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HEAD & NECK

Descending cervical mediastinitis: the multidisciplinary surgical approach

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Abstract

Purpose Descending cervical mediastinitis (DCM) is defined as spread of oropharyngeal or odontogenic infection into the mediastinum. It occurs uncommonly and has a high mortality rate.

Methods Six patients underwent surgery at our centre for DCM between November 2013 and October 2016. Five of six patients underwent drainage of neck collections via a cervical approach, and all six patients subsequently underwent thoracic surgery for drainage of pleural and mediastinal collections.

Results Four patients required further surgical intervention, of which two subsequently required a third thoracic operation. The average length of stay was 73 days (range 4–193). There were no in-hospital deaths and all patients were discharged from our hospital.

Conclusions Following diagnosis, prompt surgical intervention from ENT and cardiothoracic surgeons is essential. Our experience demonstrates that favourable outcomes can be achieved in patients with DCM when they are managed aggressively and promptly in specialist centres with appropriate multidisciplinary team involvement.

Keywords Descending cervical mediastinitis · Thoracotomy · Video-assisted thoracoscopic surgery

Introduction

Descending cervical mediastinitis (DCM) is defined as spread of an oropharyngeal or odontogenic infection into the mediastinum through the anatomical cervical fascial planes. It most commonly originates from odontogenic infection, with this source representing more than 50% of the cases reported in the literature since 1960 [1]. Diagnosis of this rare and serious infective pathology is frequently delayed, as presenting symptoms are often vague and non-specific. It is well recognised that inadequate and delayed intervention is a major factor contributing to the high mortality rate associated with DCM, which remains between 20 and 50%. As a tertiary UK centre, we recently reviewed our 5-year experience of managing this condition.

Materials and methods

Between November 2013 and October 2016, six patients with DCM were treated at our institution. Three were male (50%) and three were female. The mean age was 35.94 ± 15.68 (range 18–55 years). Primary pathology was parapharyngeal abscess ($n = 2$), tonsillar abscess ($n = 2$), submandibular abscess ($n = 1$) and traumatic pharyngeal and cervical oesophageal tears ($n = 1$). Five of the six patients (83%) were transferred from other hospitals.

All patients underwent pre-operative computed tomography (CT) scanning to establish the diagnosis. Infection was present within the neck and the mediastinum in all cases. Pleural effusions were present in five of the six cases (one right-sided unilateral and four bilateral). Mediastinal involvement was limited to the superior mediastinum in two cases, whilst the other four cases demonstrated radiological evidence of infection extending caudally into the

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compartments of the inferior mediastinum. Involvement of the inferior mediastinum was bilateral in three of the four cases.

All six patients underwent thoracic surgery to drain mediastinal and pleural collections. Five of the six patients also underwent drainage of neck collections through a cervical incision performed by ENT surgeons. The single patient in this series not requiring cervical drainage had a peritonsillar abscess as the primary pathology which improved after appropriate antibiotic therapy and subsequent thoracic surgery. 50% of the thoracic surgery was performed via posterolateral thoracotomy, whilst the other three patients underwent video-assisted thoracoscopic surgery. Intra-operative management included extensive debridement of all affected tissue, with drainage of mediastinal and pleural collections. Wide bore chest drains were inserted to allow continuing drainage of any residual collection. These were removed in a graded manner, with removal guided by the ongoing air leak, the volumes drained and the improvement in the radiological and overall clinical picture.

Results and analysis

A mixed anaerobic and aerobic polymicrobial infective process was demonstrated in all six cases. Samples from the neck, pleural and mediastinal collections along with blood and wound swabs underwent appropriate microbiological assessment. Antibiotic therapy was tailored accordingly. Streptococcus anginosis, Streptococcus oralis, Staphylococcus aureus, Prevotella oralis and Fusobacterium necrophorum were among the most frequently identified organisms.

All five patients who underwent cervical drainage had further CT scanning post-operatively, and went on to have thoracic surgery. The patient who did not undergo cervical drainage had further CT imaging following a clinical deterioration which led to thoracic surgery in response to the radiology findings. Following the initial thoracic operation, patients underwent further CT scanning if their clinical picture deteriorated, or in the absence of significant clinical improvement following the procedure. In this series, 67% ($n = 4$) of patients had further imaging performed. Two of these patients required a further thoracic operation. The other two required two further procedures to achieve comprehensive drainage. Table 1 summarises the surgical intervention undergone by all six patients within the series.

The mean length of stay was 73 days (range 4–193). There were no in-hospital deaths and all patients were discharged from hospital.

Discussion

Descending cervical mediastinitis is defined as spread of an oropharyngeal or odontogenic infection into the mediastinum through the anatomical cervical fascial planes. This is a rare condition in the developed world, with a much higher incidence in the developing world, where resources for prevention and treatment of dental and oropharyngeal diseases are often much more limited.

The most common origin of DCM is from odontogenic infection, with this source representing more than 50% of the cases reported in the literature since 1960 [1]. Other causes of DCM include retropharyngeal or peritonsillar abscess, thyroiditis, parotitis, cervical lymphadenitis, epiglottitis, jugular intravenous drug use and trauma, as well as a number of iatrogenic causes including traumatic endotracheal intubation [2]. Recognised risk factors for DCM include poor dentition, diabetes, AIDS, IV drug use and excessive alcohol intake. The main reason for the high mortality associated with this condition is delayed confirmation of diagnosis. Presenting symptoms are often vague and non-specific, frequently leading to late diagnosis. Localised pain and fever are the most common symptoms reported, with

Table 1 Summary of surgical intervention required

Patient no.	ENT procedure	Thoracic surgical approach	Thoracic surgical operation(s)
1	1	1 VATS and 1 open	Left VATS and drainage
			Left thoracotomy and drainage
2	1	1 VATS and 1 open	Right thoracotomy and drainage
			Right thoracotomy and drainage
3	1	3 open	Right thoracotomy and drainage
			Right thoracotomy and drainage
			Right thoracotomy and drainage
4	0	3 VATS	Left VATS and drainage
			Right VATS and drainage
			Right VATS and drainage
5	1	1 open	Right thoracotomy and drainage
6	1	1 open	Right thoracotomy and drainage

associated respiratory distress as the infection spreads to the mediastinum.

Awareness of the anatomical cervical fascial planes aids understanding of the subsequent mediastinal involvement and intrathoracic complications of initially localised cervical infection.

The fascial layers of the neck are divided into superficial and deep layers. The deep layer is further categorised into three components. These are the superficial (pretracheal), visceral (perivascular) and prevertebral layers. These multiple layers of fascia further divide the deep space of the neck into three discrete spaces. These are the pretracheal, perivascular and prevertebral spaces.

The pretracheal space lies posterior to the strap muscles and pretracheal fascia. It is anterior to the trachea. It extends caudally down to the mediastinum, where its lower limit is bordered by the pleura and pericardium at the level of the carina. The perivascular space is enveloped by the carotid sheath. The carotid artery, internal jugular vein and vagus nerve lie within this space. These important structures descend from the neck into the chest within this space. The prevertebral space is further subdivided into two separate spaces: the retropharyngeal space anteriorly, and the "danger space" posteriorly. These two spaces are divided by the alar fascia. The retropharyngeal space has fascial limitations both anteriorly and posteriorly. These fascial planes fuse at the level of $T1/T2$, thus limiting any further caudal extension of this space. This is in direct contrast to the danger space, which lies posterior to the alar fascia. This space is so named due to the fact that it runs from the skull base to the diaphragm, allowing for easy transmission of infection. This space also lacks the midline raphe that is to be found within the retropharyngeal space, meaning that contralateral spread of infection is also much more easily facilitated.

Once the initial focus of infection has been established, a combination of gravity, respiration and negative intrathoracic pressure encourage caudal spread into the mediastinum. Infection can also spread across fascial planes, frequently leading to contamination of multiple mediastinal compartments as well as the pleural space(s) [3]. Moreover, the cervical fascial planes are also in direct communication with fascial and cervical spaces superior to the hyoid bone. When the anatomical characteristics of the planes and spaces of the neck are considered, it is unsurprising that upwards of 70% of mediastinitis originating in the neck spreads via the two spaces (retropharyngeal and danger spaces) of the prevertebral compartment. The remainder of cases spread via the pretracheal and perivascular compartments, with vascular haemorrhage a recognised complicating factor of spread through the perivascular compartment due to its contents.

The vagueness of presenting symptoms, leading to delay in establishing diagnosis, plays a large part in the lethality of this disease. The initial cervical/odontogenic infection is often straightforward to diagnose based on history and clinical examination. The insidious and non-specific nature of the symptoms associated with mediastinal involvement poses a more significant clinical challenge. A set of formal diagnostic criteria were established by Estrera et al. [4] in 1983 (Table 2).

Table 2 Diagnostic criteria of descending cervical mediastinitis

Diagnostic criteria of descending cervical mediastinitis
Evidence of oropharyngeal infection
Characteristic radiological features of mediastinitis
Intra-operative or post-mortem documentation of mediastinal infection
Establishment of a relationship between the oropharyngeal infection and subsequent mediastinitis

Chest radiography can demonstrate features such as widening of the mediastinum and pneumomediastinum, but these features are neither strongly sensitive nor specific. Hence, the gold standard form of imaging in this condition is CT scanning. The purpose of obtaining good-quality imaging is twofold: to accurately assess the soft tissue infection in the neck, and to demonstrate the presence of mediastinitis. As per the previously mentioned guidelines by Estrera et al., the radiological identification of communication between infection in the neck and infection in the mediastinum is required to establish a formal diagnosis of DCM. In 2007, Scaglione et al. published a list of CT features that they had identified as being diagnostic of DCM [5] (Table 3).

Table 3 Diagnostic features of DCM on CT scanning

Diagnostic features of descending cervical mediastinitis on CT scanning
Fluid collections with or without gas
Increased density of cervical adipose tissue or cellulitis
Cervical lymphadenopathy
Mediastinal fluid collection
Pleural and/or pericardial fluid collections
Vascular thrombosis

Once the diagnosis has been formally confirmed, and the extent of the spread of the infection adequately and accurately assessed, the optimum treatment approach is often multi-modal. It is well recognised that inadequate and delayed intervention, often due to a delay in establishing the diagnosis, is a major factor contributing to the high mortality rate associated with DCM, which remains between 20 and 50% [6]. Prompt commencement of broad spectrum antibiotics is crucial to attempt to limit further spread of infection. However, it is now understood that antibiotic therapy alone is not sufficient for management of these complex cases. Once recognised, this condition should be treated as a surgical emergency and managed accordingly. Early CT scanning is essential, both to establish the diagnosis and to aid with surgical planning. A multidisciplinary approach involving both cardiothoracic and ENT surgeons is essential and judicious surgical debridement of all affected anatomical areas should be undertaken at the earliest opportunity. Other (non-odontogenic/oropharyngeal) causes of mediastinitis such as oesophageal perforation or as a complication of cardiac surgery are often localised and consequently much more amenable to antibiotic therapy or localised percutaneous drainage [7] as definitive management, without the need for surgical debridement.

Endo et al. further classified DCM into localised (type 1) and diffuse (types 2a and 2b) disease based on the degree of spread of infection apparent on CT scan. They classify type 1 DCM as infection localised to the superior mediastinum above the level of the carina. Accordingly, type 2 DCM refers to cases where there is involvement of the inferior mediastinum. Type 2 is further classified into types 2a and 2b, where type 2a is infection limited to the anterior compartment of the inferior mediastinum, whilst type 2b includes any cases where there is infection noted in both (anterior and posterior) compartments of the inferior mediastinum.

It has subsequently been postulated that different surgical approaches for treatment of DCM should be undertaken according to this classification of the pathology, [8] with the suggestion that type 1 DCM, where there is no spread of infection below the level of the tracheal bifurcation, can be managed with a transcervical approach alone, negating the need for a concomitant transthoracic approach. However, mediastinal infection extending down beyond this level should be treated through both a transcervical and transthoracic approach. This is due to the fact that infection spreading caudal to the level of the carina is associated with a much greater incidence of pleural empyema. Estrera et al. [4] also recommend a combined approach (concomitant transcervical and transthoracic procedures) when the infection extends below the level of the carina anteriorly, or the fourth thoracic vertebral plane posteriorly. This recommendation is supported by a 1997 meta-analysis demonstrating the significantly increased mortality of patients with type 2 DCM managed via a transcervical approach alone in comparison to those who also underwent transthoracic drainage (19% vs 47%) [6].

A traditional transcervical incision, extended bilaterally to the sternocleidomastoid muscles, allows for dissection of cervical layers, providing good exposure for judicious debridement of necrotic tissue and drainage of collections within the neck. The anterior mediastinum, up to the level of the distal trachea, can also be reached from this approach, through the pretracheal space. There is also scope to enter the posterior mediastinum via the retropharyngeal space through the cervicotomy. However, this approach allows only narrow access to the mediastinum, severely limiting the ability of the surgeon to reliably excise all affected tissue.

In 1990, Wheatley et al. [1] published a review of the literature highlighting the inadequacy of cervical drainage alone as definitive treatment of DCM. Their preferred approach was to undertake mediastinal drainage via a subxiphoid incision in addition to a cervical approach for drainage of the neck. Additional publications have explored various anatomical approaches, including median sternotomy, anterior and posterior mediastinotomy, clamshell incision and posterolateral thoracotomy. The use of video-assisted thoracoscopic surgery (VATS) as an acceptable transthoracic approach in DCM is also described [9]. Bilateral exploration is indicated if there is involvement of both thoracic cavities, and this has been approached with bilateral VATS, unilateral posterolateral thoracotomy with contralateral VATS, or via a clamshell procedure.

Median sternotomy appears unfavourable due to the very high risk of osteomyelitis and subsequent sternal dehiscence. The access to all the mediastinal compartments is also less favourable when compared to posterolateral thoracotomy or VATS. The clamshell incision, whilst often affording excellent access to all required cavities, is an extremely invasive procedure that ought to be avoided in critically ill patients wherever possible. Moreover, there are associated risks with this procedure such as phrenic nerve palsy as well as sternal complications (osteomyelitis and dehiscence).

More recent publications have included the use of VATS procedures to access the thoracic cavity, offering a less invasive approach to drainage of mediastinal and pleural collections. This approach is of increased value in patients requiring bilateral thoracic exploration. The main potential drawback with the minimally invasive approach is that the nature of DCM means that there are often diffuse and widespread fluid collections and necrotising cellulitis requiring extensive debridement in addition to straightforward drainage. However, there are multiple publications in the literature reporting acceptable results when using VATS as their thoracic approach of choice [10, 11].

Whilst all these techniques have their own advantages and disadvantages, the posterolateral thoracotomy remains the gold standard incision of choice for accessing the thoracic cavity. Not only is the procedure generally well tolerated, even in critically unwell patients, it affords excellent access to the mediastinal, pericardial and pleural spaces. The prevertebral and paraoesophageal planes are also easily accessible, and the incision does not carry the risk of sternal osteomyelitis inherent to both the clamshell incision and the median sternotomy.

Corsten [6], Marty-Ané [12] and Freeman [13] and colleagues have all published case series detailing their approach to DCM. All combined transcervical approaches with concomitant posterolateral thoracotomy to access the thoracic cavity.

Valued for its role in confirming the diagnosis, CT scanning is also an important tool for monitoring disease progression and response to treatment. Repeat surgical intervention is often needed to ensure complete resolution of infection and is undertaken based on clinical and radiological findings. These patients frequently require critical care management post-operatively. Whilst improved management of DCM has reduced the mortality burden associated with disease, complications remain both frequent and significant. Spread of infection often leads to pneumonia, acute respiratory distress syndrome, empyema and purulent pericardial disease. If allowed to persist within the body, sepsis from DCM often leads to multi-organ failure [14].

We believe that there is a considerable body of evidence supporting the role of early concomitant transcervical and transthoracic (posterolateral thoracotomy or VATS) surgical intervention in patients with DCM, and our own experience supports this position.

As a regional centre for cardiothoracic surgery, we have presented our experience of DCM. These six patients with differing aetiologies underwent surgery at our institution. All six patients survived to discharge from our hospital. Our experience demonstrates that favourable outcomes can be achieved in patients with DCM when they are managed aggressively and promptly in appropriate specialist centres.

Compliance with ethical standards

Conflicts of interest This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors. We the authors have no potential or actual conflicts of interest to declare.

Research Involving human participants and/or animals This article does not contain any studies with human participants or animals performed by any of the authors.

Informed consent No photos or patient identifiable data has been published as part of this work.

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