with rewiring of the sternum laterally for stabilization (Robicsek weave) and primary closure followed by postoperative closed mediastinal irrigation. Their closure technique, followed by a culture-driven antibiotic irrigation solution, result edin a remarkable success rate of 98%. Equally impressive in both series was the fact that the mortality rates were 0%.Closed drainage irrigation using Redon catheters has been described as another variation of closed mediastinaldrainage.79 Comparisons of Redon catheters to closed mediastinal irrigation have shown that the use of the lattertechnique is associated with improved failure and mortality rates.19 In contrast to these studies, others have shownthat closed mediastinal irrigation following primary closure of sternal dehiscence in culture-proven mediastinitis isassociated with an extremely high rate of failure. This has led some authors to caution against the use of thismodality where an internal thoracic graft has been used and there is culture-proven infection.112Flap coverage is not limited to the pectoralis advancement flap. Omental flaps have been reported to be anadequate source of flap coverage and some have reported its benefits over muscle flaps. Milano and colleagues97demonstrated that omental flaps were associated with shorter operations and decreased lengths of hospitalizationas well as lower rates of early complications. Furthermore, recurrent infections are more common with muscleflaps.97,145 Brandt and Alvarez12 have used both pectoralis flaps and omental flaps to cover the wound and occupyany potential dead spaces, with impressive results, including fewer major complications, shorter hospitalizations,decreased mortality rates, and increased overall survival.12Combination therapy with closed mediastinal irrigation using either primary closure alone or in combination withflap coverage has also been described with success. Rand and colleagues112 showed that muscle flap closure withclosed mediastinal irrigation. Hirata and colleagues65 outlined the use of closed drainage irrigation following opendebridement and omental flap closure in the setting of methicillin resistant S. aureus (MRSA) infections in fourpatients.

- Vacuum-assisted closure for the treatment of open wounds was first described by Argenta and Morykwas5 in 1997.Since then, its use has been expanded to include poststernotomy wounds due to mediastinitis. The benefits ofwound vacuum-assisted therapy have been postulated to be multifactorial, but they share the common theme ofrelying on the associated effects of negative pressure. An increase in local blood flow; decrease in tissue edema andbacterial load; and removal of stagnant fluid, necrotic debris and proteins impeding healing are all believed topromote wound healing. Furthermore, the mechanical effects exerted by the negative pressure is also thought topromote wound closure. 52,86Obdeijn and colleagues106 published one of the first reports of a vacuum-assisted closure of open wounds in threepatients with poststernotomy mediastitinitis. In this report all of the patients avoided the need for secondarysurgical closure, as closure by accelerated secondary intention was achieved. Subsequent experiences, on a largerscale, have demonstrated that vacuum-assisted treatment of wounds can be an extremely useful adjunct in themanagement of poststernotomy mediastinitis.28,36,52,86,97,125,126,127 Some of these studies have relied on vacuum-assisted closure exclusively.36,52,86 However, not all investigations have employed vacuum-assisted therapy as thesole form of wound closure, since others have used this technique intentionally as a “bridge” to another form ofdefinitive therapy.36,86 However, even with this intention, vacuum-assisted therapy has, in some cases, precludedthe need for flap coverge or sternectomy.28 The depth of infection has been thought to determine which patientswill require progression to a second operation for closure.36Direct comparisons to all forms of conventional therapy with omental or muscle flap closure have shown asignificant advantage of vacuum-assisted therapy for wound closure in terms of decreased mortality, increasedsurvival, lower frequencies of local failure, and shorter hospitalizations. 52 In contrast, studies of poststernotomymediastinitis that have not included vacuum-assisted wound closure therapy have described a worse long-termsurvival. Sjogren and colleagues125,126,127 have demonstrated that with the use of this treatment, long-termsurvival is no different than that of postoperative coronary artery bypass patients without mediastinitis. Others haveshown that vacuum-assisted therapy can facilitate primary closure by accelerating granulation.37 Catarino andcolleagues21 have shown that vacuum-assisted therapy compared with closed drainage irrigation alone is associatedwith no treatment failures and decreased lengths of hospitalization. Others have also demonstrated that there is ashorter length of hospitalization with vacuum-assisted therapy when compared with continuous irrigation. 21,37

- ir colleagues and are beyond the scope of this chapter (see Chapter 146). Management strategies of esophagealforation including that accompanying mediastinitis are based on four principles:
  Eliminate source of soilage by primary repair or diversion away from the esophageal perforation. Provide thorough and wide mediastinal drainage to control ongoing mediastinal suppuration occurringafter primary repair or diversion. In addition, gastrostomy tube decompression should be performed todecrease gastric reflux and mediastinal soilage.
  P.2184Appropriate antibiotics should be administered to augment host defenses, which must be effective againstboth gram-positive and gram-negative bacteria and against both aerobic and anaerobic bacteria.Maintain adequate nutrition. The ultimate goal is to restore alimentary tract continuity, as emphasized byBurnett and associates.18

Descending Necrotizing Mediastinitis

- Estrera and associates46 described acute purulent mediastinitis due to oropharyngeal infection as descendingnecrotizing mediastinitis. This infection remains an uncommon but still lethal form of mediastinitis.EtiologyOf the reported cases, 60% to 70% are secondary to odontogenic infections.46,88,137 Other common causes haveincluded peritonsillar abscesses0,89 (T et al.), retropharyngeal and parapharyngeal abscesses, 27,46 (Freeman et al.)and epiglottitis.23,78 Other less common causes of descending necrotizing mediastinitis include trauma to the neck,including neck or mediastinal surgery; cervical lymphadenitis; and endotracheal intubation, as reported by Guardiaand associates,63 Uram and Hauser,133 and Gould and colleagues. 61 Alsoub and Chacko4 have listed the many causesof this lethal infection.Anatomically, there are three potential planes through which descending necrotizing mediastinitis can progress: (a)pretracheal, (b) perivascular, and (c) prevertebral spaces. The pretracheal space, also referred to as the superficiallayer, is just anterior to the trachea. It is bound by the thyroid cartilage superiorly and pericardium and parietalpleura inferiorly at the carina. The perivascular space is bound by the carotid sheath and descends into themediastinum along with the structures within the carotid sheath. This route of spread results in infections of themiddle mediastinum. Finally, the prevertebral space, also referred to as the retropharyngeal space, is boundanteriorly by the posterior aspect of cervical fascia and posteriorly by the alar fascia; it extends inferiorly untilthese two fascia coalesce at the first thoracic vertebra. 60,102,108 Most cases of descending necrotizing mediastinitisare secondary to spread in this last plane and result in involvement of the posterior mediastinum (Fig. 173-1). Allthese spaces are joined by loose connective tissue, which facilitates direct spread within these planes.99 Gravityand negative pressure during inspiration allow for the descent of the infected and purulent material into themediastinum and pleura. 99 Odontogenic and peritonsillar abscesses may extend to involve the submandibular andparapharyngeal spaces, which, as McCurdy and colleagues93 have noted, readily communicate with all majorcervical fascial spaces.Chow24 and Brook and Frazier15 have recorded that the microbiological features of descending necrotizingmediastinitis are polymicrobial, with aerobes and anaerobes, reflecting the indigenous microflora of the oral cavity.The most common organisms isolated include Prevotella, Peptostreptococcus, Fusobacterium, Veillonella,Actinomyces, oral Streptococcus, Bacteroides, S. aureus, Haemophilus species, and Bacteroides melaninogenicus.Symbiosis between one or more species of gram-negative aerobic bacteria and an anaerobe can result in synergistic

- Mathieu and associates90 have described predisposing conditions that may favor this infectious process; suchconditions include diabetes (13.3%), alcoholism (17.7%), neoplasm (4.4%), and radionecrosis (3.3%). In particular,they found that age >70 years and underlying diabetes were fatal risk factors.

Diagnosis

- The criteria used for the diagnosis of descending necrotizing mediastinitis are clearly defined by Estrera andcolleagues46 and include (a) clinical evidence of severe oropharyngeal infection, (b) characteristic roentgenographicfeatures of mediastinitis, (c) documentation of necrotizing mediastinal infection at the operation or postmortem orboth, and (d) establishment of the relationship between descending necrotizing mediastinitis and the oropharyngealprocess.Because this infection progresses rapidly, early diagnosis is essential. Computed tomography (CT) scanning is morereliable P.2185than chest radiography and can provide precise information on the extent of the infection, which will guide theoptimal approach used for surgical drainage.

Clinical Manifestations

- Descending necrotizing mediastinitis is seen most often in a patient who is under treatment for a deep cervicalinfection resulting from one of the aforementioned causes. Despite antibiotics and even drainage of the deepcervical space, the infection progresses to involve the mediastinum. Early diagnosis is often difficult because of thevagueness of early symptoms that would indicate mediastinal involvement. Unfortunately the usual delay indiagnosis contributes greatly to the high mortality associated with descending necrotizing mediastinitis.88Descending necrotizing mediastinitis may occur at any time after cervical infection, manifest by signs and symptomsof sepsis with stiffness, swelling, and neck pain. Cranial nerve deficits, trismus, and stridor have also beendescribed. 60 Dysphagia may or may not be present. Mediastinal involvement may occur as soon as 12 hours to aslate as 2 weeks, but it is most commonly seen within 48 hours after the onset of deep cervical infection. Diffusebrawny induration of the neck and upper anterior chest wall is seen. Pitting edema and crepitance may be presentin the area. Substernal pain, increased dysphagia, cough, and dyspnea may also develop. Pleural and pericardialinvolvement may occur, since the necrotizing process involves the adjacent spaces. Pleural effusion, nonspecificelectrocardiographic changes, and even infection of the retroperitoneal space of the abdomen may develop as theinflammatory process ensues. The capillary leak that occurs with sepsis can further exacerbate dehydration andlead to acute respiratory distress syndrome, cardiac tamponade, and empyema.78,108

Radiographic Features

- CT is the diagnostic imaging modality of choice. Estrera and associates46 reported four radiographic features of theneck and chest present in descending necrotizing mediastinitis: (a) widening of the retrocervical space with orwithout an air–fluid level, (b) anterior displacement of the tracheal air column, (c) loss of the normal lordosis in the cervical spine. Also, the superior mediastinal shadow can be widened, and findingsof pleural or pericardial involvement may be evident (Fig. 173-2).CT scans of the chest are better than chest radiographs in delineating the infectious process. Carrol12 andBreatnach20 and their associates outlined several CT findings in descending necrotizing mediastinitis: (a) abscessformation, (b) soft tissue infiltration with loss of the normal fat planes, (c) absence of prominent lymphadenopathy,and (d) the presence of gas bubbles. Air and fluid can be seen in the visceral or anterior compartments, as canpleural or pericardial effusions. mediastinal emphysema, and (d)

- TreatmentThe management of descending necrotizing mediastinitis includes surgical drainage, antimicrobial therapy, andairway management. The surgical approach depends on the location of the abscess. Estrera and coworkers46 statedthat if the infection is in the space below the level of the tracheal bifurcation anteriorly or the fourth thoracicvertebra posteriorly, mediastinal drainage should be performed via a transthoracic approach. If only the superiormediastinum is involved and the infection is contained above the level of the carina or the fourth thoracic vertebra,standard transcervical mediastinal drainage may be adequate, as suggested by Wheatley and colleagues.137
  P.218Marty-Ane and colleagues88 have proposed a more aggressive approach regardless of the level of infection, includingthe transthoracic approach through a standard thoracotomy in addition to cervical drainage. Transthoracic drainagehas been demonstrated to result in better debridement and improved survival, as reported by Temes andcoworkers. 131 Further evidence for the inclusion of routine transthoracic drainage is provided by Corsten andassociates'27 meta-analysis comparing neck and thoracic drainage (19% mortality) with transcervical drainage alone(41% mortality,$p < 0.05$). Shimizu and colleagues124 recently described the successful use of video-assistedmediastinoscopy with adequate drainage of the cervical neck, anterior mediastinum, and middle mediastinum tothe level of the tracheal bifurcation. Numerous reports have described various different thoracic approaches. Thestandard posterior or lateral thoracotomy has unequivocally been the classic approach to mediastinal infections. In1996, Ris and colleagues114 reported on the use of the clamshell incision. Sternotomy has been described as bothinadequate and dangerous in the treatment of descending necrotizing mediastinitis owing to inability to drain theposterolateral compartments of each thoracic cavity and the risk of introducing osteomyelitis and its attendantsequela of sternal dehiscence. With the increased popularity of minimally invasive surgery, several authors60,69,115have reported the use of thoracoscopic drainage in the management of descending necrotizing mediastinitis. Thethoracoscopic approach has been reported to decrease morbidity versus a thoracotomy and to improve drainage ofthe mediastinum compared with cervical drainage. Percutaneous drainage has also been described, but its greatestutility may be in stabilizing of the critically ill patient rather than serving as the definitive form of therapy.59Irrespective of the treatment selected, mediastinal pleural irrigation following surgical debridement of themediastinum with either saline or antibiotic solution akin to a modified Claggett procedure has achieved success inthe setting of descending necrotizing mediastinitis by some, 70 but others have disputed its benefit.119Antimicrobial therapy should be given promptly and should cover both aerobes and anaerobes. At present, a singleagent such as carbapenem, as noted by Sakamoto and coworkers, 118 will effectively cover both. Initial antibioticchoice should offer the broadest possible coverage, with combinations used as necessary. Later on, when cultureresults are available, the antibiotics can be tailored accordingly.The role of tracheostomy is controversial, as it may exacerbate the spread of infection via the pretracheal space.30Adequate drainage alone should suffice, as this is the major means by which patients can recover from their sepsis,and it obviates the need for prolonged intubation.

- PrognosisThe mortality rate for patients with descending necrotizing mediastinitis before the antibiotic era wasapproximately 50%, yet the rate has only decreased to 40% despite the introduction of antibiotics, refined surgicaltechniques, and intensive care monitoring, as noted by Guardia,63 Estrera,46 and Levine 83 and their coworkers. Thereasons for this are that the infection spreads rapidly, leads to fulminant sepsis, and that, as a rule, there is asignificant delay in diagnosis and initiation of the appropriate therapy.Since 1990, there has been a decrease in the mortality rate to 15.4%, largely because of the more aggressiveapproach taken to treat these infections, as discussed by Brunelli and associates.16 Death may result from fulminantsepsis, blood vessel erosion with exsanguination, aspiration, metastatic intracranial infection, empyema, andpurulent pericarditis with tamponade.