Descending Necrotizing Mediastinitis. A Nine-Year Experience of Multidisciplinary Approach

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Abstract: ***Background*:** Descending necrotizing mediastinitis is the most lethal form of mediastinitis. It occurs as a complication of oropharyngeal or cervicofascial infections that spread along deep cervical fascial planes into the mediastinum causing widespread cellulitis, necrosis, abscess formation and sepsis. **OBJECTIVE:** The purpose of our study was to determine the clinical usefulness of percutaneous catheter drainage compared with surgical drainage for descending necrotizing mediastinitis. **Patients and Methods**: Thirty-nine patients with clinically and radiographically diagnosed DNM were included. Retrospective chart review was performed. The mean age was 28.5+ 2.6 years. DNM occurred as a complication of peritonsillar abscess in eleven patients, retropharyngeal abscess in fifteen patients and dental abscess in thirteen patients. Immediately after the diagnosis of DNM, broad-spectrum antibiotics were administered empirically for all patients. Trans-cervical drainage was performed in all cases. Residual mediastinal collection was found in twenty eight patients. Fifteen of them were successfully drained percutaneously (C group), while right thoracotomy was necessary for the remaining thirteen patients (S group). **Results**: No statistically significant difference was found between the two groups in sex (male to female ratio), age, time from the appearance of symptoms to diagnosis, duration of mediastinal drainage, duration of antibiotic therapy, mortality or complications. ICU stay was significantly longer for S-group patients than C-group patients. Also S-group patients were in need for analgesics and blood transfusion more than C-group patients ***Conclusions*:** Cervical approach may be enough for mediastinal drainage. PCD is the option of choice for cases with residual post-operative mediastinal abscesses and thoracotomy should be kept for cases that cannot be treated by PCD.
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Keywords: Descending necrotizing mediastinitis, mediastinal abscesses. drainage mediastinal abscess, and Trans-cervical drainage.

Abbreviations: DNM: Descending Necrotizing Mediastinitis, CNF: Cervical Necrotizing Fasciitis, PCD: Percutaneous Catheter Drainage, CT: Computed Tomography, VATS: Video-Assisted Thoracoscopic Surgery, ICU: Intensive Care Unit.

1. Introduction:

Descending necrotizing mediastinitis (DNM) is the most lethal form of mediastinitis. It occurs as a complication of oropharyngeal or cervicofascial infections that spread along deep cervical fascial planes into the mediastinum causing widespread cellulitis, necrosis, abscess formation and sepsis. The mortality rate associated with this condition has been reported to be in the range of 25–40%. Any delay in the diagnosis and management are believed to be the main causes for the high mortality rate [(1)].

Although the disease is rare, many reports had discussed this issue, however, no-one of them present a large group of patients. Although the main goal of treatment of this rare condition aims at controlling infection by the proper antibiotics, and early surgical debridement of the necrotic tissue, the optimal mode of surgical drainage for DNM remains controversial [(2-5)].

Many investigators have recommended the advantages of invasive procedures including transcervical mediastinal drainage, mediastinoscopy-assisted drainage, VATS drainage, thoracotomy and subxiphoid drainage. [(6-8)]

Transcervical mediastinal drainage alone was successful in patients with localized DNM to upper mediastinum, while a more aggressive approach, i.e., transthoracic drainage, was added in patients with extensive DNM. However, these invasive methods may lead to unexpected results, such as massive tissue injury, osteomyelitis, dehiscence of the sternum, and other complications [(9-11)].

Only one relatively old study discussed the value of percutaneous drainage of DNM. The study included 31 patients with CNF and DNM, twenty of them treated by PCD. They concluded that PCD for CNF and DNM was less invasive than conventional surgical drainage but produced a similar outcome [(12)].

However, most of the recent studies didn't discussed the role of PCD anymore [1,8,11,13]. In this study we report our experience focusing on the application of multidisciplinary approach including PCD in the management of patients with DNM.

2. Patients and Methods:

We reviewed the charts of all patients who were admitted to our hospital (Assir Central Hospital, Abha, Kingdom of Saudi Arabia) with DNM between March 2003 and August 2011 for all relative clinical data, including clinical course and all investigations as well as all procedures done to these patients during their hospital stay. The clinical status upon discharge, and morbidity and mortality reports of all these patients were also reviewed.

Patients with focal deep cervical abscess without mediastinal extension and Patients with cervical infection due to malignant cervical disease, neck surgery, trauma, or rupture esophagus were excluded from our study because the diagnosis, treatment, and outcomes in these subsets of patients are fundamentally different. Patients who were discovered at postmortem examination to have mediastinitis and were not admitted or treated because of DNM were also excluded from our study.

The diagnosis of cervical infection was clinically obvious in all patients (diffuse cervical swelling with local inflammatory signs and signs of septicemia).Chest radiography showed a widening of the mediastinal shadow in all patients. Contrast enhanced CT scan of the neck and chest was performed on admission for all these patients that confirmed the diagnosis of necrotizing fasciitis in the neck with mediastinal collection.

The radiographic criteria of DNM were the presence of diffuse thickening of cervical fascial planes and fat with tracking along fascial planes down to the mediastinum, un-encapsulated fluid collections in the mediastinum or mediastinal abscess. The presence of gas bubbles within the infection (17 cases), pleural effusions (thirteen cases, bilateral in seven) and pericardial effusion (twelve cases) were not considered essentially for the diagnosis.

The extent of DNM in our patients graded according to the extent of infection as determined by Endo and his colleagues[15]: type I—localization of abscess in the upper mediastinum above the tracheal bifurcation; type IIA—extension to anterior lower mediastinum; type IIB—extension from neck to anterior and posterior lower mediastinum.

Empirical broad-spectrum intravenous antibiotics were initiated for all patients once the diagnosis was suspected. These antibiotics regimens were modified according to the results of culture and sensitivity tests of materials obtained from the neck and mediastinum.

Transcervical mediastinal drainage and debridement procedures of the neck were done for all patients. Cervico-thoracic CT imaging was repeated 72 hours after operation or with any deterioration of the patient's clinical condition. These scans identified well drained mediastinum in eleven patients and residual significant mediastinal fluid collection that could not be drained through the cervical incisions and need transthoracic drainage in twenty eight patients. PCD succeeded to drain the mediastinal collection in fifteen of them (C group), while right thoracotomy was necessary for the remaining thirteen patients (S group).

Thoracotomy was selected when there was airway obstruction, severe form of DNM without localized abscess formation, or when this abscess cannot be drained percutaneously. PCD was selected when there was localized mediastinal abscess in patients without airway compromise. If PCD failed to improve the clinical condition within three days or there was any clinical deterioration, immediate surgical intervention was carried out (one patient). PCD was also done for cases with post-operative localized mediastinal fluid collection (three patients).

The surgical management aimed at radical debridement of any necrotic tissue, drainage of any abscess loculation and relieve of airway obstruction. The neck was approached through an incision anterior to the sternocleidomastoid muscle in the involved side(s) or through collar neck incision. The involved cervical spaces were opened, drained, and debrided of necrotic tissue.

In transcervical mediastinal drainage, the superior mediastinum, the pretracheal, periesophageal and perivascular spaces were dissected manually through neck incisions. Then, one or more soft tubes or Penrose drains were positioned in the open wounds in the upper mediastinum.

Transthoracic mediastinal drainage was performed via a right thoracotomy approach. The right upper mediastinal pleura were opened longitudinally, and blunt dissection of the trachea, carina, periesophageal spaces, and perivascular spaces was performed. This procedure included radical debridement, decortication, and pleural drainage via chest tubes. Tracheostomy was performed in three cases presented with laryngeal edema.

Follow-up CT scanning was performed if clinical improvement was not obvious. Any residual abscess or necrotic tissue was detected and not accessible by PCD, reoperation was performed immediately (3 cases).

The drainage tubes were removed when there was clinical improvement, return to normal CT scanning, and negative results of the cultures of fluids aspirated from the drainage tubes.

Catheter Drainage:

Percutaneous drainage was guided by CT scan in all cases. A self-retaining catheter {8.3-F pigtail catheter Jeifries set (Cook)} was inserted under local anesthesia into the infected space, targeting the largest and lowermost locule with fluid collection or foci showing scattered gas. Follow up CT scan was used to examine the efficacy of catheter drainage. We didn't injected contrast medium or even do irrigation through catheter to avoid spread of infection to other spaces. However, the catheter patency was checked by injection of 5 mL saline if it stopped to drain. If no fluid comes after saline injection, CT scan was performed in next day to ensure that there is no more fluid collection. If the scan revealed any residual fluid collection or other infected space, the drainage was considered insufficient and another catheter was added. Catheters were removed when we confirmed radiographic improvement, and cessation or decrease and sterility of the drainage fluid.

Statistical analysis:

All data were collected, organized, tabulated and statistically analyzed using SPSS software statistical computer package version 13. For quantitative data, the range, mean and standard deviation were calculated. For qualitative data, comparison between two groups and more was done using Chi-square test. Correlation between variables was evaluated. Significance was adopted at *P* value <0.05 for interpretation of results of tests of significance.

3. Results

Thirty nine patients of DNM were included in this study. Their ages ranged between 16 and 53 years with the mean age is 28.5+ 2.6 years. Twenty seven patients (69.2%) were males and the rest were females (30.8%). All of them admitted in intensive care unit.

The mean time from onset of symptoms until the diagnosis confirmed by CT scans (delay in diagnosis) was 7.1 + 2.1 days (range 4 to 10 days).

The bacteriologic investigation revealed polymicrobial infection in all cases. The focus of the inciting infection was peritonsillar abscess in eleven patients (28.2 %), retropharyngeal abscess in fifteen patients (38.5%) and dental abscess in thirteen patients (33.3 %) (Table I).

The overall duration of mediastinal drainage varied from 11 to 29 days (mean 19 + 5.1 days). The mean length of hospital stay for patients in our series was 19 + 22.3 days (Table II).

No statistically significant difference was found between S-group patients and C-group patients in sex (male to female ratio), age, time from the appearance of symptoms to diagnosis, duration of mediastinal drainage, duration of antibiotic therapy, complications or mortality Table II).

ICU stay was significantly longer for S-group patients than C-group patients. Also S-group patients were in need for analgesics and blood transfusion more than C-group patients (Table III).

One patient died and thirty eight were discharged from the hospital without major sequelae. These patients were followed up in outpatient department for six months. No recurrences or infections occurred in any patient.

Table I: Preoperative data of all 39 patients.

Variable		Number	Percentage
Age (years)	Mean	28.5+2.6	
	Range	16-53	
Sex	Male	27	69.2 %
	Female	12	30.8 %
Initial site of Infection	Peritonsillar abscess	11	28.2 %
	Retropharyngeal abscess	15	38.5%
	Dental abscess	13	33.3 %
CT imaging		39	100 %

Table II: Operative and postoperative data of our 39 patients.

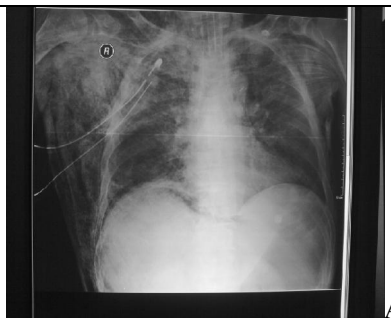
Variable		Number	Percentage
Approach for mediastinal drainage	Transcervical mediastinal drainage	15	38.5 %
	Right thoracotomy	13	33.3 %
	Reoperation	3	7.7 %
	Percutaneous CT guided drainage	28	71.7 %
Mean hospital stay (days)		51 + 22.3	
Outcome	Survivors	38	97.4 %
	Mortality	1	2.6 %

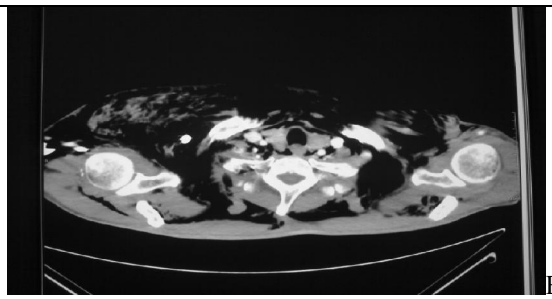

A


B


C

Case 1: 45 years old man presented with CNF and DNM. CT show right paratracheal mediastinal abscess shown in axial (A) and coronal (B) views. Percutaneous abscess drainage through posterior approach (C).


A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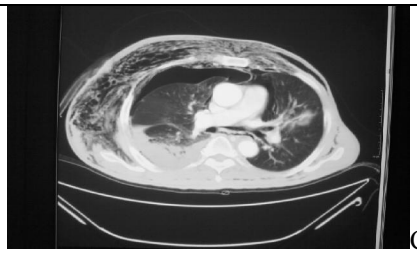
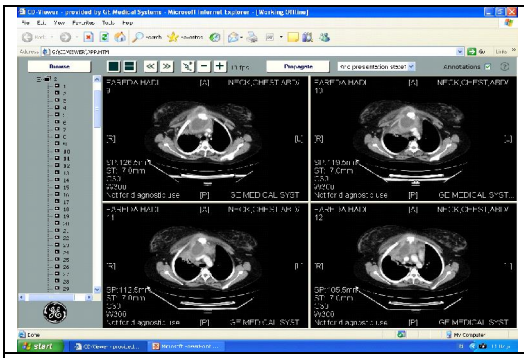
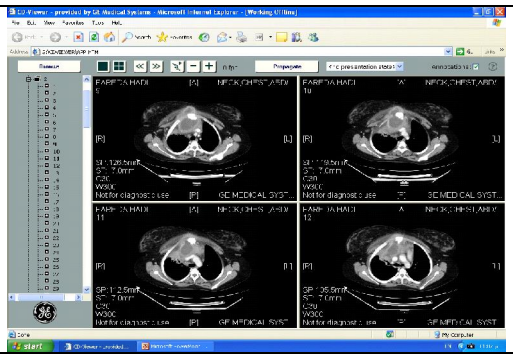

C

Case 2: 53 years old man who was presented with acute severe respiratory distress. Plain X-ray (A) show extensive surgical emphysema and pneumomediastinitis. CT scan (B and C) show extensive necrotizing fasciitis involving all fascial planes in mediastinum and subcutaneous region with associated right side pneumothorax.





Case 3: 26 years old female, presented with mediastinitis and mediastinal abscess dissected anteriorly through the chest wall to subcutaneous region.

Table III: The demographic data and results of therapy in both groups with transthoracic mediastinal drainage (28 patients).

Variables		Group S (N = 13)	Group C (N = 15)	*P* value
Mean age (years)		26.3 ± 9.8	25 ± 8.4	0,965
Sex	Male	14 (53.8%)	12 (48.2%)	0.631
	Female	5 (41.7%)	7 (58.3%)	0.546
Delay in diagnosis (days)		7.4 + 2.6	6.7 ± 2.8	0.547
Complications		4 (30.8%)	3 (20 %)	0.846
Duration of antibiotic therapy(days)		27.8 ± 7.1	32.3 ± 5.3	0.479
Total transfusion (ml)		1435 ± 840	617 ± 935	0.023*
ICU stay (days)		46.9 ± 38.3	21.6 ± 11.6	0.047*
Frequency of analgesics		17.6 ± 11.5	3.1 ± 4.2	0.024*
The duration of mediastinal drainage (days)		13.9 ± 3.3	17.6 ± 5.6	0.346
Mortality rate (%)		1 (7.7 %)	0 (0 %)	0753

*Significant (*P* value <0.05)

4. Discussion:

Necrotizing fasciitis is perhaps the most severe form of soft tissue infections. It is progressively destructive disease that bewildered physicians for centuries. The invasiveness is often influenced by synergistic interactions among multiple species [16-17]. DNM is an uncommon form of necrotizing fasciitis, which is usually caused by primary oropharyngeal infection and can rapidly progress to sepsis. The disease is considered rare in western countries owing to the good economic conditions and availability of medical resources for prevention and treatment of dental and oropharyngeal diseases. Reports indicate that this lethal complication will develop in about 2.6% of patients with deep neck infection [18-19]. We treated 39 patients in a period of about nine years, which indicated that the disease is not rare, even with strict application of infection control protocols.

Many reports had discussed the role of surgery as a solitary treatment option for DNM [1,2,5,7,9-11,]. These reports made comparison between different surgical approaches and incisions and their roles in improving patient survival. Only two reports discussed the role of PCD as a competitor to surgical interference for those patients [12,20]. However, there was no clear selection criteria for those patients to be treated with PCD. They compared the results of PCD with the results of old cases treated surgically before the study period. This is unfair, since the improvement of diagnostic tools, drainage tubes as well as the newly introduced antibiotics and vast improvements in anesthesia and critical care have played a significant role in the improved management of those patients. These reports didn't discussed how many cases of PCD failure and how they managed those patients. Although they can insert the drainage tube from the cervical region and direct it to any of the spaces in the cervical and mediastinal compartments using a guide-wire, we find this is incompatible with our results. Many of the spaces cannot be reached easily through percutaneous route for tubal insertion especially in patients with emphysema and impossible for cervical approach. In 5 cases of our patients we could not find a safe way to reach an isolated area of fluid collection at the subcarinal region. Two of them were approached after creating intentional pneumothorax. The other three patients were treated surgically.

Most of our patients were males (69.2%)), and this was consistent with other series who reported that this disease is more common in males [1-5]. Their ages ranged between 16 and 53 years with the mean age is 28.5+ 2.6 years. This was near to other series, while it was 53.8 + 23.3 years by others [7,25].

In the study done by Yuka **Sumi *and colleagues*** [20], they evaluated the clinical course of 14 patients with CNF and DNM treated with percutaneous catheter drainage and compared the clinical outcomes with those CNF without DNM. All patients except one (7.1%) survived without serious complication. There was no difference in mortality rate between both groups, however, it was lower than that previously reported for patients treated surgically before the study period by the same authors. In our study the mortality rate for those patients treated with PCD only was 0% which is superior to their results. We think this is because of our selection criteria for those cases treated with PCD.

The authors of the previous study compared their results with patients with CNF without DNM in the same study period and with those patients with DNM treated surgically before the study period. Unlike them, we compared our results of cases of PCD with those patients who treated surgically in the same study period.

Until the 2003s, the treatment strategy for DNM was immediate surgical interference through trans-

cervical or open thoracotomy approach [15,17,21]. Since that, PCD was introduced into routine medical practice for the treatment of DNM followed by dramatic reduction of the mortality rate [12]. It ranged from 55% in 1938[22-23] to 25.5-40%% in 2000[24]. We got only one mortality case (2.6%) in our series of patient. In this patient, postoperative secondary hemorrhage occurred that was explored through median sternotomy. The walls of the great vessels were found necrosed and did not take any sutures. So the bleeding increased and could not be controlled and the patient died on table. No other mortality has been recorded in our series.

The critical aspects of a treatment strategy for DNM were thought to be sufficient debridement, adequate drainage, and effective irrigation. Several reports found a statistically significant difference in survival between patients undergoing trans-cervical mediastinal drainage (53%)[6] versus those receiving trans-thoracic mediastinal drainage (81%)[7]. However, the necessity of thoracotomy especially when localized in the upper mediastinum remains controversial in other studies. Endo and his colleagues [15], classified DNM into three types according to the extension of DNM as diagnosed by CT, and proposed management strategies according to this classification. They insisted on a trans-cervical approach for type I (localized in the upper mediastinum above the tracheal bifurcation) irrigation through subxiphoidal and cervical incisions with additional percutaneous thoracic drainage for type IIA (extending to the anterior lower mediastinum), and complete irrigation and debridement of the entire mediastinum through a standard thoracotomy for type IIB (extending to the anterior and posterior lower mediastinum). Some other studies have reported more aggressive surgical interference by performing thoracotomy even for cases of Endo's types I and IIA because they think that cervical drainage is insufficient to stop the spread of DNM. However, we observed several serious problems with this procedure: the invasiveness of the surgery, the necessity of performing daily irrigation and, secondary infection. We think that transcervical mediastinal drainage may be sufficient in many cases (Type I Endo classification). It was sufficient in 28.2% of our patients. We tried PCD to control residual mediastinal fluid collection after transcervical mediastinal drainage in the first case at 2003. The great success in the first case pushed us to try it in the next patient and so on until it become the first choice as a treatment option for those patients. Our trend was supported by other study done by Yasushi Nakamori and Coworkers[12], who recommend PCD as a novel treatment option for cases of CNF with DNM. We believe that the main target of surgical interference is to open the infected space and draining the contained pus and this will decompress the infected area and will decrease the spread to other spaces. The small amount of pus drained from each abscess by PCD were comparable to those drained by surgical interference. This support our suggestion that decompression is the most important factor to prevent spread of infection to other spaces not the way of decompression. The small skin incision by PCD is more tolerable by the patient than the large surgical incision and allow early patient mobilization and consequently decrease the possibility of developing pulmonary embolism. Also it is less harmful than the large skin incision which will expose tissue to more infection and to lose large volume of protein through the exposed surfaces. In our study the ICU stay was significantly longer for S-group patients than C-group patients. Also S-group patients were in need for analgesics and blood transfusion more than C-group patients. This was similar to the results in other series [12].

Because of the complex anatomy of the mediastinum. Like others, we used CT to identify the origin and extent of the infection and to determine the point of percutaneous puncture and the layer in which the catheter could be guided to the area of severe infection and necrosis. Sonography was found insufficient in most of the cases and kept only for directing pleural and pericardial drainage. Follow up of the cases was performed by CT scan when the tube stops drainage even after irrigation with 5cc of sterile saline. Repeated chest X-rays were performed every day for adequacy of drainage by monitoring the size of the drained abscess and the tubal location. Changing or reposition of the drainage tube was performed under fluoroscopic control without technical difficulty.

Conclusions:

After analysis and discussion of our results and results of other authors, we can conclude that;

- Transcervical operative drainage and debridement may be sufficient in management of Type I and IIa Endo classification.
- If there is residual mediastinal collection, immediate transthoracic mediastinal drainage is essential without delay.
- PCD should be considered as a treatment option of choice for transthoracic mediastinal drainage.
- We recommend PCD as a treatment option of choice for Type IIb Endo classification. Moreover, it should be an adjuvant line of management together with surgery in cases of post-operative mediastinal collections.
- However, surgical drainage is kept only as the second line of management in cases cannot be treated by PCD.

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