Case Report

Surgical Treatment of Virulent Descending Necrotizing Mediastinitis

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We report a 58-year-old male treated with surgical drainage by mediansternotomy using a pedicled omental flap for descending necrotizing mediastinitis (DNM). The patient recovered from DNM after five months of mechanical respiratory support. In deciding upon the most appropriate surgical approach for mediastinal drainage, the level of infection is a good landmark and should be investigated by CT scan. We also review the 43 cases of successful surgical treatment of DNM reported since 1989 in Japan, including our own patient, who were diagnosed with DNM by CT scan according to the classification proposed by Endo et al., and discuss the most appropriate surgical approach for mediastinitis based on the literature. In the treatment of DNM localized to the upper mediastinal space above the carina, a transcervical approach may be appropriate. In diffuse DNM extending into the lower anterior mediastinum, a mediansternotomy or a thoracotomy may be useful, and in diffuse DNM extending into both the anterior and posterior lower mediastinum, a thoracotomy may be the best approach for debridement of the lower posterior mediastinum, in addition to early complete debridement of the entire cervical area. (Ann Thorac Cardiovasc Surg 2004; 10: 34–8)

Key words: descending necrotizing mediastinitis, surgical treatment, mediansternotomy.

Introduction

Despite early diagnosis, effective antibiotics, and aggressive surgical treatment, the mortality of descending necrotizing mediastinitis (DNM) patients remains as high as 40% to 50% due to the persistence of infection with empyema, pericarditis, and blood vessel erosion.[1)] Recently, successful surgical treatment of DNM has been increasingly reported,[2-38)] however, the strategy for treatment of DNM remains vague and controversial. We report a patient with surgical drainage by mediansternotomy for virulent DNM using a pedicled omental flap, and discuss the surgical management of DNM based on the literature.

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Case Report

A 58-year-old male who complained of a sore throat and a fever of 39°C for three days was admitted to a peripheral hospital on March 20, 2001. He was released with a diagnosis of peritonsillar abscess. A left submandibular swelling and crepitation down the left anterior neck to the level of the thyroid cartilage were noted. Despite left cervical drainage and intravenous antibiotic therapy, his condition worsened and the skin of his neck and upper thorax became erythematous. He developed severe respiratory distress on March 24, 2001. A chest radiograph revealed a widened mediastinum and pleural fluid on the right side (Fig. 1). Computed tomography (CT) revealed peritonsillar and parapharyngeal abscess descending into the upper mediastinum and the anterior mediastinum below the carina and bilateral thoracic empyema (Fig. 2). The patient was immediately transferred to the intensive care unit (ICU) of our hospital. On admission, laboratory results revealed a white blood cell count of 9,600/mm^3 with 92.2% bands and toxic granules, a C-reactive pro-

Fig. 1. A chest radiograph revealed a widened mediastinum and right pleural fluid.

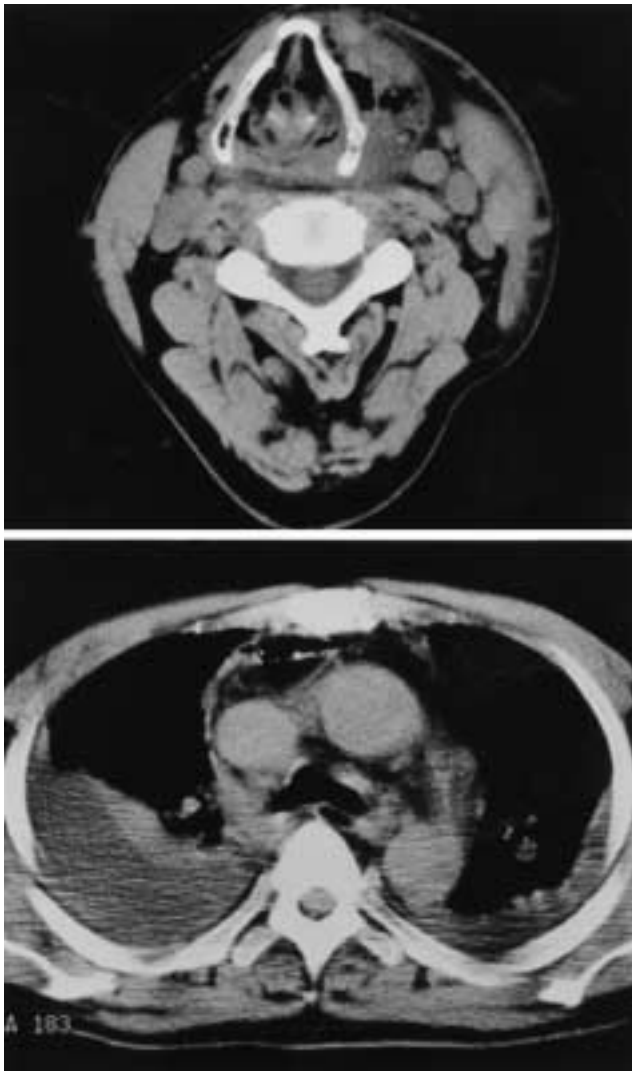

Fig. 2. The computed tomography revealed peritonsillar and parapharyngeal abscess (upper) descending into the upper mediastinum and the anterior mediastinum below the carina and bilateral thoracic empyema (bottom).

tein (CRP) of 41.1 mg/dl, and a serum creatinine level of 1.74 mg/dl. Arterial blood gas analysis revealed PaO_2 of 68.5 mmHg and $PaCO_2$ of 47.7 mmHg under 10 L/min oxygen inhalation and an arterial pH of 7.33 with a base excess of –2.7 mmol/L. As his condition rapidly deteriorated, requiring inotropic support consisting of dopamine of 3 γ/kg/min, emergency surgery was performed. Mediansternotomy under general anesthesia was conducted and the cervical region was extensively debrided. A penrose drainage tube was inserted, followed by radical debridement of the mediastinum and bilateral pleural cavities, which were filled with pus. A median laparotomy was conducted to produce a pedicled omental flap to cover the superior and anterior mediastinum. After adequate pleurolysis, double lumen drainage tubes for treatment of thoracic empyema were inserted into the bilateral pleural cavities to permit pleural irrigation with saline containing isodine and antibiotics. Cultures of the cervicomediastinal abscess revealed a Streptococcus anginosus/milleri infection. Despite continuing intravenous antibiotic therapy on the basis of cultures and irrigation, on March 26, 2001, continuous hemodiafiltration was initiated for acute renal failure. On March 29, 2001, extensive cervical redebridement and four drainage tubes through an incision anterior to the sternomastoid muscle and a bilateral collar incision were performed for ongoing cervical infection. On April 3, 2001, emergency pericardial drainage through an emergency anterior thoracotomy was performed for cardiac tamponade with increasing pericardial effusion caused by pericarditis. The patient continued to receive broad spectrum intravenous antibiotics on the basis of the culture results, cardiopulmonary support, transfusion, and hemodialysis for circulatory, respiratory, and renal failure causing shock lung, and disseminated intravascular coagulation. However, we were able to remove all cervical, pleural, and pericardial drainage tubes at four weeks after surgery. A tracheostomy was subsequently performed for mechanical respiratory support. The patient continued to recover slowly and was transferred from the ICU on June 26, 2001. The patient required a lengthy period for recovery of respiratory function, swallowing function, liver function, bedsores, and disuse atrophy. Although the patient has had to continue the hemodialysis for chronic renal failure, he was dis-

Table 1. The successful surgical approach for drainage of mediastinitis in DNM reported since 1989 in Japan

Procedures	Type 1	Type 2A	Type 2B
1) Transcervical mediastinal drainage	12	–	–
2) Mediansternotomy	–	4	–
3) Thoracotomy	3	4	4
4) Subxyphoid drainage	–	1	–
5) Anterior transmediastinal drainage	1	3	–
6) Mediastinoscopic drainage	–	–	1
7) 1) + thoracoscopic drainage	–	1	–
8) 1) + 3)	1	1	–
9) 1) + 4)	–	1	–
10) 1) + puncture drainage by echo-guide	–	–	1
11) 3) + 4)	–	1	–
12) 3) + puncture drainage by echo-guide	–	1	–
13) 4) + 5)	–	1	–
14) Unknown	2	–	–
Total	19	18	6

charged from the hospital in good condition on July 31, 2002. At the last follow-up, eight months after discharge, the patient remained well.

Discussion

Mediastinitis following a deep neck infection, DNM, is rare, and is associated with a poor prognosis.[32] Because of its rapid development and severe complications such as purulent pericarditis or thoracic empyema leading to multiple organ dysfunction, the mortality of DNM remains as high as 40% to 50%.[1] Early diagnosis is important in order to initiate appropriate treatment without delay. Four fascial spaces that involve both the neck and mediastinum (the pretracheal space, the retropharyngeal space, the perivascular space, and the parapharyngeal space) are important to the understanding of DNM, because infections reach the mediastinum through those spaces. In our patient, a peritonsillar abscess developed into a deep neck abscess, which migrated into the mediastinum and invaded both the thoracic and pericardial cavities within 15 days. The diagnostic method used to investigate DNM was a cervicothoracic CT scan. The CT scan determined the optimal thoracic approach for efficient surgical drainages. Inadequate drainage yields poor results. Endo et al.[3] classified four patients with DNM into three groups according to the degree of diffusion of infection as diagnosed by CT scan. Localized DNM (Type 1) was localized to the upper mediastinal space above the carina. Diffuse DNM (Type 2A) extended into the lower anterior mediastinum. Diffuse DNM (Type 2B) extended into both the anterior and posterior lower mediastinum. We reviewed the 43 cases of successful surgical treatment of DNM reported since 1989 in Japan,[3-31] including our own patient, who were classified on the basis of CT scan according to Endo et al.'s classification system. The most appropriate surgical approach is discussed below. The patients included 30 males and 13 females ranging in age from 21 to 71 years old, with an average age of 54 years old. The primary infections in DNM were neck infections in 35 cases, odontogenic infections in seven cases, and pyogenic spondylitis in one case. A total of 10 patients were diabetic. Tracheostomy was performed in eight cases. Mixed aerobic and anaerobic organisms have been reported to be causative in many cases. The most common complications of DNM were thoracic empyema in 24 cases and pericarditis in eight cases. The transcervical approach, thoracotomy, mediansternotomy, anterior transmediastinal approach, subxyphoid approach, thoracoscopic approach, and the mediastinoscopic approach have all been reported as successful approaches for mediastinal drainage. The classifications of the patients who underwent a successful surgical approach for drainage of mediastinitis were Type 1 in 19 cases, Type 2A in 18 cases, and Type 2B in six cases. Surgical approaches were as follows: transcervical approach (63%) and thoracotomy (16%) in Type 1, mediansternotomy (22%), thoracotomy (22%), and anterior transmediastinal approach (17%) in Type 2A, and thoracotomy (67%) in Type 2B (Table 1). Cervicomediastinal drainage seemed to improve upper mediastinal infections in Type 1 patients. We considered the cervicomediastinal approach to be less invasive, al-

though this approach is not sufficient for the management of Type 2A and Type 2B cases if the abscess has extended to a level below the fourth thoracic vertebra or the tracheal bifurcation. Wheateley et al.[32] also reported that transcervical mediastinal drainage provided incomplete or inadequate drainage in 26 (79%) of the 33 patients with DNM. Mediastinal drainage using mediansternotomy or thoracotomy seemed to be useful in the treatment of Type 2A DNM. We propose that mediansternotomy using a pedicled omental flap offers favorable exposure for debridement of the subauricular region, the mediastinum, and both pleural cavities, and provides effective drainage of the entire region, despite the risk of osteomyelitis. We assumed that if adequate cervical drainage was achieved with the first attempt, our patient might recover earlier using this procedure. On the other hand, although it has been reported that a clamshell approach provides effective exposure for a complete one-stage surgical treatment with mediastinal debridement and bilateral decortication including pericardiectomy,[33] this approach may be unfavorable in consideration of cutting off bilateral internal thoracic arteries for future coronary aorta bypass grafting and the risk of phrenic nerve palsy. In Type 2B, thoracotomy with complete debridement of the entire mediastinum seemed to be the best surgical approach. Recently, it had been reported that thoracoscopic exposure of the anterior or the posterior mediastinum allows complete drainage of substantial mediastinal contamination and drainage of infected pericardial fluid at the same time.[27,34] This method may provide an alternative approach in the future management of Type 2A and 2B DNM patients, because it is less invasive.

Conclusion

We believe that in Type 1 DNM, the transcervical approach may be sufficient, in Type 2A mediansternotomy or thoracotomy may be useful, and in Type 2B thoracotomy may be the best approach for debridement of the lower posterior mediastinum in addition to cervical drainage. Regardless of the approach, early debridement of the entire cervical and mediastinal area and complete irrigation with broad-spectrum intravenous antibiotics is essential for the treatment of DNM.

References

1. Estrera AS, Landy MJ, Grisham JM, Sinn DP, Platt MR. Descending necrotizing mediastinitis. *Surg Gynecol Obstet* 1983; **157**: 545–52.
2. Marty-Ane CH, Berthet JP, Alric P, Pegis JD, Rouviere P, Mary H. Management of descending necrotizing mediastinitis: an aggressive treatment for an aggressive disease. *Ann Thorac Surg* 1999; **68**: 212–7.
3. Endo S, Murayama F, Hasegawa T, et al. Guideline of surgical management based on diffusion of descending necrotizing mediastinitis. *Jpn J Thorac Cardiovasc Surg* 1999; **47**: 14–9.
4. Takahashi M, Satomi K, Fukuda H, Terasawa K. Acute purulent mediastinitis secondary to a case with diabetes mellitus acute tonsillitis. *Jpn J Chest Dis* 1989; **48**: 1017–21. (in Japanese)
5. Yamasawa Y, Fujita S, Okamoto T, Kanaoka K, Mayumi T. Two cases of mediastinitis secondary due to deep neck infection. *ICU CCU* 1990; **14**: 1075–9. (in Japanese)
6. Nakajima H, Sega H, Yokota T, et al. Two cases of mediastinitis as a complication of odontogenic infection and tonsillitis. *Nippon Kyobu Shikkan Gakkai Zasshi* 1993; **31**: 754–9. (in Japanese)
7. Takao M, Ido M, Hamaguchi K, Chikusa H, Namikawa S, Kusagawa M. Descending necrotizing mediastinitis secondary to a retropharyngeal abscess. *Eur Respir J* 1994; **7**: 1716–8.
8. Kimura Y, Abo S, Kitamura M, Hashimoto M, Izumi K. A case of deep neck abscess and acute mediastinitis, secondary to peritonsillar abscess. *Nippon Kyobu Geka Gakkai Zasshi* 1995; **43**: 879–83. (in Japanese)
9. Izumoto H, Komoda K, Okada O, Kamata J, Kawazoe K. Successful utilization of the median sternotomy approach in the management of descending necrotizing mediastinitis: report of a case. *Surg Today* 1996; **26**: 286–8.
10. Fukada J, Inaoka M. A successful surgical case of descending necrotizing mediastinitis with fistula formation to the right main bronchus. *Nippon Kyobu Geka Gakkai Zasshi* 1996; **44**: 529–33. (in Japanese)
11. Ohno K, Takada T, Terada M, et al. Recovery from descending necrotizing mediastinitis and multiple organic failure after seven months of mechanical ventilation. *Nippon Kyobu Shikkan Gakkai Zasshi* 1996; **34**: 1021–9. (in Japanese)
12. Shimizu H, Kodama A, Takebayashi S, Sasano A. Mediastinitis secondary to deep-neck infections. *Jibi Inkoka, Tokeibu Geka* 1996; **68**: 986–9. (in Japanese)
13. Mikami K, Izumi H, Masuda S, Yamamoto S, Hosoda Y. Descending necrotizing mediastinitis secondary to retropharyngeal abscess--a case report. *Nippon Kyobu Geka Gakkai Zasshi* 1997; **45**: 1096–101. (in Japanese)
14. Nomori H, Horio H, Kobayashi R. Descending necrotizing mediastinitis secondary to pharyngitis. *Scand Cardiovasc J* 1997; **31**: 233–5.
15. Ohno K, Yamasaki Y, Hatanaka N, Yamamoto S, Naitoh H, Kuwata K. Mediastinoscopic drainage for descending necrotizing mediastinitis. *Jpn J Thorac Cardiovasc Surg* 1998; **46**: 175–8. (in Japanese)
16. Sato K, Ono N, Yokomise H, Tamura K. Descending

necrotizing mediastinitis: a case report. *Nippon Kokyuki Geka Gakkai Zasshi* 1999; **13**: 68–71. (in Japanese)
17. Iyoda A, Yusa T, Fujisawa T, Mabashi T, Hiroshima K. Descending necrotizing mediastinitis: report of a case. *Surg Today* 1999; **29**: 1209–12.
18. Matsuura Y, Watari M, Wada M, Inoue K. Descending necrotizing mediastinitis. *Jpn J Clin Exp Med* 1999; **76**: 758–62. (in Japanese)
19. Sato K, Sato Y, Yosiya K, et al. Two cases of descending necrotizing mediastinitis. *Kyobu Geka* 1999; **52**: 97–101. (in Japanese)
20. Sonobe M, Miyazaki M, Nagakawa M, et al. descending necrotizing mediastinitis with sternocostoclavicular osteomyelitis and partial thoracic empyema: report of a case. *Surg Today* 1999; **29**: 1287–9.
21. Narimatsu M, Baba H, Hazama S, Noguchi M, Yamaguchi H, Nishi K. Successfully treated descending necrotizing mediastinitis through mediansternotomy using a pedicled omental flap. *Jpn J Thorac Cardiovasc Surg* 2000; **48**: 447–50.
22. Ishida I, Sagawa M, Suzuki S, et al. Succesful treatment for descending necrotizing mediastinitis: a case report. *Kyobu Geka* 2000; **53**: 1058–61. (in Japanese)
23. Nonaka M, Kadokura M, Yamamoto S, Takabe T, Uchida J, Kukita N. Surgically treated two cases of descending necrotizing mediastinitis. *ICU CCU* 2000; **24**: 431–6. (in Japanese)
24. Uetsuki T, Mizunuma K, Matsumoto S, Kikuchi M, Tada S, Fukuda K. Percutaneous transcervical mediastinal abcess drainage for descending necrotizing mediastinitis: a case report. *Interven Radiol* 2000; **15**: 249–53. (in Japanese)
25. Kamiyoshihara M, Hamada Y, Ishikawa S, Iizuka T, Nakano M, Morishita Y. Hyperbaric oxygen as an adjunctive treatment for descending necrotizing mediastinitis: report of a case. *Kyobu Geka* 2000; **53**: 715–7. (in Japanese)
26. Kondo R, Nishimura H, Yamada T. A case of anterior mediastinal abscess with skin fistula resulting from descending necrotizing mediastinitis. *Kyobu Geka* 2000; **53**: 698–701. (in Japanese)
27. Takanami I, Takeuchi K. Favorable results of early diagnosis by cervicothoracic computed tomography scans for descending necrotizing mediastinitis. *Jpn J Thorac Cardiovasc Surg* 2001; **49**: 220–3.
28. Aikawa M, Osaki T, So T, Yoshimatsu T, Yano K, Yasumoto K. Descending necrotizing mediastinitis: case of two cases. *Nippon Rinsho Geka Gakkai Zasshi* 2001; **62**: 72–5. (in Japanese)
29. Nishida E, Toribatake Y, Mori Y, et al. Descending necrotizing mediastinitis following a cervical pyogenic spondylitis: a case report. *Rinsho Seikei Geka* 2001; **36**: 339–42. (in Japanese)
30. Moriwaki Y, Matsuda G, Karube N, et al. Usefulness of ultrasonography for detection of progression of deep cervical phlegmon to descending necrotizing mediastinitis. *Nippon Kyukyu Igakkai Zasshi* 2001; **12**: 195–201. (in Japanese)
31. Moriwaki Y, Yoshida K, Matsuda G, et al. Anterior transmediastinal drainage in descending necrotizing mediastinitis. *Nippon Shokaki Geka Gakkai Zasshi* 2002; **35**: 460–4. (in Japanese)
32. Wheatley MJ, Stirling MC, Kirsh MM, Gago O, Orringer MB. Descending necrotizing mediastinitis: transcervical drainage is not enough. *Ann Thorac Surg* 1990; **49**: 780–4.
33. Ris HB, Banic A, Furrer M, Caversaccio M, Cerny A, Zbaren P. Descending necrotizing mediastinitis: surgical treatment via clamshell approach. *Ann Thorac Surg* 1996; **62**: 1650–4.
34. Roberts JR, Smythe R, Randall W, et al. Thoracoscopic management of descending necrotizing mediastinitis. *Chest* 1997; **112**: 850–4.
35. Moncada R, Warpeha R, Pickleman J, et al. Mediastinitis from odontogenic and deep cervical infection. *Chest* 1978; **73**: 497–500.
36. Kruyt PM, Boonstra A, Fockens P, Reeders JWAJ, Lanschot JJB. Descending necrotizing mediastinitis causing pleuroesophageal fistula. *Chest* 1996; **109**: 1404–7.
37. Corsten MJ, Shamji FM, Odell PF, et al. Optimal treatment of descending necrotizing mediastinitis. *Thorax* 1997; **52**: 702–8.
38. Kiernan PD, Hernandez A, Byrne WD, et al. Descending cervical mediastinitis. *Ann Thorac Surg* 1998; **65**: 1483–8.