Deep neck infections in children: experience in a tertiary care center in Turkey

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The aim of this study was to elucidate the clinical presentations, diagnostic clues and management of deep neck infections (DNI) in pediatric patients. Demographic characteristics, clinical manifestations, predisposing factors, duration of symptoms before presentation, history of previous antibiotic use, duration of hospitalization, laboratory and radiographic evaluations, management, complications, and outcomes of 25 patients (19 male/6 female; mean age: 47.9±39.0 months) diagnosed with DNI were analyzed retrospectively. Retropharyngeal abscesses occurred especially in preschool children, whereas peritonsillar abscesses occurred especially in school children. Nine of 25 (36%) patients underwent surgical intervention in addition to medical therapy. Contrast-enhanced computed tomography provided additional information in half of the patients. DNIs should be considered in the differential diagnosis of children who present with fever and neck mass even in the absence of more specific findings. Medical treatment can be considered an option to surgical treatment by utilizing the advantages of imaging techniques and empirical antibiotics.

Key words : deep neck infection, pediatric, contrast-enhanced computed tomography.

Deep neck infections (DNI) are infectious processes of the deep fascial space in the head and neck area. They can occur at any age, but because of their rapidly progressive nature, pediatric DNIs require thorough management. The complex head and neck anatomy causes difficulties in the diagnosis; thus, a high index of suspicion is necessary to avoid any delay in treatment. Infection in one space can easily spread to another potential space as well as to connecting regions such as the mediastinum and along the vertebral spine. DNIs can be categorized according to the sites of infection as retropharyngeal, prevertebral, parapharyngeal, and peritonsillar abscesses. The peritonsillar space is defined as the space between the palatine tonsil and superior pharyngeal constrictor muscle. Although it is not a true deep neck space, it is contiguous with the other deep neck spaces, such as the parapharyngeal and retropharyngeal spaces, and thus, peritonsillar abscess can be considered a DNI. The parapharyngeal space lies between the visceral part of the middle layer and the superficial layer of the deep cervical fascia. Retropharyngeal and prevertebral spaces involve the entire length of the neck. The retropharyngeal space lies between the visceral fascia, which covers the posterior pharynx and esophagus, and the alar fascia, a part of the deep cervical fascia, and is situated posterior to the pharynx and esophagus. The prevertebral space lies between the prevertebral fascia and the underlying vertebral bodies and deep cervical musculature[1]. Although incidence of DNI has been reduced with the widespread availability of antibiotics, they remain an important clinical problem because of their serious potential complications, such as airway obstruction, jugular vein thrombosis, mediastinitis, and sepsis. Appropriate antimicrobial therapy, surgical drainage and management of complications are the mainstays of treatment for DNIs. Although cultureguided antimicrobial therapy is considered, appropriate empirical antibiotic selection plays a critical role in altering the clinical course[2]. The purpose of this study was to evaluate patients in the pediatric age group with a diagnosis of DNI with respect to their age and sex, clinical presentation, radiological and laboratory findings, diagnosis, and management.

Material and Methods

Between September 2005 and September 2011, 25 patients (19 boys, 6 girls) with a diagnosis of DNI (demonstration of an abscess in the potential spaces, including retropharyngeal, prevertebral, parapharyngeal, or peritonsillar abscess) were evaluated retrospectively with respect to the clinical, radiological and laboratory findings. Data regarding age, sex, clinical manifestations, predisposing factors, duration of symptoms before presentation to the hospital, history of previous antibiotic use, duration of hospitalization, laboratory and radiographic evaluations, management, complications, and outcome were recorded. Blood cultures, peripheral blood white blood cell (WBC) count and serum C-reactive protein (CRP) levels were obtained from all of the patients at presentation. Pus cultures were obtained when surgical drainage was performed. Diagnosis of DNI was confirmed by ultrasonography (USG) and/or contrast-enhanced computed tomography (CECT). USG (General Electric Co., Milwauke, WI, USA) was performed in 18 patients at presentation. In addition, CECT (Hitachi Radix Turbo, Kashiwa, Chiba, Japan) was performed except in two patients who had peritonsillar abscess that was drained immediately at presentation.

Data were entered into a database, and statistical analyses were performed using the Statistical Package for the Social Sciences (version 15.0, SPSS, Inc., Chicago, IL). The overall results of this study were expressed as percentages for categorical variables, means±SD, and as medians for continuous variables. The significance of differences between groups was evaluated using Mann-Whitney U test.

Results

A total of 25 patients diagnosed as DNI were evaluated in this study. There were 19 (76%) boys and 6 (24%) girls ranging in age from 5 months to 12 years (mean age: 47.9±39.0 months). Four patients had peritonsillar abscess, 11 had parapharyngeal abscess, 7 had retropharyngeal abscess, and 3 had prevertebral abscess. Retropharyngeal abscesses occurred especially in preschool children (mean age: 28.8±22.3 months), whereas peritonsillar abscesses occurred especially in school children (mean age: 64.25±35.17 months). There was a significant difference between these two DNI groups according to mean age ($p=0.007$).

The duration of symptoms before presentation was 1-3 days in 14 (56%) patients, 4-7 days in 8 (32%) patients, and more than 7 days in 3 (12%) patients (total range: 1-14 days). A predisposing cause of the DNI was determined in 19 (76%) patients: upper respiratory tract infection (URTI) (16 patients), history of oral trauma (1 patient), varicella infection (1 patient), and dental abscess (1 patient). In 6 (24%) cases, no predisposing factor was found. The most frequent symptoms and/or clinical findings were fever (100%), neck mass (92%), neck stiffness (40%), odynophagia (40%), and difficulty in breathing (24%). A total of 15 (60%) children had a history of taking oral antibiotics before admission. None of the blood cultures of the patients yielded a pathogenic organism. In 1 of the 7 pus cultures, group A streptococcus was detected. The mean±SD WBC count and CRP at the time of presentation were 25,300±8,961/mm^3 (range: 11,300/mm^3 – 48,000/mm^3) and 129.04±96.68 mg/L (normal: 0-20 mg/L; range: 11 g/L - 395 mg/L), respectively, in the study group. Cervical USG and CECT investigations were performed for confirmation of the localizations of abscesses (Figs. 1-3). Seven of 25 (28%) patients had retropharyngeal abscesses, while parapharyngeal, peritonsillar and prevertebral abscesses were determined in 11 (44%), 4 (16%) and 3 (12%) patients, respectively.

All patients were treated with parenteral antibiotic therapy. The preferred empirical treatment regimens and correlation between CECT and USG findings are shown in Table I. Nine (36%) patients underwent surgical intervention in addition to antibiotic therapy. Surgical treatment was performed in 3 of 7 (42.8%) patients with retropharyngeal abscesses, 1 of 3 (33.3%) patients with prevertebral abscesses, all of the 4 patients with peritonsillar abscesses, and only 1 of the 11

(9.1%) patients with parapharyngeal abscesses. The mean duration of hospitalization was 15.1±8.0 days (range: 5-35 days) in the study group. The mean duration of hospitalization was 16.4±8.7 days (range: 5-35 days) in the patients treated solely with intravenous antibiotics and 13.3±6.6 days (range: 7-26 days) in the patients who underwent surgical drainage. No significant difference was found between the two groups ($p>0.05$). Mechanical ventilation treatment and intensive care unit management were applied in 1 patient (Case 7) with retropharyngeal abscess after surgical drainage. This patient was treated empirically with meropenem and vancomycin. When group A streptococcus was isolated from the pus culture of this patient, the antibiotic regimen was simplified. The outcome of all patients was good, without morbidity or mortality.

Discussion

Inflammatory neck masses are common in the pediatric population, especially in young children. Most of these patients had enlarged reactive or suppurative lymph nodes, caused by URTI or pharyngeal infection. Dental-parotid infections and infected congenital cystic lesions may result in neck masses. All of these processes can lead to abscess formation[3]. We included the patients with deep neck space abscesses in this study, and thus not all of the inflammatory neck masses. Although antibiotic therapy of these infectious diseases has reduced the incidence of deep neck space abscesses, life-threatening complications can develop if they are not identified and treated promptly. As recognition of DNI in children is difficult, a high index of suspicion and appropriate diagnostic facilities are needed.

Deep neck infections may develop in different spaces in the different age groups. Retropharyngeal abscesses tend to occur more frequently in younger children because lymph nodes are prominent in young children but regress with age[4]. Peritonsillar abscesses due to *Streptococcus pyogenes* throat infections tend to occur in older children and adolescents. In our study, retropharyngeal abscesses were seen in a younger age group than peritonsillar abscesses, similar to other studies[5]. Males are more prone to develop DNI. This may be attributed to the differences in the strength of connective tissue between males and females, with the infection being more likely to spread to the potential spaces in males[6]. Most of the patients with DNI in the current study were males.

Deep neck infections often arise from pharyngotonsillitis, dental infections, lymphadenitis, salivary gland infection, or direct trauma[7]. The most common predisposing factor for DNIs in our study was URTI. Infection of the ears, nose, or throat may spread to deep neck spaces by direct continuity or by lymphatic drainage to lymph nodes in these spaces[8]. Varicella infection, dental infection and pharyngeal trauma (1 case each) were also included as predisposing factors in our series. It is known that varicella zoster virus infections predispose to severe group A streptococcus and *Staphylococcus aureus* infections[9].

The most common signs and symptoms of DNIs are neck mass or swelling, fever, poor oral intake, URTI symptoms such as rhinorrhea or cough, neck pain, irritability, decreased neck mobility, sore throat, upper airway obstructive symptoms, and febrile seizures[10]. Adults with DNIs often have numerous localizing signs and symptoms, while infants and younger children tend to have subtle presentation; the latter may not verbalize their symptoms

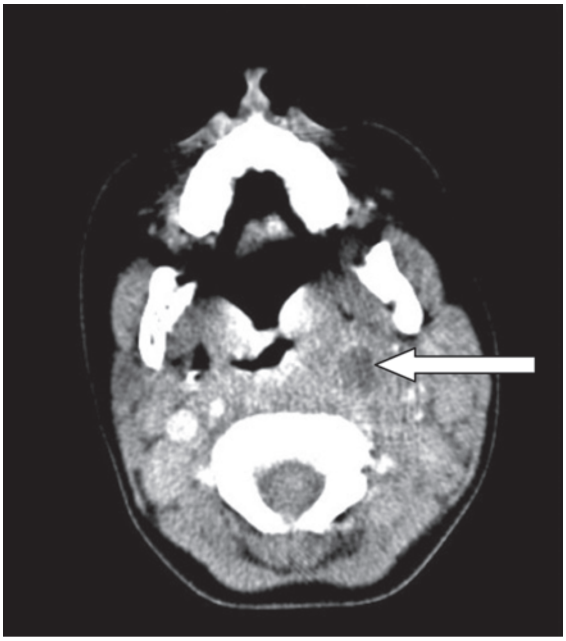

Fig.1. CECT scan showing left-sided retropharyngeal abscess (arrow) with airway compression who required only medical treatment (patient 2 in the Table).

Table I. Ultrasonography, Contrast-enhanced Computed Tomography Findings and Characteristics of Patients

Patient No	Age(months) / Sex	Etiology	Clinical findings	USG findings	CECT findings	Diagnosis	Antibiotic treatment	Surgical treatment
1	11 / M	Trauma	Fever, neck mass, neck stiffness, odynophagia, difficulty in breathing	Enlarged lymph nodes	Retropharyngeal abscess formation-airway compression-cellulitis-myositis	Retropharyngeal	Ceftriaxone + clindamycin	-
2	43 / F	?	Fever, neck mass, neck stiffness, odynophagia	Enlarged lymph nodes-adipose tissue thickening	Retropharyngeal abscess formation-airway compression-adipose tissue thickening	Retropharyngeal	Ceftriaxone + clindamycin	-
3	70 / M	URTI	Fever, neck mass, neck stiffness, odynophagia	Enlarged lymph nodes-adipose tissue thickening	Peritonsillar abscess formation-airway compression	Peritonsillar	Ceftriaxone + clindamycin	+
4	80 / F	Dental	Fever, neck mass, neck stiffness, odynophagia	Enlarged lymph nodes-adipose tissue thickening	Parapharyngeal abscess formation-airway compression	Parapharyngeal	Ceftriaxone + clindamycin	-
5	21 / F	URTI	Fever, neck mass	Enlarged lymph nodes-adipose tissue thickening	Prevertebral abscess formation-airway compression	Prevertebral	Ceftriaxone + clindamycin	+
6	13 / M	URTI	Fever, neck mass, neck stiffness, odynophagia	Enlarged lymph nodes-adipose tissue thickening	Retropharyngeal abscess formation-airway compression	Retropharyngeal	Ceftriaxone + clindamycin	+
7	64 / M	URTI	Fever, neck mass, neck stiffness, odynophagia, trismus	Enlarged lymph nodes-adipose tissue thickening	Retropharyngeal abscess formation-airway compression	Retropharyngeal	Carbapenem + vancomycin	+
8	52 / M	URTI	Fever, neck mass	Enlarged lymph nodes	Parapharyngeal abscess formation-myositis	Parapharyngeal	Ceftriaxone	-
9	6 / M	?	Fever, neck mass	Enlarged lymph nodes-adipose tissue thickening	Retropharyngeal abscess formation	Retropharyngeal	Ceftriaxone + clindamycin	-
10	5 / M	?	Fever, neck mass	Enlarged lymph nodes-abscess formation	Parapharyngeal abscess formation-airway compression	Parapharyngeal	Ceftriaxone + clindamycin	-
11	66 / M	URTI	Fever, neck mass	Enlarged lymph nodes-abscess formation-adipose tissue thickening	Prevertebral abscess formation-airway compression	Prevertebral	Ceftriaxone + clindamycin	-
12	146 / F	?	Fever, neck mass, neck stiffness, odynophagia	Enlarged lymph nodes-adipose tissue thickening	Parapharyngeal abscess formation-airway compression	Parapharyngeal	Sulbactam-ampicillin+clindamycin	-
13	80 / M	Varicella	Fever, neck mass, unilateral tonsillar enlargement	-	Parapharyngeal abscess formation-airway compression	Parapharyngeal	Ceftriaxone + clindamycin	-
14	11 / M	?	Fever, neck mass	Enlarged lymph nodes-adipose tissue thickening	Parapharyngeal abscess formation	Parapharyngeal	Ceftriaxone + clindamycin	-
15	73 / M	URTI	Fever, neck mass, neck stiffness, odynophagia	Enlarged lymph nodes	Parapharyngeal abscess formation-airway compression	Parapharyngeal	Ceftriaxone + clindamycin	-

16	23 / M	URTI	Fever, neck mass, neck stiffness	-	Parapharyngeal abscess formation-myositis-cellulitis	Parapharyngeal	Sulbactam-ampicillin+clindamycin	-
17	13 / M	?	Fever, neck mass, neck stiffness	-	Retropharyngeal abscess formation-airway compression-cellulitis-adipose tissue thickening	Retropharyngeal	Ceftriaxone + clindamycin	+
18	39 / M	URTI	Fever, neck mass, neck stiffness, difficulty in breathing	Enlarged lymph nodes-abscess formation-adipose tissue thickening	Prevertebral abscess formation-airway compression	Prevertebral	Sulbactam-ampicillin	-
19	34 / M	URTI	Fever, neck mass	Enlarged lymph nodes	Retropharyngeal abscess formation-airway compression	Retropharyngeal	Ceftriaxone + clindamycin	-
20	90 / M	URTI	Fever, neck mass, neck stiffness, difficulty in breathing	Enlarged lymph nodes	Peritonsillar abscess formation-airway compression	Peritonsillar	Ceftriaxone	+
21	21 / F	URTI	Fever, neck mass	Enlarged lymph nodes	Parapharyngeal abscess formation-airway compression	Parapharyngeal	Ceftriaxone + clindamycin	-
22	128 / F	URTI	Fever, neck mass, odynophagia, trismus	-	Parapharyngeal abscess formation	Parapharyngeal	Sulbactam-ampicillin+clindamycin	+
23	12 / M	URTI	Fever, neck mass	-	Parapharyngeal abscess formation-airway compression	Parapharyngeal	Ceftriaxone	-
24	13 / M	URTI	Fever, neck mass, difficulty in breathing, unilateral tonsillar hypertrophy	-	-	Peritonsillar	Ceftriaxone + clindamycin	+
25	84 / M	URTI	Fever, neck mass, odynophagia, unilateral tonsillar hypertrophy	-	-	Peritonsillar	Ceftriaxone	+

URTI, upper respiratory tract infection.
USG, ultrasonography.
CECT, contrast-enhanced computed tomography.

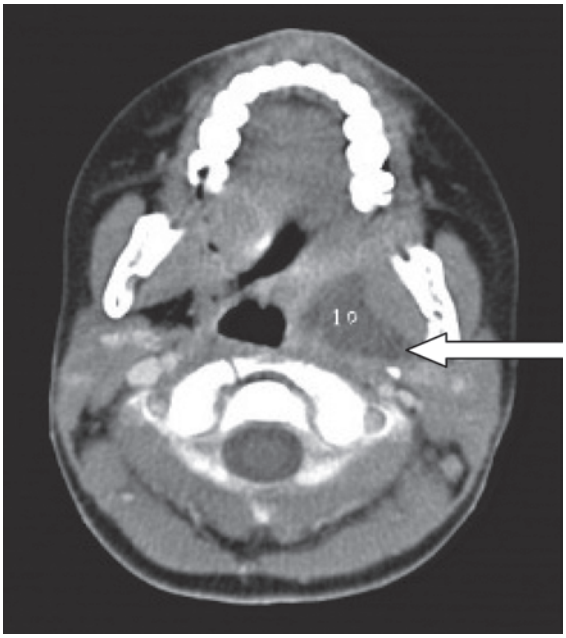

Fig.2. CECT scan showing left-sided parapharyngeal abscess (arrow) with airway compression (patient 13 in the Table).

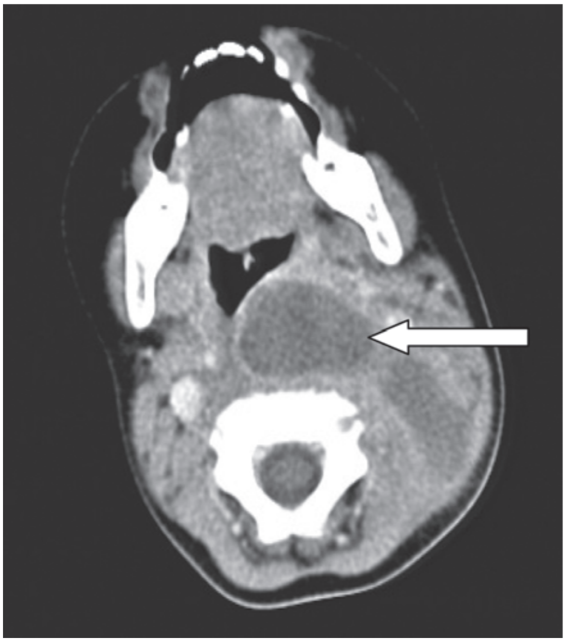

Fig.3. CECT scan showing left-sided retropharyngeal abscess (arrow) with airway compression (patient 6 in the Table).

and/or may not cooperate during the physical examination[8]. In the present series, the most frequent symptoms and clinical findings were fever, neck mass, neck stiffness, odynophagia, and difficulty in breathing. Although trismus, uvular deviation and unusual tonsil enlargement may alert the physicians, the signs and symptoms unfortunately may not be obvious in retropharyngeal and parapharyngeal abscess, so an accurate diagnosis may be delayed[11,12]. Only a small number of our patients had these alerting symptoms.

Imaging techniques are the cornerstone in the evaluation of DNIs. The most common diagnostic techniques used for this purpose are USG and CECT. As CECT has many advantages in demonstrating the relationship between the abscess and important structures, such as major vessels, and in planning surgical drainage, it is the most appropriate and widely used imaging technique for DNIs[13]. CECT provided additional information in half of our patients, revealing airway compromise and collections that could not be visualized sufficiently in the involved area with USG. We suggest that USG might not be good for diagnosing and identifying the location of DNIs. CECT should be used in the presence of DNI suspicion or airway compromise.

The predominant aerobic bacteria isolated in DNIs are *Streptococcus pneumoniae, Haemophilus influenzae*, and *Moraxella catarrhalis* related to acute URTI. Anaerobic streptococci (Peptostreptococcus spp) are prevalent in all types of URTI and their complications. The predominant oropharyngeal anaerobes responsible for the DNIs include gram-negative bacilli (Bacteroides, Prevotella, Porphyromonas, Fusobacterium, Bilophila, and Sutterella spp), gram-positive cocci (primarily Peptostreptococcus spp), and non–spore-forming bacilli (Actinomyces, Propionibacterium, Eubacterium, Lactobacillus, and Bifidobacterium spp), and gram-negative cocci (mainly Veillonella spp) are responsible especially for peritonsillar and peripharyngeal abscess. It was recommended that empirical parenteral broad-spectrum antibiotic treatment should be started immediately in patients with DNIs, before the culture results become available. Cultures of aspirates from DNIs are commonly polymicrobial and reflect the oropharyngeal flora and odontogenic nature of these infections. Empiric treatment should cover the antimicrobial activity against aerobic and anerobic bacteria including resistant organisms, induce little or no resistance, achieve sufficient concentration in the infected site, have a good safety record, cause minimal toxicity, and have maximum stability. In this report, the etiological agent could be detected in only one patient. This was probably because the specimens for cultures were taken from seven patients with surgical exploration after antibiotic treatment had been given. In this study, the preferred empirical treatment regimen was ceftriaxone and clindamycin in the majority of patients with DNI, followed by a sulbactam ampicillin+clindamycin regimen. Clindamycin is active against staphylococci, penicillin-resistant strains of *S. pneumoniae*, *S. pyogenes*, and viridans streptococci as well as most anaerobes. It is known that clindamycin also reduces some virulence factors of microbes such as toxin production by *S. aureus* and Clostridium spp and capsule formation by *S. pyogenes* and *S. pneumoniae*, and it enhances phagocytosis of susceptible organisms[14].

Treatment of DNIs consists of medical treatment, surgical intervention and management of complications. There is no universal approach to the management of DNIs with respect to indications of surgical intervention, empirical choice and duration of antibiotic therapy. It is generally recommended that the duration of treatment be individualized, depending on the clinical response. Because of the potential life-threatening complications like airway compression, mediastinitis and vascular rupture, hospitalization is advised in all DNIs[15]. In our study, surgical treatment was performed in nearly one-third of the patients. It was reported that surgical intervention might not be necessary in every DNI case, especially in patients who respond well to medical treatment[5]. Medical treatment has advantages over surgical treatment, such as preventing iatrogenic injury to cranial nerves or great vessels. It was recommended that treatment of parapharyngeal abscess consists of early surgical drainage along with parenteral antibiotic therapy. In our series, all except one of the patients with parapharyngeal abscess were treated successfully with parenteral antibiotics alone. It was reported previously that uncomplicated parapharyngeal abscess could be treated conservatively without early open surgical drainage[13]. In one study, it was found that 55.9% of 34 parapharyngeal abscesses responded well to conservative medical management, and in another study, 25% of 65 children with retropharyngeal abscesses responded well to conservative medical management[13,16]. We found that surgical treatment had no effect on the mean duration of hospital stay. It was shown previously in several studies that surgical treatment did not change the duration of hospitalization or morbidity rates related to infection[17].

In conclusion, when DNIs are identified and treated early, potentially fatal complications may be prevented. Therefore, DNIs should be considered in the differential diagnosis of children who present with fever and neck mass even in the absence of more specific findings like odynophagia and respiratory distress. The diagnosis of DNIs may be difficult, especially in pediatric patients. The advent of modern imaging techniques, specifically CECT scanning, can facilitate an earlier diagnosis and earlier therapy for these infections. Culture results may not always be available because of the difficulty in obtaining appropriate specimens. As a result, many patients are treated empirically on the basis of suspected rather than known pathogens. Medical treatment can be considered an alternative to surgical treatment by utilizing the advantages of imaging techniques and empirical antibiotics. We believe that morbidity and mortality may be reduced in the pediatric population with earlier diagnosis and appropriate medical and surgical treatment of DNIs.

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