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CONSERVATIVE MANAGEMENT OF DEEP NECK ABScessES IN ADULTS: THE IMPORTANCE OF CECT FINDINGS

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OBJECTIVES: To review cases of DNAs with special emphasis on contrast-enhanced computed tomography (CECT) findings and their implications for treatment planning.

STUDY DESIGN AND SETTINGS: Retrospective evaluation of adult patient records with diagnosis of DNAs on CECT at Treviso Regional Hospital.

RESULTS: Eighty patients were identified. In 30.0% of cases, an immediate surgical drainage was performed. In 22.5% of cases, surgical drainage was necessary because of the lack of clinical response to medical therapy alone. Almost half of the patients were treated with antibiotics alone with complete remission. DM was predictive for lack of response to medical therapy alone ($P = 0.014$). Intraoperative findings confirmed the CECT diagnosis in 88.1%.

CONCLUSIONS: Although the mainstay of treatment for deep neck abscesses remains surgical drainage, small abscesses can respond to antibiotics alone. CECT monitoring of DNAs was the essential steps in choosing the more appropriate treatment and, probably, the basis for the good prognosis of patients.

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Deep neck abscesses (DNAs) are abscesses that develop within deep neck spaces. Deep neck spaces are regions of loose connective tissue filling the areas between layers of deep cervical fascia. The fascial layers separate one area from another; however, the spaces of the neck communicate with one another forming avenues by which infections may spread from one space to another.

Although the incidence and mortality of DNAs have declined, these infections are not uncommon and are potentially lethal because of life-threatening complications that may arise. The advent of contrast-enhanced studies, particularly computed tomography (CT), has made a critical contribution to the identification of an abscess, to differentiation of deep neck abscess from cellulitis, to delineation of involved spaces, and to the diagnosis of complications. Furthermore, contrast-enhanced CT (CECT) is helpful in checking the evolution of infection.

Intravenous antibiotic therapy and open surgical drainage were for decades the mainstay of treatment for DNAs. Recent reports have argued that some DNAs may be successfully treated with more conservative approaches like needle aspiration or antibiotic therapy alone.

The purpose of this study was to review all cases of DNAs in adults presenting to our departments over the past 8 years with special emphasis on CECT findings and their implications for treatment planning.

PATIENTS AND METHODS

We retrieved and evaluated the records of all patients older than 17 years who were admitted to the Department of Otolaryngology, University of Padua, Treviso, Italy, and the Department of Infectious Diseases, Treviso Regional Hospital, Treviso, Italy, with the diagnosis of DNAs on CECT between January 1997 and June 2005. Clinical charts, imaging, and bacteriologic studies were reviewed. Patients with superficial and peritonsillar abscesses, those with head and neck cancer, and those with posttraumatic deep abscesses were not included in the analysis.

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The following variables were reviewed: demographic data (age and sex), cause of the abscess, presenting signs and symptoms (pain, fever, swelling, dysphagia, trismus, dyspnea, dysphonia, stiff neck, and otalgia), associated systemic diseases, bacteriology, CECT findings, medical and surgical treatment, complications, length of hospital stay, and outcome. The abscess was categorized according to the anatomic location (parapharyngeal space, retropharyngeal space, prevertebral space, parotid space, masticatory space, visceral vascular space, submandibular space, and anterior visceral space). Patients with involvement of two or more spaces were classified as having a multiple-spaces abscess. Three-millimeter slides from the skull base to the superior mediastinum were obtained before and after contrast injection by using the helical technique. The CT scan was interpreted as showing an abscess in presence of the enhancing rim around nonenhancing central density consistent with fluid. The initial CT scan was extended to include the chest in cases of suspected descending infection.

All patients were placed on intravenous antibiotics on admission. Patients who were clinically unstable (airway compromising and signs and symptoms of sepsis); patients with descending infection; patients with prevertebral, anterior visceral, vascular visceral, or with abscess involving more than two neck deep spaces; and patients with abscess larger than 3.0 cm underwent immediate surgical drainage. On the other hand, for patients showing clinical improvement (resolution of swelling, pain, neck stiffness, dysphagia, and defervescence) was noted after 48 hours, surgical drainage was performed. On the other hand, if clinical response was seen, a CECT was repeated to confirm clinical judgment. If the repeat CT scan did not confirm a regression of collection of pus, surgical intervention was considered. In selected cases, therapeutic needle aspiration of DNAs was considered an alternative to conventional surgery.

This study protocol was approved by the institutional review board of Treviso Regional Hospital. Data were subjected to statistical analysis using χ² test and a Student t test as appropriate.

### Table 1

<table>
<thead>
<tr>
<th>Cause</th>
<th>No.</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pharyngitis</td>
<td>27</td>
<td>45.0</td>
</tr>
<tr>
<td>Dental infection</td>
<td>19</td>
<td>31.7</td>
</tr>
<tr>
<td>Submandibular sialadenitis</td>
<td>8</td>
<td>13.3</td>
</tr>
<tr>
<td>Parotitis</td>
<td>4</td>
<td>6.7</td>
</tr>
<tr>
<td>Lymphadenitis</td>
<td>1</td>
<td>1.7</td>
</tr>
<tr>
<td>Epiglottitis</td>
<td>1</td>
<td>1.7</td>
</tr>
<tr>
<td>Unknown</td>
<td>20</td>
<td></td>
</tr>
</tbody>
</table>

*Of 60 patients with known causes.

### RESULTS

A total of 80 patients were included in this study. Patients ranged in age from 18 to 87 years, with a mean age of 51.1. Of these patients, 55 (68.8%) were men and 25 (31.2%) were women.

Patients were symptomatic for an average of 6.3 days before admission. The most common signs were swelling and pain of the neck presenting in 76 patients (95.0%); 52 patients (65.0%) were febrile: the mean temperature was 37.4 ± 0.90°C (range, 36.5-40.0°C). Other symptoms included pharyngodynia in 37 patients (46.3%), dysphagia in 33 patients (41.3%), dysphonia in 12 patients (15.0%), dyspnea in 9 patients (11.3%), trismus in 8 patients (10.0%), and otalgia in 7 patients (8.8%).

Twenty-six patients had an underlying systemic illness (32.5%). Diabetes mellitus (DM) was the most common associated systemic disease, occurring in 18 patients (22.5%). Other conditions included chronic hepatopathy (n = 3), ischemic cardiopathy (n = 3), and lymphoproliferative disease (n = 2).

The cause of abscess was identified in 60 patients (75.0%, Table 1); the most common cause was a pharyngeal infection (45.0% of the known causes) followed by dental infection (31.7%). No cases from intravenous drug use were observed.

The anatomic locations of DNAs are shown in Table 2. Parapharyngeal space was the most commonly involved space (56.2%) followed by the submandibular space (47.5%). In 31 patients (38.7%), the infection involved more than 1 deep space. Patients with DM tended to have a more frequent involvement of multiple spaces than other patients (P = 0.009; rate difference = 0.38; 95% confidence interval [CI], 0.12-0.57).

White blood cells were >10 × 10³/μL in 48 patients (60.0%), with an average of 12.1 × 10³ ± 4.92 × 10³/μL. The erythrocyte sedimentation rate was pathological (>10 mm/h) in 100% of the 49 patients in whom it was measured, with an average value of 48.3 ± 25.49 mm/h. The C reactive protein, available for 47 patients, was >0.5 mg/dL in all cases. Microbiological diagnosis was successful in 47 patients (58.7%.

### Table 2

<table>
<thead>
<tr>
<th>Space</th>
<th>No.</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parapharyngeal space</td>
<td>45</td>
<td>56.2</td>
</tr>
<tr>
<td>Submandibular space</td>
<td>38</td>
<td>47.5</td>
</tr>
<tr>
<td>Parotid space</td>
<td>19</td>
<td>23.7</td>
</tr>
<tr>
<td>Anterior visceral space</td>
<td>13</td>
<td>16.2</td>
</tr>
<tr>
<td>Masticatory space</td>
<td>10</td>
<td>12.5</td>
</tr>
<tr>
<td>Retropharyngeal space</td>
<td>5</td>
<td>6.2</td>
</tr>
<tr>
<td>Visceral vascular space</td>
<td>4</td>
<td>5.0</td>
</tr>
<tr>
<td>Prevertebral space</td>
<td>3</td>
<td>3.7</td>
</tr>
</tbody>
</table>

*The sum of total percentage exceeds 100 because of 31 patients with multiple-space involvement.
Anaerobic cultures were not performed in all cases. All patients underwent otolaryngological examination with fiber optic and CECT. On admission, antibiotic therapy was started empirically in all patients and later eventually tailored to organism sensitivities. The most common choices for antibiotic treatment, alone or in combination, were amoxicillin/clavulanate potassium (58.8%, n = 47), various first, second and third generation cephalosporins (25.0%, n = 20), clindamycin (23.7%, n = 19), and metronidazole (13.7%, n = 11).

Twelve patients (15.0%) developed life-threatening complications including descending mediastinitis (n = 6, 7.5%), airway obstruction (n = 4, 5.0%), jugular vein thrombosis (n = 1), and pneumonia (n = 1). A higher rate of complications was observed in patients with multiple space involvement (P < 0.001; proportion difference = 0.56, 95% CI, 0.36-0.72), in those with visceral anterior space involvement (P < 0.001; proportion difference = 0.80, 95% CI, 0.53-0.89), and in patients with DM (P < 0.001; proportion difference = 0.47, 95% CI, 0.22-0.66). No clinical signs and symptoms were statistically associated with descending mediastinitis, jugular vein thrombosis, and pneumonia. All 12 patients met the previously mentioned criteria for immediate surgical drainage.

In total, 24 patients (30.0%) underwent immediate surgical drainage. In 22 cases, an open surgical drainage was performed under general anesthesia. Two approaches were considered: an external approach in 17 cases and an intraoral approach in five cases. In two cases, a needle aspiration was used. Patients with mediastinitis (n = 6) underwent external drainage of the cervical abscess in conjunction with a thoracotomy as primary surgical treatment in cooperation with thoracic surgeons. Patients with airway obstruction (n = 4) underwent immediate tracheotomy in conjunction with abscess drainage. The patient developing jugular vein thrombosis underwent surgical drainage of parapharyngeal space abscess followed by anticoagulant therapy with subcutaneous enoxaparin; the anticoagulant therapy was orally continued for 3 months with complete resolution of thrombosis.

Fifty-six patients (70.0%) were observed for 48 hours. In 38 cases, a clinical improvement was noted, which was confirmed by CT scan. No change or clinical and/or radiologic worsening was noted in 18 cases. These patients underwent surgical drainage that consisted in an open approach in 11 cases and in a needle aspiration for drainage in 7 cases. No patients in the observed group developed life-threatening complications. DM was the only clinical factor predictive for lack of response to medical therapy alone (P = 0.014; proportion difference = 0.73; 95% CI, 0.22-0.83). Intraoperative findings confirmed the CT diagnosis of abscess in 88.1% (37/42). Fourteen patients required postoperative ventilatory support for at least 24 hours after the surgery.

All patients were discharged in stable condition with a mean length of hospital stay of 11.9 ± 6.43 days. A longer duration of hospital stay was noted in patients who underwent surgical drainage (P = 0.003; mean difference = 4.80, 95% CI, 1.73-7.87), in patients with DM (P = 0.003; mean difference = 5.33, 95% CI, 1.82-8.83), in patients with multiple space involvement (P < 0.001; mean difference = 6.53, 95% CI, 3.68-9.37), and in those with complications (P < 0.001; mean difference = 8.16, 95% CI, 5.34-10.98).

### DISCUSSION

Although the advent of antibiotics and improved dental care dramatically decreased the incidence and mortality, DNAs remain a challenging problem because of the complex anatomy and potentially lethal complications that may arise. Several recent reports have indicated that most DNAs in adults are secondary to an odontogenic infection. However, in our series, most cases were secondary to pharyngitis (45.0% of the known causes). This may be because of the fact that patients with dental infection were admitted to the Department of Maxillo-Facial and Oral Surgery.

Consisting with this finding, parapharyngeal space was the most common involved space (56.2%) followed by submandibular space (47.5%). Although, the fascial layers may limit to some degree the spread of most infections, the spaces of the neck communicate with one other forming avenues by which infections may spread; in more than one-third of cases, the infection involved more than 1 deep space. Patients with multiple-spaces involvement were apt to have a more severe clinical course with a higher rate of complications (P < 0.001). The tendency in diabetic patients to have a multiple-space involvement may be because of a defect in the immune system (see later).

The etiology of DNAs is often polymicrobial including aerobes and anaerobes. In a retrospective series of 186 patients with DNAs, 62% of positive cultures were polymicrobial.
crobial and anaerobes constituted 35% of the overall bacteria isolates. In this sense, the lack of directing appropriate against anaerobes may lead to clinical failure. Clindamycin has the broader coverage against anaerobes and a good activity against gram-positive cocci; metronidazole provides an effective treatment of anaerobic infections, but it is ineffective against aerobes. Therefore, both these antibiotics should be used in combination with other agents with a broader spectrum of activity against aerobes. In order “to kill 2 birds with 1 stone,” the combination of β-lactamase inhibitors plus a β-lactam antibiotic is a possible choice. In this series, the most common antibiotic regimen used for empiric treatment was amoxicillin/clavulanate potassium 1.5 to 2 g three times a day, providing a good coverage for aerobic and anaerobic bacteria. High-dosage intravenous antibiotic therapy before surgical drainage and inconsistent use of appropriate methods for isolation and identification of anaerobic bacteria can be responsible for 41.3% of negative cultures and for low isolation rate of anaerobes.

Appropriate treatment planning of patients with deep neck infections requires a clear differentiation between cellulitis and abscess. Imaging of soft tissue of the neck has developed significantly with the advent of CT scan and magnetic resonance imaging, and it plays a fundamental role in the diagnosis of DNAs. The critical contributions of contrast-enhanced studies in DNAs are the identification and the extent of an abscess, the delineation of involved spaces, and the diagnosis of complications. Because CT scan is more readily available, less expensive, and less time consuming than magnetic resonance imaging, it is invaluable in the initial evaluation of patients with DNAs. An area of low attenuation with a complete circumferential rim of enhancement is the hallmark of abscesses. However, in differentiating DNAs from cellulitis, several studies have reported a false positive rate from 8% to 25%. In our series of patients with the diagnosis of DNAs on CECT, who underwent surgical drainage, the false-positive rate was 11.9% (5/42). All 5 patients with false-positive results on CECT underwent surgical exploration few hours after CECT; therefore, an effect of previous antibiotic therapy is rather unlikely. It has been shown that CT findings may be ambiguous in the transition stages from cellulitis to abscess, specifically, a thin or partial enhanced rim may be present in cellulitis. This could explain the false-positive results.

The unquestioned mainstay of treatment for DNAs has been for decades open surgical drainage. In the last years, some authors have proposed antibiotic therapy alone as an alternative to surgical incision in cases of small abscesses. In this series, after placing all patients on broad-spectrum intravenous antibiotic, a wait and watch policy was adopted in patients who meet the following criteria: 1) clinically stable conditions, 2) abscess <3.0 cm, 3) absence of involvement of that which we call “danger spaces” (prevertebral, anterior visceral, and vascular visceral spaces), 4) absence of involvement of more than 2 spaces, and 5) absence of descending infection.

Altogether, less than half (47.5%) of the patients were treated with antibiotic therapy alone with complete remission. In patients in which a surgical drainage was necessary because of the lack of clinical response to medical therapy alone (32.1% of the observed group), DM was the only variable predictive for lack of response to antibiotics (P = 0.014). In patients who underwent surgical drainage, the choice between external and intraoral approach mainly depended on the site of abscess and its relationship with great vessels of the neck. Retropharyngeal and parapharyngeal space abscesses, provided that CECT scan showed the abscess to be medial to the great vessels of the neck, were drained intraorally.

Percutaneous CT-guided aspiration of DNA is an alternative to conventional surgery in selected cases (eg, small collections not responding to antibiotic therapy). CT-guided aspiration may be useful in cases in which an abscess is suspected but not definite. Furthermore, this approach increases the likelihood of microorganism isolation, it is less expensive, and it avoids a superficial surgical scar.

The anterior visceral space extends from hyoid bone down to the superior mediastinum. This space contains the larynx, thyroid gland, trachea, and cervical esophagus. Therefore, anterior visceral space involvement seemed to play a crucial role in determining airway obstruction and spreading of infection to anterior mediastinum; in 5 of 6 cases of mediastinitis occurring in this series, the mediastinum was reached via anterior visceral space. Surprisingly, the spread of infections to visceral vascular space, mediastinum, and lung occurred without warning; in these cases, a CT scan was critical to establish early diagnosis of complications.

DM was the most common associated systemic disease (69.2% of patients with an underlying systemic illness); this is consistent with other series. Compared with other patients, diabetic patients tended to have a more aggressive clinical course. Patients with DM are susceptible to frequent infections with significant morbidity. The hyperglycemia altered the host’s immune functions such as all steps of polymorphonuclear leukocytes function, cellular immunity, and complement activation. A higher rate of extended space infection and complication in diabetic patients may be because of failure of the host’s immune function to confine the infection. In this sense, particular attention should be paid in the control of hyperglycemia, and an early surgical treatment should be considered also in seemingly less severe cases.

**CONCLUSION**

The mortality of deep neck infections is significantly decreased with the advent of antibiotics. Nevertheless, an
improper use of antibiotic treatment may mask or distort the clinical picture of these infections making it vaguer and, on the other hand, leading to an unhurried and slow course of disease and delayed improvement and developing of complications.

Although the mainstay of treatment for deep neck abscesses has been surgical drainage, small abscesses can respond to antibiotic alone. In our experience, nearly half of the patients treated showed a rapid response to medical therapy alone. We cannot exclude that part of them had a deep neck spaces cellulitis misdiagnosed for an abscess based on CT findings. However, the ability of intravenous antibiotics to penetrate an abscess has been clearly proven. Hence, according to our results, we suggest, for selected cases, a trial of intravenous antibiotic treatment before immediate surgical drainage. A management algorithm based on our findings is proposed in Figure 1.

In this series, CECT results and assessment of response to medical therapy after 48 hours were the essential steps in choosing the more appropriate treatment and, hence, probably the basis for the good prognosis of our patients. Finally, the clinical assessment in diabetics should require careful consideration of potential complications, and an early surgical treatment should be considered also in apparently less critical cases.

Figure 1  Algorithm for management of deep neck abscesses (‘danger spaces’: prevertebral space, anterior visceral space, and visceral vascular space).
REFERENCES