REVIEWS

DESCENDING NECROTIZING MEDIASTINITIS OF ODONTOGENIC ORIGIN – PERSONAL EXPERIENCE AND LITERATURE REVIEW

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ABSTRACT
Descending necrotizing mediastinitis is the most severe form of mediastinal infection. The aim of the study was to present the optimal diagnostic and treatment approach to this severe, life-threatening condition.

PATIENTS AND METHODS: Three patients (men, aged 75, 73, and 63) with descending necrotizing mediastinitis hospitalised between April 2007 and February 2009 have been included in the study. The diagnosis of the condition was made based on cervico-thoracic computed tomography and surgical findings. The surgical treatment in each of the cases included bilateral longitudinal cervicotomy, transversal suprasternal cervicotomy and posterior-lateral thoracotomy.

RESULTS: The period between the initiation of ambulatory treatment of the dental infection and diagnosing the mediastinitis was 9, 8 and 11 days, respectively. Engagement of all cervical spaces and mediastinal sections with polybacterial (three or more agents) dental infection, originating from third and fourth lower molars was present in each of the patients. Chronic alcoholism and diabetes are factors influencing the course of mediastinitis. The outcome in all the three patients was lethal (within 72 hours).

CONCLUSION: Success in the treatment of descending necrotic mediastinitis of odontogenic origin may be expected only in case of early diagnose and aggressive cervical and mediastinal drainage, performed by bilateral longitudinal cervicotomy and posterior-lateral thoracotomy.

Key words: descending mediastinitis, dental infection, cervical cellulitis, cervicotomy, thoracotomy

INTRODUCTION
The first classification of acute purulent mediastinitis in the antibiotic era dates back to 1937 (H. Neuhof). Depending on the spread of the infection H. Neuhof divided acute mediastinitis into localized (mediastinal abscesses) and diffuse spread (mediastinal phlegmons).1,2 In 1938 E. Pearse described a case of mediastinitis resulting from oropharyngeal infection, and in 1983 A. Estrera et al. formed the group of “descending necrotizing mediastinites”.1-3 These are cases of mediastinitis resulting from bacterial infection, originating from the oropharynx, over 2/3 of which are diagnosed postmortem according to Estrera. It has been found that 60% to 70% of the cases of necrotic mediastinitis are of odontogenic origin – result of dental infection, descending into the mediastinum.1-4

The descending necrotizing mediastinitis is undoubtedly the most severe form of mediastinal infection. The disease has fulminant course with potential occurrence of sepsis and high mortality. Two of the main reasons for the high mortality in patients with descending necrotizing mediastinitis are delay in making the correct diagnosis and delay and/or inappropriate surgical treatment.1,2,5,6 There is still no consensus concerning the optimal surgical approach in patients with descending necrotizing mediastinitis. This is especially applicable to the forms of mediastinal drainage. The opinions vary from drainage of the mediastinum only by transcervical access to routine application of combination of thoracotomy, transcervical mediastinal drainage and tracheostomy.1,6-8 The aim of the current study was to contribute to the search of the optimal approach
to the treatment of descending necrotizing mediastinitis by discussing the diagnostic and surgical attitude to this life-threatening condition.

PATIENTS AND METHODS

The present study includes three patients (men, aged 75, 73, and 63) diagnosed with descending necrotizing mediastinitis between April 2007 and February 2009. In their cases the condition was caused by dental infection descending into the mediastinum – mediastinitis of odontogenic origin. The source of infection was dental abscess affecting the lower molars (right third, right third, and left fourth, respectively). Chronic alcoholism in two of the patients and diabetes mellitus in the third case were predisposing factors for the progressive course of the dental infection.

Appropriate selection of patients is guaranteed by fulfillment of all four criteria suggested by A. Estrera for descending necrotizing mediastinitis: 1) clinical evidence of severe oropharyngeal infection; 2) characteristic roentgenographic features of mediastinitis; 3) documentation of necrotizing mediastinal infection at operation or necropsy (or both); 4) establishment of the relationship between the oropharyngeal infection and descending necrotizing mediastinitis.

The patients had started their treatment in ambulatory settings (treatment of the dental infection). In the three cases presented here the site of admission was a maxillofacial surgery department because of the progression of patient complaints and descent of the inflammatory process to the floor of the oral cavity and the neck. In case of determined descent of the infection into the mediastinum, patients were admitted to a clinic of thoracic surgery. After accomplishment of mediastinal debridement and drainage, post-surgical treatment was performed in an intensive care unit.

DIAGNOSTIC METHODS

Conventional roentgenographic examination of the chest and computed tomography of the floor of the oral cavity, the neck and the chest were used in the study. Microbiological investigation of mediastinal exudate was performed to determine the bacteriological agent causing the descending necrotizing mediastinitis.

SURGICAL APPROACH

The following surgical interventions were performed: 1. incision and drainage of the floor of the oral cavity; 2. bilateral longitudinal cervicotomy with removal of necrotic tissue (debridement) and drainage of cervical fascial spaces; 3. transcervical, suprasternal drainage of the mediastinum; 4. lateral thoracotomy with mediastinal debridement and drainage of all sections of the mediastinum and the respective pleural cavity; 5. application of intrapleural drainage catheter. In each of the patients several drainage procedures, presented in the “Results” section, were performed.

RESULTS

The period between initiation of the ambulatory treatment of the dental infection and the admission to the Thoracic Surgery Clinic was established for each of the patients – respectively 9, 8 and 11 days. The infection of the floor of oral cavity presented with identical signs and symptoms in all three patients – pain in the mandible and the throat, dysphagia, trismus, fever (>38.6°C). The findings from the physical examination in all subjects included painful edema of the submandibular area and the neck. Palpable subcutaneous emphysema of the neck was present in two of the cases. Symptoms, that were found in all subjects and presumed descent of the infection into the mediastinum, were dyspnea, chest pain, hyperemia and edema of the upper chest.

Widening of the mediastinal shadow, associated with pneumomediastinum was found on conventional chest X-ray in the three study patients.

Computed tomography was used to diagnose the infection of the floor of the oral cavity and the neck (Fig. 1). The diagnosis of “descending necrotizing mediastinitis” was confirmed by computed tomography of the chest findings (Fig. 2). The latter investigation allows determination of the progression of the inflammatory process in the neighboring structures – into the pleural space (Figs 2, 3).

Spreading of the dental infection (according to the findings from the imagings and the surgery), the isolated bacterial agents, causing mediastinitis, the applied surgical treatment and its outcome are systematized and presented in Table 1 and Figs 4, 5, 6.

DISCUSSION

Descending necrotic mediastinitis is defined as the most severe form of acute mediastinal infection. The current study is based entirely on patients with descending necrotic mediastinitis of odontogenic origin. This fact confirms the standpoint that in more than 60% of the cases, the descending necrotic mediastinitis is of odontogenic origin. Several factors contribute to the pathogenesis of this life-threatening condition.
Figure 1. Computed tomography showing descent of the dental infection into the bottom of the oral cavity. Soft-tissue edema (cellulitis) with formation of submandibular abscess on the right (designated with arrows) is present.

Figure 2. Computed tomography of the chest (patient with descending mediastinitis). All sections of the mediastinum are affected. The mediastinum is enlarged, with air collections in it – pneumomediastinum (arrows). The neighboring left pleural cavity is also engaged (left-side empyema).

Figure 3. Computed tomography of the chest of a patient with descending necrotizing mediastinitis. Along with engagement of the mediastinum, the inflammatory process affects both pleural cavities (bilateral pleural empyema).

Figure 4. Picture of a patient with fulminant odontogenic infection, descending into the neck and the mediastinum. The descending infection had caused skin necrosis of a vast area of the neck and the upper part of the chest. Drainage tube, placed in the mediastinum via transcervical access, is marked with arrow.

Disease. First, this is the type of the bacterial infection. Descending mediastinitis is typically a result of mixed aerobic-anaerobic bacterial infection with synergy between different agents.9-11 This synergy between bacterial agents is the reason for their high virulence which in turn determines the severe course of the disease. The microbiological examination in our study confirms that the descending mediastinitis is a result of polybacterial infection. The fact that in our results there are no anaerobic bacterial agents isolated from the mediastinum does not mean that they have no participation in the beginning and the
development of the disease. In our opinion, the severe changes and the fatal outcome in all three patients are indirectly supporting the presence of anaerobic microorganisms as causing agents of descending necrotic mediastinitis.

Other factors, contributing to the pathogenesis of the disease, are the way of descending of the infection and the medium for its development. The descent of oral cavity infection into the mediastinum follows the cervical fascial spaces – pretracheal, retropharyngeal (retrovisceral) and perivascular. These are potential spaces, confined of the three layers of the deep cervical fascia. Advancing through the pretracheal space, the infection descends into

**Figure 5.** Right-side thoracotomy in patient with descending necrotic mediastinitis. Debridement of all mediastinal sections was performed. The distal end of a drainage tube placed in the mediastinum via transcervical access is marked with arrow.

**Figure 6.** Left-side thoracotomy in patient with descending necrotic mediastinitis. Spreading of the inflammatory process causes left-side pleural empyema (purulent exudate in the pleural cavity is marked with arrows).

**Table 1.** Spreading and type of the dental infection, performed surgical treatment and outcome

<table>
<thead>
<tr>
<th>Patient</th>
<th>Spreading of dental infection</th>
<th>Isolated bacterial infection</th>
<th>Surgical drainage</th>
<th>Outcome</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>- submandibular abscess on the right; - bilateral neck cellulitis; - mediastinitis; - bilateral pleural empyema</td>
<td>- Escherichia coli; - Pseudomonas aeruginosa; - Streptococcus salivarous</td>
<td>- right-side submandibular drainage; - bilateral longitudinal cervicotomy; - suprasternal mediastinal drainage; - right-side thoracotomy; - left pleural cavity drainage</td>
<td>- lethal (endotoxic) shock - 48 h after mediastinal drainage</td>
</tr>
<tr>
<td>2</td>
<td>- submandibular abscess on the right; - bilateral neck cellulitis; - mediastinitis; - bilateral pleural empyema</td>
<td>- Staphylococcus aureus; - Escherichia coli; - Pseudomonas aeruginosa; - Streptococcus β-hemoliticus</td>
<td>- right-side submandibular drainage; - bilateral longitudinal cervicotomy; - suprasternal mediastinal drainage; - right-side thoracotomy; - left pleural cavity drainage (tubular drainage)</td>
<td>- lethal (endotoxic) shock - 48 h after mediastinal drainage</td>
</tr>
<tr>
<td>3</td>
<td>- bilateral neck cellulitis; - mediastinitis; - pleural empyema on the left</td>
<td>- Streptococcus β-hemoliticus; - Staphylococcus epidermis; - Pseudomonas aeruginosa;</td>
<td>- bilateral longitudinal cervicotomy; - suprasternal mediastinal drainage; - left-side thoracotomy;</td>
<td>- lethal (endotoxic) shock - 72 h after mediastinal drainage</td>
</tr>
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</table>
the frontal mediastinum, overcoming connective tissue membrane on the level of superior thoracic aperture - suprapleural membrane of Sibson.\textsuperscript{10,13} The retropharyngeal space begins from the base of the skull passing downwards into the posterior mediastinum, thus enabling direct access of the dental infection to the mediastinum. The descent of the infection via the perivasal space into the mediastinum is along the route of the big cervical blood vessels – carotid artery and internal jugular vein. It has been proven that descending necrotic mediastinitis is most commonly caused by infection of the second and the third lower molars.\textsuperscript{6,8,9,11} The current study confirms that opinion. The reason behind this fact is that the roots of the second and the third lower molars are situated below m. myohyoideus, which in case of infection of these particular teeth ensures direct access to the submandibular space. Computed tomography results and surgical findings in the patients of the study are representing the easiest and most common way of descent of the dental infection into the mediastinum – from the floor of the oral cavity, through the submandibular space (submandibular process) to the frontal mediastinum. The determination of the way of descent of the infection, as well as which of the mediastinal sections is affected by the descending necrotic mediastinitis is quite conditional. The reason for that standpoint is that synergically acting polybacterial infectious agents find ideal medium for development in the loose connective tissue of the neck and the mediastinum and does not stay isolated in one space.\textsuperscript{10} The current study confirms the above-mentioned opinion and serves as an ideal example for fulminant development of the dental infection spreading in all cervical spaces and mediastinal sections.

It has to be mentioned that numerous predisposing factors are of importance for the severe course of the descending necrotic mediastinitis. Their role is in suppressing organism’s defense, which favors progression of the mediastinal infection.\textsuperscript{1,2,14} In the current study, three of the most common predisposing factors are present: age over 70 years, alcoholism and diabetes mellitus. Bacterial infection, associated diseases and age affecting the course of the descending mediastinitis, are given objective factors. The outcome of the descending necrotic mediastinitis, however, is determined by other two factors, which are influenceable and are subject of discussion in the present study. These are diagnosing the disease and the methods of its surgical treatment.

The overview of a number of publications allows outlining several conclusions, concerning the diagnosing of descending necrotic mediastinitis.\textsuperscript{4,9,11-15} It has been determined that delayed diagnosing of the disease is the main reason for the high mortality. Some of the reasons for the late diagnosis of mediastinitis are subjective. These are prolonged ambulatory treatment of the dental infection and delayed admission of patients to thoracic surgery clinics. The results of the current study are perfectly representative of an example for a delayed diagnose resulting from subjective factors. Delayed diagnosing of the disease has also its objective explanation. While the diagnosis of cervical infection is easy due to the obvious clinical symptoms and signs, it is not the case with the early engagement of the mediastinum from the inflammatory process, lacking typical clinical symptoms related to it. Because of that reason and taking into account the discussed above fast progression of mediastinitis, we accept the view that in case of clinical presentation of dental infection with trismus, dysphagia and emerging edema of the face and the neck, imaging methods for diagnosing of eventual neck and mediastinal infection must be used immediately. The two imaging methods that are commonly used in diagnosing of mediastinitis are conventional chest X-ray and cervico-thoracic computed tomography. The findings from the conventional X-ray investigation are accepted as late manifestation of the disease. Often, they are non-specific and therefore are of little informative value for determination of the spread of the mediastinal inflammatory process. That is why conventional X-ray is not accepted as a reliable method for early diagnosing of descending necrotic mediastinitis. Cervico-thoracic computed tomography is considered a reliable method for early diagnosing of the disease. Except its diagnostic value, cervico-thoracic tomography also determines spreading of inflammatory-necrotic process into cervical and mediastinal area\textsuperscript{1,2,16}, which allows determination of optimal surgical drainage approach. The high diagnostic value of cervico-thoracic computed tomography has been demonstrated also in this study. We share the opinion for its obligatory application as a diagnostic method in all patients in whom presence of descending necrotic mediastinitis is suspected.

Together with formulation of the criteria for descending necrotic mediastinitis in 1983 A. Esterra also presented the approach to its surgical treatment.\textsuperscript{3} In case of spreading of the mediastinal infection above the level of the tracheal bifurcation
(4th thoracic vertebra) Estrera performed transcervical mediastinal drainage. In case of descent of the mediastinal infection below the level of the carina, he performed transthoracic drainage (thoracotomy). Other authors report successful treatment of descending mediastinitis by combination of transcervical and subxyphoidal mediastinal drainage. Some authors report successful mediastinal drainage by means of videothoracoscopic approach. The presented variants of surgical drainage of the mediastinum may be defined as conservative surgical approach. Data analysis of the these studies shows that conservative surgical treatment is successful only in patients with localized forms of descending mediastinal infection. The origin of infection in these cases is the neck – peritonsilar abscess, lateropharyngeal abscess, esophagus lesion (cervical segment). On the contrary, infections of dental origin are rapidly descending into the cervix and the mediastinum, being prone to diffuse spreading, well-demonstrated here. Therefore, conservative surgical approach is not suitable for the treatment of patients with mediastinitis of odontogenic origin. Success in treatment of acute odontogenic mediastinitis may be achieved only by aggressive surgical drainage of the neck and the mediastinum. Only the transthoracal access – thoracotomy, ensures adequate debridement and drainage of all mediastinal sections. Spreading of the infection from the mediastinum to the pleural cavity (empyema) in most of the patients with odontogenic mediastinitis is a fact that may not be neglected. That is why early thoracotomy is accepted as a standard in the treatment of patients with descending odontogenic mediastinitis, irrespective of the level of mediastinal engagement.

Among the described in the literature several transthoracic access ways to the mediastinum, we recommend the posterior-lateral thoracotomy. If possible, we perform right-side thoracotomy, since it ensures good and easy access to all mediastinal sections. In case of spreading of the infection into the pleural cavity (empyema), the choice of side for the thoracotomy is consistent with the localization of the empyema.

Simultaneously with the mediastinal drainage, it is obligatory to perform also debridement and drainage of the affected cervical fascial spaces. Adequate drainage of the neck is achieved by longitudinal cervicotomy – bilateral, along the frontal edges of mm. sternocleidomastoidei. Except for the longitudinal cervicotomy, we always perform drainage of the submandibular space.

The patients in this study underwent adequate in volume, but separated in time drainages of the neck and the mediastinum. In these cases the mediastinitis was diagnosed only after cervical drainage had been performed (treatment of the cervical cellulitis). These are cases of late diagnosing of the odontogenic mediastinitis. Late diagnosing of the disease is the main factor determining the lethal outcome of the disease in all three patients. Prerequisite for avoidance of such fatal, late diagnosing of mediastinitis is determination and accomplishment of the diagnostic treatment plan for patients with dental infection, descending into the bottom of the oral cavity, by a multidisciplinary team, obligatory including thoracic surgeon. Only multidisciplinary surgical team may diagnose at the earliest odontogenic mediastinitis and accomplish its adequate treatment.

CONCLUSIONS

Analysis of the results of the present study and the overview of the literature allows us to make the following conclusions:

The descending necrotic mediastinitis of odontogenic origin presents with the course of a polybacterial infection, usually affecting diffusely the cervical fascial spaces and all mediastinal sections.

Success in the treatment of descending necrotic mediastinitis of odontogenic origin may be expected only in case of early diagnosing and aggressive cervical and mediastinal drainage, performed by bilateral longitudinal cervicotomy and posterior-lateral thoracotomy.

REFERENCES

Десцентирующий некротический медиастинит одонтогенного происхождения — собственный опыт и литературный обзор

И. Новаков, Г. Сафев, С. Пейчева

Резюме

Десцентирующий некротический медиастинит одонтогенного происхождения представляет собой самую тяжелую форму медиастинальной инфекции.

Цель: Работа ставит себе цель представить оптимальный подход при диагностике и лечении пациентов в этом тяжелом жизнеугрожающем состоянии.

Пациенты и методы: В исследование включены трое пациентов – мужчин (возраст - 75, 73 и 63 г.) с десцентирующим некротическим медиастинитом, госпитализированных в периоде апрель 2007 – февраль 2009 г. Диагноз заболевания основывается на шейно-торакальной компьютерной томографии и оперативной находке. Оперативное лечение каждого пациента включает двустороннюю лонгитудинальную цервикотомию, трансверсальную супрастернальную цервикотомию и заднебоковую торакотомию.

Результаты: Время от амбулаторного лечения дентальной инфекции до диагностирования медиастинита соответственно 9, 8 и 11 дней. У пациентов установлено поражение всех шейных пространств и отделов медиастинума полибактериальной (три возбудителя и более) дентальной инфекцией, происходящей от нижних трети и четверти моляров. Наличие хронического алкоголизма и сахарного диабета как факторы, оказывающие влияние на течение медиастинита. Во всех трех случаях исход летальный (до 72-ого часа).

Заключение: Успех при лечении десцентирующего некротического медиастинита одонтогенного происхождения возможен только в случаях ранней диагностики и агрессивного шейного дренажа и медиастинального дренажа, осуществляемых посредством двусторонней лонгитудинальной цервикотомии, трансверсальной супрастернальной цервикотомии и заднебоковой торакотомии.