



Acute Descending Necrotizing Mediastinitis: Spectrum of Management and Role of Video Assisted Thoracoscopic Surgery

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Abstract

A thoracic surgeon in the UK is likely to come across Descending Necrotizing Mediastinitis once a year in a busy tertiary referral hospital. This is a rare but life-threatening complication of oropharyngeal sepsis. It carries a poor prognosis if recognised late. In this report we selectively describe five cases treated differently, with emphasis on Computed Tomography guidance to bespoke surgical drainage of pus. We specifically discuss two aspects of our experience with these patients. Firstly the spectrum of surgical management and role of Video Assisted Thoracoscopic Surgery (VATS). Secondly we discuss “dysphagia”, which is invariably a presenting symptom/ complication, its progression, and natural course. We also emphasise the important role of different teams on the Intensive Therapy Unit as a major cause of these patients surviving the gruesome infection.

Keywords: Video assisted thoracoscopic surgery; Necrotizing Mediastinitis; Spectrum

Introduction

Descending necrotizing mediastinitis (DNM) is a rare complication of oropharyngeal and odontogenic infections (tonsillitis, pharyngitis and tooth abscess). It usually affects young adults, who were previously fit and healthy. Specific aetiologies have not been recognised, although patients with insulin-dependent diabetes and alcoholics are more commonly affected [1]. Mixed aerobic and anaerobic organisms are usually the culprit. A special form of DNM caused by fusobacterium necrophorum known as Lemierre’s syndrome, which presents as acute oropharyngeal infection with life threatening septic thrombophlebitis of the internal jugular, and or subclavian veins and metastatic abscesses [2].

The point of origin of the infection is almost always located deep in the cervical area. Among these, periodontal disease (tooth abscess) constitutes 41%, while pharyngeal abscess is the second most frequent aetiology [3]. The infection spreads along the cervical spaces into the retropharyngeal space to reach the posterior mediastinum. The submental and submaxillary abscesses, however, spread posteriorly towards the vascular space, and thereby may extend into the anterior mediastinum [4]. Grodinsky and Holyoke presented the concept of the three fasciae and fascial spaces and showed how an infection in these areas is likely to gravitate to the mediastinum [5].

Odynophagia (painful swallowing) and later dysphagia (resulting in regurgitation and aspiration) is invariably reported in most published series. Dysphagia continues into the recovery period posing a challenge to nutrition in the severely debilitated patient. It also predisposes to aspiration, lung consolidation and lung abscess formation. The full pathology of dysphagia in DNM is not fully understood.

In this report we selected five cases encountered in the last 10 years to describe the Southampton experience in management of DNM. The emphasis is on the varied clinical picture, progression and the bespoke surgery designed. We also discuss the invariable symptom of dysphagia in this group of patients.

Case Presentation

Case 1

A 17-year-old female was admitted with a four days history of sore throat, difficulty swallowing

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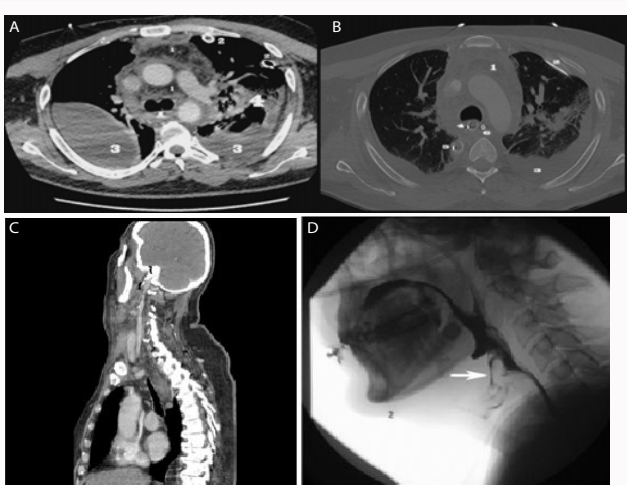


Figure 1: Radiological images.

A: CT of Case No. 4 before right thoracotomy. 1= Gas and brawny oedema of the mediastinum 2= left pleural chest drain, not draining effusion 3= bilateral pleural effusions 4= patchy consolidation of the left lung.

B: CT of same patient one week after right thoracotomy. 1= Pre-Aortic persistent gas and brawny oedema/pus of the mediastinum 2= left pleural chest drain, not draining 3= Posterior Left pleural effusion 4= 36F mediastinal drain between trachea and oesophagus 5= 32F drain in free right pleural space.

C: Type I DNM in patient No. 2. Brawny oedema in neck and superior mediastinum, not seen below level of carina.

D: Speech Video Fluoroscopy in case No. 3. Oropharyngeal dysmotility, with contrast crossing the vocal cords into the trachea (arrow).

and fever. Haematological investigations revealed raised white cell count ($WCC=16 \times 10^9/L$), C-reactive protein ($CRP=300 \text{ mg/L}$) and positive Epstein Barr virus serology. She was treated for tonsillitis with intravenous Ceftriaxone 1 gm 8 hourly (tds), but failed to respond. Subsequent CT scan of the neck and thorax demonstrated a pharyngeal perforation with extensive retropharyngeal abscess extending from the suprahyoid region to the aortic arch, air in the soft tissues of the neck and prevertebral fascia, and fluid tracking down into superior mediastinum around the great vessels. Her condition deteriorated necessitating ventilatory and inotropic support in the Intensive Therapy Unit (ITU).

In view of this, the patient underwent surgical exploration by the Ear Nose and Throat (ENT) surgeons of the left anterior cervical triangle as well as a right anterior mediastinotomy (Chamberlain approach) by thoracic surgeons. Through the neck incision oedematous tissue, pus and necrotic debris were encountered in the plane lateral to the thyroid. Necrotic tissue was debrided, the loculi were broken and pockets of pus in the retro-pharyngeal and retro-oesophageal spaces were drained. Surgical toilet with Aqueous Iodine and 3% hydrogen peroxide (H_2O_2) was performed and a 28 F Argyle tube placed behind the oesophagus from a cervical approach. Through the anterior mediastinotomy approach the pleura was entered medially and dissected off the superior vena cava (SVC), where more pus and necrotic tissue were encountered. This was debrided and a 16 F Redivac catheter drained the space. A right intercostal tube was also placed through a different stab wound to drain a pleural effusion. Microbiological analysis revealed mixed culture and the patient was started on intravenous Clindamycin 400 mgs tds, Imipenem 2 gms tds, and Metranidazole 400 mg tds.

Despite initial improvement in the post-operative course, the patient relapsed with septicaemia on the 4th post operative day

requiring inotropic support. A repeat CT scan demonstrated residual collection in the right perivascular space anterior to the SVC, left parapharyngeal space and anterior to the aortic arch and right internal jugular vein thrombosis (a feature of Lemiere's disease). The neck was subsequently re-explored via the initial cervical incision. With blunt dissection, a track was created behind the pharynx to the right and a corrugated Yates drain was placed behind the pharynx, across the midline. Next the left cervical incision was joined to the right anterior mediastinotomy incision by a J-shaped manubriotomy (leaving the sterno-manubrial joints intact), giving excellent exposure to the retro-manubrial space. The pockets of pus in the space around the SVC and the aorta were drained, necrotic tissues debrided and corrugated Yates drain left in situ. The surgical wounds were left open.

The patient's post-operative course was complicated by persistent swinging pyrexia and increasing inotropic requirement. Repeat CT scan showed a collection in the right retropharyngeal space and at the base of the skull, requiring drainage by right cervical incision and peroral incision. A left pleural effusion required tube thoracostomy drainage. She underwent a percutaneous endoscopic jejunostomy (PEJ) for feeding. Tracheostomy was required for the protracted weaning off the mechanical ventilation. Following this, the patient made slow but progressive improvement and was eventually weaned off the ventilator. Three months later her sternal wound was closed using a left pectoralis major flap from which she recovered uneventfully and was discharged home. Dysphagia was encountered immediately after weaning off the ventilator, and the Speech and Language Team (SALT) were involved in her care at an early stage. The patients' dysphagia recovered over a period of six months and recent video assisted fluoroscopy revealed a residual left vocal cord palsy with intact swallowing reflex. She was well at 2 years follow up.

Case 2

A 65 yr old lady was referred with a two week's history of sore throat, acute epiglottitis, anterior neck swelling and odynophagia progressing to dysphagia. Early in the course of her illness she started discharging pus through her mouth. She was treated with intravenous antibiotic (Tazocin 4.8 grams tds.) to which she had a good response. Her CT scan demonstrated an extensive prevertebral right retropharyngeal abscess throughout the superior mediastinum (Figure 1C). A barium swallow excluded oesophageal perforation. Follow up CT scan a week later demonstrated a considerable improvement in the collections in the neck and superior mediastinum with reduced peri-oesophageal oedema. Microbiological analysis on blood, sputum and pus culture were negative. In view of being symptom free and the spontaneous drainage of the posterior pharyngeal abscess she was treated conservatively with intravenous and later oral antibiotics. Her dysphagia improved over a period of two weeks and was tolerating fluid and solids of all consistencies without regurgitation. After two weeks in hospital she was discharged home symptom free, without surgical intervention.

Case 3

A 67 yrs old lady was admitted to the hospital with a 2-days' history of sore throat, odynophagia and subsequent right sided anterior neck swelling. Consequently the odynophagia progressed to complete dysphagia with nasal regurgitation. On examination she was pyrexial at 38.2°C , with an evident 3 cm x 4cm swelling in the right anterior cervical triangle. A fine nasal endoscopy (FNE) revealed a right sided parapharyngeal swelling obliterating the aryepiglottic fold. A CT scan illustrated marked abscess in the right

parapharyngeal space, extending into the right submandibular gland. Intravenous antibiotic therapy with Ceftriaxone 2 grams once daily (od) and Metronidazole 500 mgs tds failed to control the sepsis. A repeat CT scan demonstrated the right parapharyngeal collection extending from the base of the skull to the superior mediastinum, into the posterior mediastinum to the level of the carina. There were also bilateral pleural effusions.

In view of this, the patient underwent exploration of her right cervical triangle. One high and one low stab incisions in the midline were fashioned. The abscess cavity was explored superiorly upto the base of the skull, posteriorly to the posterior triangle, anteriorly to the midline in front of the trachea and laterally to the ramus of the mandible. The anterior mediastinum was approached through the low stab incision via the pretracheal plane. This was communicated with the right lateral and posterior mediastinum via a separate plane lateral to the carotid sheath. A 32F Argyll drain was introduced from the neck wound in the left paratracheal space all the way into the mediastinum blindly. A 28F Argyll intercostal drain was inserted into the right chest. A tracheostomy was fashioned the post-operative recovery was slow and protracted. Naso-gastric tube was used to feed the patient as his swallowing was impaired. Speech video fluoroscopy demonstrated weakness in the right pharyngeal wall to be the cause of dysphagia. The tracheal tube was downsized and removed when the patient swallowing improved. She was discharged home after 4 weeks in hospital and was well at 6 months follow up. Her swallowing had returned to normal.

Case 4

A 42 year old gentleman very fit previously presented to the ENT department with severe tonsillitis, and odynophagia. His inflammatory markers were significantly high, WCC=17 × 10⁹/L, CRP=728 mg/L. His HIV status was negative. Initial intravenous antibiotics included; Tazocin 4.5 grms tds, Clindamycin 12 gm qds, Clarithromycin and metronidazole 1 gm bd. His sepsis was not controlled, therefore; under local anaesthesia a retropharyngeal abscess was drained via bilateral neck incisions. There was no Quincy. 3 corrugated drains were left on the right side and 2 similar drains on the left side of the neck. Group G Streptococci were isolated from drained pus. The wounds and drains were reviewed in theatre 5 days later as he was not making progress. A CT was ordered and this led to the diagnosis of DNM (Figure 1A). The mediastinum showed collection of pus, oedema and gas formation, together with bilateral effusions and lung patchy consolidation. An echocardiogram revealed a moderate pericardial effusion that did not require drainage. A left chest drain was inserted but without much improvement. Two days later he underwent right thoracotomy and opening of mediastinum from neck to diaphragm. Originally the operation was planned as VATS, but sepsis, hypoxia and retention of CO₂ necessitated high inflation pressures making lung isolation impossible, therefore a single lumen Endotracheal tube was used. After initial improvement in the Intensive care unit and substantial reduction in WCC and CRP he relapsed one week later, with a temperature of 37.9°C and rising markers. The ENT team reviewed the neck drains, and a second CT was ordered. The latter showed a new collection of pus anterior to the arch of the aorta and to the back of the left hilum, not drained by the left chest drain or the new right mediastinal drains (Figure 1B). Further left sided surgery was necessary. VATS would have been the preferred approach; however for the same reasons as in the previous operation isolation was impossible. Initially a limited left anterior

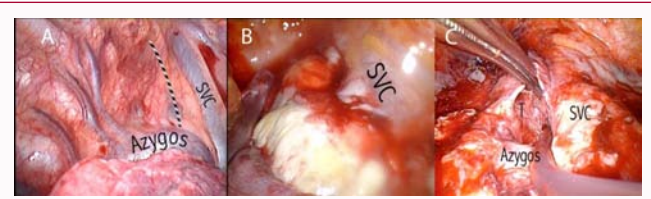


Figure 2: VATS debridement of superior mediastinum.

A: Normal looking superior triangle (borders: phrenic nerve, vagus nerve and Azygos vein). Dotted line represents where pleural reflection should be incised.
B: Same view in Case 5 showing tense mediastinum bulging with abscesses, before incision.
C: Same patient after incision debridement and drainage. T= Trachea, SVC= Superior Vena Cava.

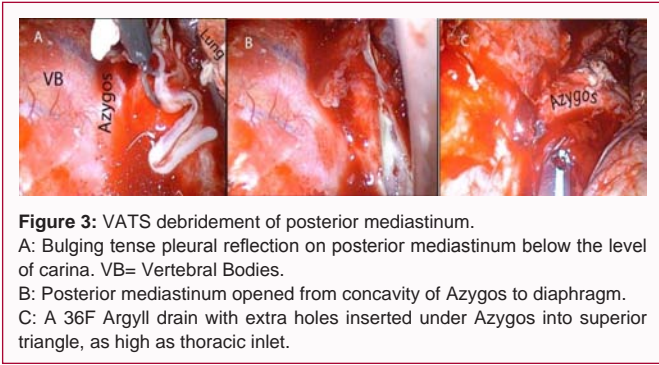
mediastinotomy (Chamberlain approach) was tried to gain access to the arch of aorta. The high inflation pressures made it impossible to retract the apex of the lung down to expose the aorta. The wound was closed and a proper posterolateral left thoracotomy was opened. The pleural reflection over the aorta between phrenic and vagus nerves was opened from below over the main pulmonary artery, up over the arch and all the way over the neck vessels. The crossing superior intercostal vein was thrombosed. The incision was continued down behind the hilum to the level of diaphragm, disconnecting all bronchial vagal branches. The finger was used to open all loculations of pus. A 36F posterior and 32 F anterior drains were inserted in the left chest.

His subsequent recovery was slow, but finally was extubated without the need for a temporary tracheostomy. Because we had some experience with dysphagia by this time, the SALT team were involved early, and persevered with Naso-Gastric Tube feeding, rather than fashioning a PEJ. He was discharged home after 4 weeks in hospital and it took over two months for his swallowing to come back to normal.

Case 5

An athletic 48 year old gentleman presented with sore throat, odynophagia and subsequent right sided anterior neck swelling. CT scan of his head, neck and chest revealed extensive neck and mediastinal abscess and bilateral empyema and a diagnosis of DNM (Lemierre's Disease) was made. Neck abscess was drained and two chest drains placed to drain 1.5 litres of pus. Blood Cultures grew Fusobacteria and antibiotics were changed to Tazocin and Metronidazole. Duplex studies confirmed thrombosis of his left subclavian vein and he was anticoagulated with short acting Heparin and Warfarin. He was then transferred to the ITU for septic deterioration in preparation for emergency surgical drainage. Warfarin was stopped 2 days prior to surgery, but Heparin infusion continued, keeping activated partial thromboplastin time (APTT) twice the norm. At operation a right Video assisted thoracoscopic procedure (VATS) was performed. The chest was found to be full of thin fluidy amber colour pus. The superior mediastinum was bulging especially between superior vena cava and main trachea, as well as anterior to the SVC, and below Azygos vein in the subcarinal space deep into the posterior mediastinum.

On opening the pleural reflection on these sites, frank yellow projectile thick yellow pus exuded (Figure 3). The lung parenchyma at the back of the hilum was exuding pus from metastatic lung abscesses. The pericardium anterior to the phrenic nerve was also bulging and tense, and was therefore aspirated with a needle and blood stained fluid was obtained, therefore; was not opened to avoid purulent pericarditis. The pleural reflection over the superior triangle



(between vagus, phrenic nerve and Azygos vein) was opened and pus drained (Figure 3A, 3B, 3C). Likewise the subcarinal space was opened longitudinally between Azygos vein and oesophagus down to diaphragm (Figure 4A, 4B, 4C). The space anterior to the SVC was opened and bluntly dissected under the left innominate vein across the midline, up to the left side of neck and pus was drained. The superior triangle and subcarinal spaces were joined below the Azygos vein. Formal decortications of the rind on the visceral pleura was carried out. This was not difficult as this was an early phase empyema. The pleural cavity was washed with warm water and aqueous Iodine solution mixed with 3% Hydrogen Peroxide (H₂O₂). A 32F drain with 4 extra holes was introduced via the inferior port and placed within the mediastinum behind vena Azygos up to the superior triangle (Figure 4C).

The patient was returned to ICU for respiratory and cardiac support. A per-cutaneous tracheostomy was fashioned the following day. After two weeks in ITU he was extubated. It appeared that he had right sided weakness and expressive dysphasia. CT head was normal but MRI showed 2 subcortical watershed infarcts. Aspirin was added to his subcutaneous heparin. He was fed thorough nasogastric tube and later via gastrostomy (PEG). A speech video fluoroscopy was

performed to elucidate whether the dysphagia was due to the stroke or other causes. Oropharyngeal dysmotility with silent nasopharyngeal and laryngeal penetration was reported, as well as minor aspiration into trachea (Figure 2D). He made slow recovery and at the time of his discharge he was mobilizing on the ward with satisfactory CT chest and chest X-ray. He was discharge to a local hospital after 8 weeks in our hospital. He was reviewed in the clinic 4 months later when swallowing was back to normal and he could walk 5 miles without stopping. His speech was still slightly tongue tied with some words. Warfarin treatment was planned for 9 months.

Discussion

DNM has been classified according to extension of the inflammatory tracts into the mediastinum [6]. Type I lesions remain above the carina, whereas type IIA lesions reach the anterior inferior mediastinum, and type IIB lesions involve the posterior inferior mediastinum. DNM has high mortality of 31% even with appropriate treatment [7]. Delay in diagnosis and inadequate drainage are thought to be the cause for this high mortality. When infection spreads below the level of the carina, mediastinal drainage should be performed through a thoracic approach, as mortality associated with cervical drainage alone is 47% compared to 19 % for combined cervical and thoracic drainage [7]. There is no widely adopted consensus as to the best surgical approach. Ridder et al. [8] discussed the contemporary trends in management recently. Bilateral thoracotomy, subxiphoidal, clamshell and median sternotomy amongst other approaches have been described [7-13]. Full postero-lateral thoracotomy has been traditionally advocated as it offers the best access to the prevertebral and paraoesophageal planes without the risk of cutting through bone. Sternotomy carries the risk of sternal breakdown and osteomyelitis.

In this selected series of five patients with DNM who were managed at Southampton General Hospital – UK in the last 10 years, bespoke surgical approach was the theme. Table 1 summarises

Table 1: Summary of basic characteristics and outcome in 5 patients treated for Descending Necrotising Mediastinitis.

Case	Age	Origin of infection	Infection spread on CT	surgical procedures	Total Number of surgical procedures	Feeding	Ventilatory support in ITU	Outcome
1	17	parapharyngeal	Type IIB retropharyngeal abscess superior, anterior & posterior mediastinitis & right empyema.	Left cervicotomy Chamberlain incision J-shaped manubriotomy Reviews of neck wounds X2 Plastic surgery to cover the manubrium X2	7	PEJ	Ventilated 6 weeks Tracheostomy required	Discharged well
2	65	parapharyngeal	Type IIA retropharyngeal abscess superior & anterior mediastinum spontaneous discharge per oral	Treated with antibiotics only	0	Oral	Managed in the ward 2 weeks	Discharged well
3	67	parapharyngeal	Type IIB right parapharyngeal space base of skull to posterior mediastinum	Two midline cervicotomy upper cervicotomy for the neck & the lower for the mediastinum	2	NGT	Ventilated 2 weeks Tracheostomy not required	Discharged well
4	42	parapharyngeal	Type IIB retropharyngeal abscess superior, anterior and posterior mediastinitis with gas formation, bilateral effusions and patchy lung consolidations	Bilateral neck drainage stab wounds Right and left thoracotomies drainage of mediastinum and debridement	4	PEG	Ventilated 4 weeks Tracheostomy required	Discharged well
5	48	parapharyngeal	Type IIB retropharyngeal abscess superior, anterior & posterior mediastinitis & Bilateral empyema	Drainage of right Neck and mediastinal Abscess. Right VATS and drainage of anterior, superior, and posterior mediastinal abscess	3	NGT	Ventilated 4 weeks Tracheostomy required	Discharged well

Legend: PEJ: Percutaneous Endoscopic Jejunostomy; PEG: Percutaneous Endoscopic Gastrostomy; NGT: Nasogastric Tube

the demographics and outcomes of these patients. Our institution previously published the importance of contrast CT imaging in identifying the extent of infection and the presence of complications [14]. Clinicians are reminded that the disease is not uniform, different patients have different maps of pus locations and that mediastinal drainage was the single most important factor in recovery. One should not be under the illusion that bilateral large sized intercostals drains would sort out the sepsis. Intact mediastinal pleural reflections are an impediment to drainage of pus originating within the mediastinum. Opening the mediastinal pleural reflections from neck to diaphragm and entering into the loculations of pus is mandatory. Nakamori et al. [15] seem to suggest that the principal objective of surgery is drainage and not debridement. They successfully treated 6 patients with per cutaneous mediastinal drainage. We agree with this principle as it forms the basis for the success of minimal access surgery. However; drainage must be accompanied by opening all loculations of pus for proper drainage, and this might not amount to debridement.

In case No. 1, the J shaped manubriotomy offered direct access to the anterior and superior mediastinum, especially the pre-aortic and SVC spaces thus reducing surgical trauma. Both sterno-manubrial joints were preserved. However; Saute et al. [16] stated that “sawing healthy bone in the presence of infection is not a correct surgical practice”. With improved VATS experience and if the patient condition allows lung isolation, a right VATS approach will give a similar exposure, if not better.

In case No. 2 there was a huge discrepancy between the CT findings in the mediastinum and the clinical behavior. The CT showed gross involvement of the superior mediastinum without gross extension into the posterior mediastinum below level of carina. The clinical response to antibiotics and the early spontaneous discharge of the abscess into the mouth, necessitated a wait and watch approach. Similar approach has been advocated recently by Iyer et al. and Jayasekera et al. [17,18]. The clinical improvement avoided any need for surgical intervention, and this was a pleasant reminder that clinicians treat patients and not their X-rays. Within two weeks in hospital the symptoms abated and dysphagia resolved completely without restricting oral intake. The radiological improvement lagged roughly two weeks behind the clinical improvement. The other point about the CT is its inability to differentiate between brawny oedema and frank pus, especially when contrast is not given. The former signifies thick indurated non-fluid necrosis that does not require drainage, and if incised does not drain fluid pus, leading to persistence of CT findings. Resolution of mediastinal brawny oedema takes weeks long after the patient has turned the corner. Positron Emission Tomography (PET) has been used in similar situations in the past to reveal the site of “pus somewhere” [19].

In case No. 3 adequate drainage was achieved via a cervical approach alone. The blind insertion of a large bore chest drain from the neck parallel to the oesophagus all the way down to diaphragm achieved adequate drainage. This emphasises the previously mentioned principle of drainage versus debridement pointed out by Nakamori et al. [15].

Case No. 4 represents the classical approach of bilateral full thoracotomies, which surgeons might have to resort to, or will bail out those with limited experience in VATS mediastinal surgery. VATS can be difficult in many cases, but using CO₂ insufflation can help at times and low tidal volume, although VATS was decided in the first instance in this case but due to sepsis, hypoxia and retention

of CO₂ necessitated high inflation pressures making lung isolation impossible therefore patient underwent thoracotomy. Drainage by VATS on the left side can prove to be difficult with the greater vessels in your way. However, VATS procedure on the right is a very common procedure, especially when done in a VATS lobectomy for cancer. Mediastinal lymph node dissections are done routinely and a drainage procedure on the right would be a very simple procedure indeed. Most of the times, if discovered early, a drain may be placed in the neck and prevent further extension to the mediastinum although a drain was placed early in the neck but due to extension in the mediastinum warrant a surgical exploration in this case. We believe that open procedure is not the answer and may only prove to be a dangerous procedure considering it may only aggravate the situation but if VATS cannot be performed either due to limited experience or clinical condition than open procedure should be considered. The mortality rates for mediastinitis are high (60%) [20] And thus all options must be considered.

Case No. 5 reflects our experience with VATS at Southampton General Hospital. We amassed a good experience with mediastinal anatomy during VATS Systematic Nodal Dissection for lung cancer. This proved very useful and the experience rolled over in extensive mediastinal drainage, avoiding caveats and areas of danger. The authors believe that a right sided VATS procedure is more than capable of opening the mediastinum from neck to diaphragm, making an additional left VATS unnecessary. Similar experience was previously reported by Min et al. and Hsin et al. [21,22]. However; patients could present in extremis, requiring high percentage of Oxygen entraining and high inflation pressures as in case No. 4 making VATS not an option in such cases. Access to the left pleural space for drainage of left effusion could be achieved from the right side by retrosternal dissection and opening the contralateral pleura in the anterior mediastinum, again from neck to diaphragm. Dajer-Fadel et al. [12] described a way of opening the left pleura from a right thoracotomy approach between the Azygos vein and oesophagus just above the diaphragm. Such an approach could be tried by VATS if the necrosis allows a degree of anatomical identification of structures. Mobilisation of the oesophagus in extreme necrotic conditions carries the risk of perforation and injury to the thoracic duct. The weak point in a right sided VATS approach is that it does not provide good access to the pre-aortic space, at the level of the aortic arch in the left chest. A left Chamberlain, a left VATS or a cervical midline approach might complement a right VATS approach in such cases. Deep knowledge of anatomical structures is required as major vessels are difficult to identify within the debris of a purulent milieu. If the pockets of pus are not all opened and drained, relapse of sepsis is almost guaranteed. The use of large calibre drains such as 32F and 36F connected to high suction of -3 to -5 Kilo Pascal ensures good drainage of necrotic material as well as fluid pus. In our experience the use of mixed Aqueous Iodine and H₂O₂ for wash out of the chest cavity is safe and has the advantage of combating anaerobic organisms.

Recent improvement in ITU capabilities plays an important part in the recovery of these patients, involving several teams of anaesthetist, intensivists, radiologists, cardiologist, gastroenterologists, ENT, maxillofacial and Thoracic surgeons, clinical microbiologists, pharmacists, physiotherapists, nutritionists amongst other specialist teams. The integrated care of all these teams and marginal gains underpin a successful outcome. It is of note that none of the patients included in this series were immune compromised, and were previously fit and healthy. Three patients in this series were gravely

ill, on mechanical ventilatory support for weeks, however; Acute Respiratory Distress Syndrome (ARDS) or acute lung injury was never a problem. Because of early intervention; late decortication of the lung was never required. Exacerbation of febrile illness, rising inflammatory markers and inotropic requirement were common despite a good surgical drainage procedure. Unexpected turn to the worse was an indication for emergency review by contrast CT scan, from base of skull to abdomen. Usually a fresh collection of pus is revealed, and multiple surgeries are required.

The striking symptom of dysphagia was common to all, albeit in varying degrees, but was difficult to interpret. The pathophysiology for dysphagia in DNM is ill understood, however numerous factor interplay, e.g. pharyngeal sepsis (tonsillitis, Quincy, pharyngitis), pharyngeal perforation, peri-oesophageal sepsis, external compression by pus or enlarged nodes, drug induced and bacterial toxins induced neurotoxicity to vagal nerve branches and the local Auerbach and Meissners plexuses. Scientific investigation of this phenomenon is not always possible as these patients could be debilitated and mechanically ventilated in the ITU. Dysphagia is recognised when patient resumes self-ventilation in the ITU. It has to be presumed in all patients and SALT should be involved early, as it could lead to regurgitation, aspiration and lung parenchymal infections including abscess formation, further complicating the situation and adding significantly to morbidity and mortality.

In conclusion, DNM is a rare but life-threatening complication likely to be encountered once every 1-2 years by a UK thoracic surgeon. It has a wide spectrum of presentations which requires targeted individual management ranging from conservative management to several surgical cervical and thoracic drainage procedures, guided by contrast CT scans. These cases require multitude of specialised teams and should be managed in a tertiary referral hospital. Minimal access surgery (VATS) can play an important role and can achieve the same objective as thoracotomy. Dysphagia is an ill understood complication of this life-threatening sepsis and takes a long time to recover.

References

- Novellas S, Kechabtia K, Chevallier P, Sedat J, Bruneton JN. Descending necrotizing mediastinitis: a rare pathology to keep in mind. *Clin Imaging*. 2005;29(2):138-40.
- Bhattacharya S, Livsey SA, Wiselka M, Bukhari SS. Fusobacteriosis presenting as community acquired pneumonia. *J Infect*. 2005;50(3):236-9.
- Perez A, Cueto G, de la Escosura G, Cicero R. Descending Necrotizing Mediastinitis. Results of Medical-Surgical Treatment in 17 Cases. *Gac Med Mex*. 2003;139(3):199-204.
- Makeieff M, Gresillon N, Berthet JP, Garrel R, Crampette L, Marty-Ane C, et al. Management of descending necrotizing mediastinitis. *Laryngoscope*. 2004;114(4):772-5.
- Grodinsky M, Holyoke EA. The fasciae and fascial spaces of the head, neck and adjacent regions. *Am J Anat* 1938;63:367.
- Hasegawa T, Endo S, Sohara Y. Classification of descending necrotizing mediastinitis. *Ann Thorac Surg*. 2000;69(4):1296.
- Corsten MJ, Shamji FM, Odell PF, Frederico JA, Laframboise GG, Reid KR, et al. Optimal treatment of descending necrotizing mediastinitis. *Thorax*. 1997;52(8):702-8.
- Ridder GJ, Maier W, Kinzer S, Teszler CB, Boedeker CC, Pfeiffer J. Descending necrotizing mediastinitis: contemporary trends in etiology, diagnosis, management, and outcome. *Ann Surg*. 2010;251(3):528-34.
- Marty-Ané CH, Berthet JP, Alric P, Pegis JD, Rouvière P, Mary H. Management of descending necrotizing mediastinitis: an aggressive treatment for an aggressive disease. *Ann Thorac Surg*. 1999;68(1):212-7.
- Papalia E, Rena O, Oliaro A, Cavallo A, Giobbe R, Casadio C, et al. Descending necrotizing mediastinitis: surgical management. *Eur J Cardiothorac Surg*. 2001;20(4):739-42.
- Freeman RK, Vallières E, Verrier ED, Karmy-Jones R, Wood DE. Descending necrotizing mediastinitis: An analysis of the effects of serial surgical debridement on patient mortality. *J Thorac Cardiovasc Surg*. 2000;119(2):260-7.
- Dajer-Fadel WL, Ibarra-Pérez C, Argüero-Sánchez R. Mediastinal drainage in descending necrotizing mediastinitis. *Asian Cardiovasc Thorac Ann*. 2013;21(4):493-5.
- Erkmen CP, Wang H, Czum J, Paydarfar JA. Use of cervicothoracic anatomy as a guide for directed drainage of descending necrotizing mediastinitis. *Ann Thorac Surg*. 2012;93(4):1293-4.
- Lyle NJ, Rutherford EE, Batty VB. A pain in the neck--imaging in neck sepsis. *Clin Radiol*. 2011;66(9):876-85.
- Nakamori Y, Fujimi S, Ogura H, Kuwagata Y, Tanaka H, Shimazu T, et al. "Conventional open surgery versus percutaneous catheter drainage in the treatment of cervical necrotizing fasciitis and descending necrotizing mediastinitis," *AJR Am Roentgenol*. 2004;182:1443-49.
- Saute M. Descending necrotizing mediastinitis: an old issue with a new approach. *Eur J Cardiothorac Surg*. 2012; 42:e73.
- Iyer S, Collum J, Babores M. Descending necrotizing mediastinitis: a conservative approach. *Ear Nose Throat J*. 2014;93(3):E11-4.
- Jayasekera BA, Dale OT, Corbridge RC. Descending necrotizing mediastinitis: a case report illustrating a trend in conservative management. *Case Rep Otolaryngol*. 2012;2012:504219.
- Mandry D, Tatopoulos A, Chevalier-Mathias E, Lemarié J, Bollaert PE, Roch V, et al. ¹⁸F-fluorodeoxyglucose positron emission tomography combined with whole-body computed tomographic angiography in critically ill patients with suspected severe sepsis with no definite diagnosis. *Eur J Nucl Med Mol Imaging*. 2014;41(10):1924-30.
- Erkmen CP, Wang H, Czum J, Paydarfar JA. Use of cervicothoracic anatomy as a guide for directed drainage of descending necrotizing mediastinitis. *Ann Thorac Surg*. 2012;93(4):1293-4.
- Min HK, Choi YS, Shim YM, Sohn YI, Kim J. Descending necrotizing mediastinitis: a minimally invasive approach using video-assisted thoracoscopic surgery. *Ann Thorac Surg*. 2004;77(1):306-10.
- Hsin MK, Yim AP. Video assisted thoracoscopic surgery is a valuable approach for the management of descending necrotizing mediastinitis. *Ann Surg*. 2011;253:1055.