Descending necrotizing mediastinitis: surgical management

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Abstract

Objective: Descending necrotizing mediastinitis (DNM) is a primary complication of cervical or odontogenous infections that can spread to the mediastinum through the anatomic cervical spaces. Methods: Between April 1994 and April 2000, 13 patients, mean age 39.23 ± 18.47 (median 38, range 16–67) years, with DNM were submitted to surgical treatment. Primary odontogenic abscess occurred in six, peritonsillar abscess in five and post-traumatic cervical abscess in two patients. Diagnosis was confirmed by computed tomography (CT) of the neck and chest. All patients underwent surgical drainage of the cervico-mediastinal regions by a bilateral collar incision associated with right thoracotomy in ten cases. Results: Six patients out of 13 required reoperation. Two patients previously submitted only to cervical drainage required thoracotomy; four patients, which have been submitted to cervico-thoracic drainage, underwent contralateral thoracotomy in two cases and ipsilateral reoperation in two cases. Ten patients evolved well and were discharged without major sequelae; three patients died of multiorgan failure related to septic shock. Mortality rate was 23%. Conclusion: Early diagnosis by CT of the neck and chest suggest a rapid indication of surgical approach to DNM. Ample cervicotomy associated with mediastinal drainage via large thoracotomic incision is essential in managing these critically ill patients and can significantly reduce the mortality rate for this condition, often affecting young people, to acceptable values. © 2001 Elsevier Science B.V. All rights reserved.

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1. Introduction

Acute mediastinitis is a serious infection involving the connective mediastinal tissue that fills the interpleural spaces and surrounds the median thoracic organs. The most common causes of mediastinitis are oesophageal perforations and postoperative infections after operations through sternotomy incisions. Undoubtedly, one of the most dreaded, and the most lethal, form of mediastinitis is the diffuse necrotizing variety that occurs as a complication of infections that may arise from odontogenic or cervico-fascial infections or cervical trauma, best referred to as descending necrotizing mediastinitis (DNM). As infection spreads along deep cervical fascial planes into the mediastinum, widespread cellulites, necrosis, abscess formation and sepsis may occur.

Criteria for diagnosis of DNM were accurately defined by Estrera and colleagues in 1983 [1]: (1) clinical manifestations of severe infection; (2) demonstration of characteristic roentgenographic features; (3) documentation of the necrotizing mediastinal infection at operation or postmortem examination, or both; (4) establishment of the relationship of oropharyngeal or cervical infection, with the development of the necrotizing mediastinal process. Delay of diagnosis and delayed or inappropriate drainage of the mediastinum are the main causes for the high mortality in this life-threatening condition. Surgical management, and particularly the optimal form of mediastinal drainage, remains controversial with support ranging from cervical drainage alone, to cervical drainage and routine thoracotomy.

We report about our experience with 13 patients affected by DNM and its surgical management. Our series is then added to the previously reported data from the international literature which are analyzed trying to evaluate the best surgical approach for DNM treatment.

2. Patients and methods

Between April 1994 and April 2000, 13 patients (nine
men and four women) were referred to us because they were affected by DNM. The mean age was 39.23 ± 18.47 (median 38, range 16–67) years. Symptoms at hospitalization included pirexia (n = 13), odynophagia (n = 9), neck swelling (n = 8), dysphagia (n = 6), tachypnoea (n = 5), tachycardia (n = 5), shortness of breath (n = 4), hypotension (n = 3), trismus and neck and mandibular rigidity (n = 2). Primary cervical fascial infection was an odontogenic abscess in six patients, a peritonsillar abscess in five patients and cervical abscesses complicating chronic haematoma following blunt trauma in two patients. Ten patients out of 13 had previous antibiotic therapy which was associated to steroidal therapy in three of them.

Eight patients were referred as long-term smokers, three patients had alcohol intake history, three patients were affected by diabetes, two had immunodeficiency related to undetected aplastic anemia, two had hyperthyroidism, one had bone tuberculosis and one was affected by psychotic disturbances. Delay between onset of primary infection and hospitalization ranged from 4 to 22 days (median 6 days).

Diagnosis was made by preoperative cervicothoracic computed tomography (CT) scan in all patients. Preoperative CT scan demonstrated neck infection with soft-tissue infiltration and oedema of the muscular tissue in all patients and signs of mediastinal infection (uncapsulated fluid collections or abscess with gas bubbles). Nine patients had radiological signs of involvement of both anterior and posterior mediastinum and four of the anterior mediastinum only. Six patients out of 13 had pleural effusion (monolateral in three and bilateral in three cases). Empirical broad spectrum antibiotics were initiated as soon as the diagnosis was suspected. Prior surgical management was as follows. In all cases a collar bilateral incision was carried out, involved cervical spaces were opened, debridement of necrotic tissue (one patient underwent thyroidectomy because of necrotic fusion of the gland) and drainage were performed. Four tracheostomies were carried out during cervical drainage. The first three patients of the series following a chronological criteria (between April 1994 and August 1995) underwent debridement and resection of necrotic tissue and drainage of both upper anterior and posterior mediastinum via cervical incision, in one associated with subxyphoid retrosternal drainage. The last ten patients of the series following the chronological criteria (between December 1995 and April 2000) were submitted to right thoracotomy with radical surgical debridement of the mediastinum, excision of necrotic tissue, and mediastinal and pleural drainage by large-bore chest tubes.

3. Results

Bacteriologic results from materials obtained from the neck, pleura, mediastinum and blood revealed in all cases a polymicrobial infection, with mixed aerobic and anaerobic organism in ten patients; the most frequent isolated germs were aerobic Streptococci, Staphylococci, *Pseudomonas aeruginosa, Bacteroides, Fusobacterium, Escherichia coli, Enterobacteriaceae and Stenotrophomonas maltophilia*. In each case the primary broad spectrum intravenous antibiotic therapy was modified as culture and sensitivity results became available.

Each patient was promptly submitted to CT scan of the neck and thorax when clinical conditions worsened or remained invariable in spite of surgical management.

Six patients out of 13 required reoperation: two patients underwent right thoracotomy on postoperative days 3 and 4, respectively, after cervical drainage only, because of postoperative spread of the infection in the deep posterior mediastinum; two were submitted to contralateral thoracotomy on postoperative days 1 and 4, respectively, for paraortic spread of the infection, left pleural empyema and purulent pericarditis necessitating pericardectomy; two required serial cervicotomy and right thoracotomy for debridement and drainage of newly formed necrotic abscesses 5 and 12 days, respectively, after the first operation.

Three patients out of 13 experienced early postoperative onset of septic shock and they died because of multiorgan failure a mean of 34 h (range 8–70) after the operation.

Ten patients were discharged from hospital without major sequelae. The mortality rate in our series was 23%.

4. Discussion

Knowledge of the cervical fascial planes is essential in understanding the propagation pathways, symptoms and thoracic complications of cervical infections [2]. Furstenberg and Yglesias provided an excellent review of this topic [3].

The deep cervical fascia is arranged into three layers, i.e. the superficial layer (pretracheal), visceral layer and prevertebral layer; these layers partition the deep neck into three spaces: pretracheal, perivascular and retrovisceral or prevertebral.

The pretracheal space is the space anterior to the trachea and posterior to the strap muscles and pretracheal fascia. Its upper limit is bound by the thyroid cartilage and below in the mediastinum by the pericardium and parietal pleura at the level of the carina. The perivascular space is surrounded by the carotid sheath. It is formed by the fusion of the major layers of cervical fascia and contains the carotid artery, internal jugular vein, and vagus nerve, and descends into the chest with these structures. The prevertebral (or retrovisceral) space is divided in retropharyngeal and ‘danger space’ by the alar fascia. The retropharyngeal space is limited anteriorly by the posterior visceral layer of the cervical fascia and posteriorly by the alar fascia. The retropharyngeal space is only contiguous until the T1/T2 level where these two fascia fuse. The ‘danger space’ is so called because it is patent from the skull base to the diaphragm,
allowing spread of the infection to the mediastinum when involved.

The three above-mentioned spaces of the neck are in continuity with the cervical and facial spaces located above the hyoid bone.

Once cervical infection is established, caudad spread is facilitated by gravity as well by negative intrathoracic pressures. It has been estimated that 8% of mediastinitis cases originating in the neck spread through the pretracheal space: greater than 70% of spread occurs through the retrovesical and ‘danger space’. Perivascular spread occurs in the remainder of cases, sometimes producing complicating arterial haemorrhage [4].

As discussed in the literature, odontogenic infection is the most common cause of DNM [1,5–14]; other less frequent reported causes are peritonsillar abscess [7–11], retropharyngeal abscess [1,8,10], cervical trauma [1,12], epiglottitis [16,17], sinusitis [7,8], parotitis [18], lymphadenitis of the neck [8], or intravenous drug use [17]. Causative agents most commonly referred to are anaerobic and aerobic (frequently associated) bacteria of the oral flora. The most frequent bacterium involved is beta-haemolytic streptococcus because of the higher frequency of odontogenic infections. Symptoms commonly referred to are fever, pain and sepsis; cranial nerve deficits are common, as is trismus and stridor; erosion into adjacent hypopharynx, oesophagus or vascular structures may occur. Capillary leak occurs with possible consequence of de hydration, adult respiratory distress syndrome, cardiac tamponade and empyema.

The most early part of diagnosis can be made by physical examination and clinical history. Delay of diagnosis is one of the primary reasons for the high mortality in DNM. The diagnosis of cervical infection is easy because clinically obvious, but early diagnosis of mediastinitis is often difficult because of the vagueness of early symptoms implicating mediastinal involvement. Radiographic examination of the neck and chest can reveal several features such as widening of the retrovesical space, anterior displacement of the tracheal air-column, mediastinal emphysema and widening of superior mediastinal shadow.

CT scan immediately confirms mediastinitis diagnosis with high accuracy, showing soft tissue infiltration with loss of the normal fat planes or collection of fluid with or without the presence of gas bubbles. The use of contrast-enhanced cervicothoracic CT imaging is the diagnostic method of choice for patients in whom DNM is suspected. However, CT scan was found to be equally valuable in identifying unsuspected progression of DNM into previously unaffected areas of the neck and chest. If CT imaging is used frequently for surveillance, it allows prompt, directed operative drainage, often before clinical signs of deterioration would have prompted reinvestigation.

Intravenous broad spectrum antibiotic therapy is not efficient without adequate surgical drainage of the cervical and mediastinal collections, extensive debridement and excision of necrotic tissue. Estrera and colleagues [1], in 1983, recommended transthoracic drainage of any mediastinitis extending below the fourth thoracic vertebral plane posteriorly (the plane of the tracheal bifurcation anteriorly) as mediastinitis caudad to such levels has been shown to be complicated by an increased incidence of pleural empyema.

In 1990, Wheatley and associates [6] condemned simple cervical drainage too (his review of the literature revealed that transcervical mediastinal drainage was inadequate in 80% of patients), preferring the combination of cervical drainage with anterior mediastinal drainage through the subxyphoid approach along with tracheostomy to secure the airway. Before 1990 primary drainage of the mediastinum had been done through minimal thoracic approach on the basis of predominance of infection as determined by the CT scans (anterior mediastinotomy or subxyphoid drainage in the anterior mediastinitis, posterior mediastinotomy in the posterior one) [6,12,13].

Transcervical drainage and other minor thoracic approaches provided only narrow access to the mediastinum, thus excluding complete excision of the tissue necrosis. The opinion has been stated in the literature that aggressive surgical drainage of the neck and mediastinum through thoracic incisions should be considered the standard care for these patients. Our experience supports this view. We feel, such as other authors, that there is a considerable evidence to suggest the use of an early thoracic approach in adult DNM [8–10]. The literature describes several approaches for optimal transthoracic drainage and debridement in patients with DNM. Reports recommending the use of wide postero-lateral thoracotomy, median sternotomy or clamshell incision can all be found [7–10,15,19].

Corsten and associates [8] reported successful treatment of seven out of eight patients with DNM, and six of these underwent mediastinal drainage through thoracotomy. They stated that the mediastinum cannot be adequately drained by a limited approach through subxyphoid or anterior mediastinotomy and he suggested the use of early thoracotomy for the best control of mediastinal sepsis.

Ris and colleagues [15] reported the successful treatment of two out of three patients with DNM who had mediastinal drainage via the clamshell incision. If the exposure of the entire mediastinum and both chest cavities is excellent with the advantage of a one-stage operation, this approach is particularly invasive in critically ill patients and exposes them to the risk of phrenic nerve palsy and sternum osteomyelitis. However, the authors using this approach did not observe these complications in their series.

Median sternotomy [19] also seems inadequate in DNM, because subsequent osteomyelitis and dehiscence of the sternum may occur and the access to the posterobasal compartments of the chest cavity is difficult, especially on the left side.

Some authors recently reported on thoracoscopic [20] or CT-guided percutaneous drainage management [21] as a valuable alternative to surgical intervention in selected
patients with mediastinal abscesses resulting from oesophageal perforation or postoperative complication. DNM is a diffuse infection making thoracoscopic and percutaneous drainages inadequate in most cases because the uncapsulated fluid collections associated with extensive necrotizing cellulitis require surgical debridement and not merely simple drainage.

Although each of these techniques offers potential advantages and disadvantages, the postero-lateral thoracotomy incision remains the standard by which other transthoracic approaches should be measured: it allows comprehensive access to the entire hemithorax, including the ipsilateral mediastinum and pericardium. Postero-lateral thoracotomy provides the broadest exposure of the prevertebral and paraoesophageal planes without the risk of sternal osteomyelitis encountered with a sternotomy or clavicle incision. Furthermore, postero-lateral thoracotomy is generally tolerated even by acutely ill patients.

Corsten [8], Marty-Âne [9] and Freeman [10] and their associates in 1999 and 2000 supported the use of early wide thoracotomy in the management of DNM, citing mortality rates of 16.5 and 0% in large series, respectively. Marty-Âne and Freeman emphasized the role of CT scan in the perioperative follow-up for assessing the results of surgical drainage, determining the duration of irrigation (when present) and drainage and establishing the timing of possible reoperation in patients with continued sepsis [9,10].

Freeman and colleagues [10] suggested an algorithm which includes the use of CT scan in all patients with any clinical deterioration or empirically 48–72 h after operative drainage to identify any progression of the infection. They based their strategy of CT-scan surveillance on the fact that 59% of these scans in their series identified unanticipated progression of the necrotizing infection necessitating further surgical therapy. Their high success in the treatment of DNM is undoubtedly related to the serial transcervical and transthoracic reoperation performed on the basis of their rigid surveillance conducted by repeated CT scans of the chest and neck.

In our experience, even without a standardized empirical algorithm, we surveyed our patients with CT scan of the neck and thorax during the perioperative period, especially when the clinical condition after surgical drainage did not improve or remained stable: this radiological surveillance allowed to identify incomplete treatment or progression of the septic spread in the mediastinum and prompted urgent reoperation in six out of 13 patients.

In summary, DNM remains a life-threatening infection. An improved understanding of the natural history of this infectious process and the relevant anatomy continue to promote improvements in therapy for affected patients. Early diagnosis and surveillance with contrast-enhanced CT imaging, serial transcervical and transthoracic operative drainage and debridement reduce the excessive mortality associated with DNM, which often affects young patients, to acceptable values.

References