ORIGINAL ARTICLE ÖZGÜN ARAŞTIRMA

Evaluation of Deep Neck Infections in Children

Çocuklarda Derin Boyun Enfeksiyonlarının Değerlendirilmesi

Arife Özer (0000-0001-9232-0084), Solmaz Çelebi (0000-0002-3536-0263), Cansu Turan (0000-0003-3146-6391), Edanur Yeşil (0000-0002-8926-9959), Beyhan Bülbül (0000-0002-5720-1212), Mustafa Hacımustafaoğlu (0000-0003-4646-660X)

Bursa Uludağ University Faculty of Medicine, Department of Pediatrics, Division of Pediatric Infectious Diseases, Bursa, Türkiye

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Abstract

Introduction: Deep neck infections (DNIs) are cellulitis and/or abscess-shaped infections that develop in the superficial and deep neck; are classified as peritonsillar, retropharyngeal, and parapharyngeal infections. Since mortality rates reaching 50% can be observed in cases, the diagnosis and treatment of DNIs need to be analyzed carefully. This study aimed to evaluate the cases hospitalized with a diagnosis of deep neck infection in university hospital.

Materials and Methods: The records of cases with deep neck infections who were hospitalized between January 1, 2015 and December 31, 2018 were examined retrospectively. The demographic characteristics, clinical, microbiological, and radiological findings, complications, and treatment responses of the cases were evaluated.

Results: A total of 35 cases diagnosed with deep neck infection were included in the study. Twenty-one (60%) of the cases were male and the average age of the cases was 80.68±56.57 months. Eighty percent of the cases previously received outpatient antibiotic treatment, and the average time to hospital admission after the onset of symptoms was 3.8±1.61 days. The most common symptoms were neck lymph node swelling (100%) and high fever (94.2%). Peritonsillar infection was detected in 17 cases (48.6%), retropharyngeal infection in 11 cases (31.4%), and parapharyngeal infection in 7 cases (20%). The average age of the cases with parapharyngeal abscess was significantly lower than the others (p=0.008). The average hospital stay of cases diagnosed with peritonsillar abscess was shorter than other infections (p=0.003). The average duration of antibiotic use of cases diagnosed with retropharyngeal abscess was found to be longer than in other cases (p=0.009). Fifteen cases (42.8%) improved with antibiotic treatment alone. Surgical drainage was performed in 20 cases (57.2%). In our study, 100% agreement was observed between the findings detected on computed tomography and surgical findings. Tonsillectomy was performed in two cases with peritonsillar abscess due to recurrence occurring after an average of 5 months. No complications or mortality were observed in our study.

Conclusion: Deep neck infections should be considered in the differential diagnosis in children presenting with high fever and neck swelling. Most cases improve with antibiotics, but in cases that do not respond to treatment, surgical drainage should be performed without delay.

Keywords
Deep neck infections, peritonsillar abscess, retropharyngeal abscess, parapharyngeal abscess, childhood

Anahtar kelimeler
Derin boyun enfeksiyonları, peritonsiller apse, retrofaringeal apse, parafaringeal apse, çocukluk dönemi

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Address for Correspondence/Yazışma Adresi: Arife Özer, Bursa Uludağ University Faculty of Medicine, Department of Pediatrics, Division of Pediatric Infectious Diseases, Bursa, Türkiye
E-mail: drozerarife@gmail.com

Öz

Giriş: Derin boyun enfeksiyonları (DBE), yüzeyel ve derin boyunda gelişen selülit ve/veya apse şeklindeki enfeksiyonlar olup; peritonsiller, retrofaringeal ve parafaringeal enfeksiyonlar olarak sınıflandırılır. Olgularda %50'lere ulaşan mortalite oranları görülebildiğinden, DBE'larının tanısının ve tedavisinin dikkatli analiz edilmesi gerekmektedir. Bu çalışmada, bir üniversite hastanesinde derin boyun enfeksiyonu tanısıyla yatarak izlenen olguların değerlendirilmesi amaçlandı.

Gereç ve Yöntem: 1 Ocak 2015-31 Aralık 2018 tarihleri arasında yatarak izlenen derin boyun enfeksiyonlu olguların kayıtları geriye dönük olarak incelendi. Olguların demografik özellikleri, klinik, mikrobiyolojik ve radyolojik bulguları, komplikasyonları ve tedavi yanıtları değerlendirildi.
Bulgular: Bu dönemde toplam 35 derin boyun enfeksiyonu tanısı olan olgu izlendi. Çalışmaya alınan olguların 21'i (%60) erkekti, olguların yaş ortalaması 80,68±56,57 ay idi. Olguların %80'i daha önce ayaktan antibiyotik tedavisi almış olup, semptomların başlangıcından sonra hastaneye başvuru süresi ortalama 3,8±1,61 gün idi. En sık başvuru yakınması boyunda lenf bezinde şişlik (%100) ve ateş yüksekliği (%94,2) idi. On yedi olguda (%48,6) peritonsiller, 11 olguda (%31,4) retrofaringeal ve 7 olguda (20%) parafaringeal enfeksiyon saptandı. Parafarengeal apse tanısı alan olguların yaş ortalaması diğerlerine göre daha küçüktü (p=0,008). Peritonsiller apse tanısı alan olguların ortalama hastanede kalış süresi diğer enfeksiyonlara göre daha kısaydı (p=0,003). Retrofarengeal apse tanısı alan olguların ortalama antibiyotik kullanım süresi diğer olgulara göre daha uzun bulundu (p=0,009). On beş olgu (%42,8) sadece antibiyotik tedavisi ile düzeldi. Antibiyotik tedavisine yanıt alınmayan 20 olguya (%57,2) cerrahi drenaj uygulandı. Çalışmamızda, BT'de tespit edilen bulgular ile cerrahi bulgular arasında %100 uyum gözlendi. Peritonsiller apseli iki olguya ortalama 5 ay sonra nüks gelişmesi nedeniyle tonsillektomi yapıldı. Çalışmamızda komplikasyon ve mortalite gözlenmemiştir.
Sonuç: Ateş yüksekliği ve boyunda şişlikle başvuran çocuklarda ayırıcı tanıda derin boyun enfeksiyonları düşünülmelidir. Olguların çoğu antibiyotik ile düzelmektedir, ancak tedaviye yanıt alınmayan olgularda gecikmeden cerrahi drenaj uygulanmalıdır.

Introduction

Although deep neck infections (DNIs) are rare in children, they usually occur as a complication of upper respiratory tract infections. In some cases, no predisposing cause can be found. DNIs start as cellulitis or phlegmon in the lymph nodes, pharynx, tonsils, trachea, superficial and deep neck fascia, and neck muscles, and if left untreated, cause abscess development. Depending on the anatomical features of the deep neck fascia, an abscess can spread into deeper cervical cavities and lead to serious, life-threatening infections (1,2).

Deep neck infections can generally be localized in the peritonsillar, retropharyngeal, or parapharyngeal regions. In addition to the complex anatomy of the neck region, its proximity to vital structures and difficulty in surgical access to deep neck cavities make diagnosis and treatment difficult. This requires careful and meticulous management of deep neck infections (1,3,4)

Complications in deep neck infections, which are most commonly seen in children under the age of six, are 2.2-20% and mortality is 1.5%, while in cases with complications such as mediastinitis, internal jugular vein thrombosis, carotid artery rupture, respiratory distress, septic shock, empyema, disseminated intravascular coagulopathy and cranial nerve paralysis, this rate increases to 50% (3-5).

The aim of our study is to evaluate the demographic characteristics, clinical, microbiological, and radiological findings, complications, and treatment responses of cases with deep neck infections.

Materials and Methods

The data of child cases under the age of 18 who received inpatient treatment with the diagnosis of deep neck infection at a university hospital, Department of Child Health and Diseases, Pediatric Infection Clinic between January one, 2015, and December 31, 2018, were retrospectively examined.

Demographic characteristics, symptoms and findings, microbiological and radiological findings, treatment and duration, response to treatment, hospitalization period, and complications of the cases were recorded. A diagnosis of deep neck infection was made based on clinical symptoms, physical examination and laboratory findings, and neck ultrasonography or contrast-enhanced neck computed tomography (CT) results. Contrast-enhanced neck CT scans were interpreted by the pediatric radiologist in terms of deep neck infection. Cultures were taken from cases where abscess drainage was performed and blood cultures were taken from all cases, and the drainage material was incubated in an aerobic culture medium. Leukocytosis was defined as leukocyte count >10,000/mm^3, high C-reactive protein level was defined as >1 mg/dL) and high sedimentation level was defined as >20 mm/hour.

Statistical Analysis

SPSS 26.0 (SPSS Inc; Chicago, IL, USA) statistical package program was used to enter and evaluate the obtained data. In addition to graphic analysis, the distribution of the data was evaluated with the Shapiro-Wilk test. Measurement variables were given as mean ± standard deviation (SD) for those with normal distribution, median (minimum-maximum) for those not with normal distribution, and categorical variables as numbers and percentages (%). The chi-square test was used to compare qualitative variables between groups, the independent samples t-test was used to compare normally distributed numerical data, and Mann-Whitney U tests were used to compare non-normally distributed data. One-way

analysis of variance was used to determine the difference between the independent means of the three groups. Statistically $p<0.05$ was considered significant.

Results

Demographic and Clinical Characteristics

Of the 35 cases included in the study, 21 were boys (60%) and 14 were girls (40%). The mean age of the cases was 80.68±56.57 months (min 9-max 215 months). 68.6% of the cases had a diagnosis of upper respiratory tract infection and 11.4% had a history of receiving antibiotic treatment as an outpatient at the outpatient clinic, with a diagnosis of dental infection. The most common symptoms in the cases are swelling in the lymph node in the neck (100%), high fever (94.28%), sore throat (88.57%), pain in neck movements (71.4%) and dysphagia (37.14%). Of the 35 cases examined in the study, peritonsillar abscess was observed in 17 (48.57%), retropharyngeal abscess in 11 (31.4%), and parapharyngeal abscess in 7 (20%). The average duration of antibiotic use before admitted to our clinic was determined as 4.23±5.36 days (min 0-max 30 days). The average time from the onset of symptoms to admission to our hospital was 3.8±1.61 days (min 2- max 7 days). When the symptoms were compared in our study; complaints of dysphagia were detected in 1 of 7 cases in the parapharyngeal abscess group, in 1 of 11 cases in the retropharyngeal abscess group, and in 11 of 17 cases in the peritonsillar abscess group, and this difference was found to be statistically significant ($p=0.03$) (Table 1). Neck swelling was present in all 11 cases in the retropharyngeal abscess group, in 6 of 7 cases in the parapharyngeal abscess group, and in 8 of 17 cases in the peritonsillar abscess group. Neck swelling was seen more frequently in patients with retropharyngeal abscess than in patients with peritonsillar abscess, but this difference was not found to be statistically significant ($p=0.07$).

Clinical and Laboratory Findings Associated with Deep Neck Infection

Cervical lymphadenopathy (100%) was detected in all cases, other findings include high fever (94.23%), neck swelling (71.4%), tonsillopharyngitis (71.4%), tooth decay (54.28%), limitation of neck movements (48.57%) and pushing in the uvula (17.14%). When the localizations of deep neck infections were examined according to the average age in our study, the average age of the cases with parapharyngeal abscess was 35.43±20.69 months (min 14-max 70 months), which was significantly lower than the average age of the cases with retropharyngeal and peritonsillar abscess ($p=0.008$) (Table 2). The average hospitalization period of all the cases was 9.97±6.05 days (min 2-max 25 days), and the average hospitalization period of the cases with peritonsillar abscess was found to be shorter than the average hospitalization period of the cases with retropharyngeal abscess and parapharyngeal abscess ($p=0.003$) (Table 2). The average duration of antibiotic use of all the cases was 19.14±7.11

Table 1. Frequency of symptoms in children with DNI

Symptoms	Parapharyngeal abscess n (%)	Retropharyngeal abscess n (%)	Peritonsillar abscess n (%)	p-value
Fever				
Yes	5 (71.4%)	11 (100%)	17(100%)	**0.031**
No	2 (28.6)	0 (0%)	0 (0%)	
Sore throat				
Yes	5 (71.4(%)	10 (90.9%)	10 (58.82%)	0.186
No	2 (28.6(%)	1 (9.1%)	7 (41.17%)	
Pain in neck movements				
Yes	5 (71.4%)	7 (63.63%)	5 (29.41%)	0.084
No	2 (28.6%)	4 (36.36%)	12 (70.59%)	
Dysphagia				
Yes	1 (14.28%)	1(9.09%)	11(64.7%)	**0.03**
No	6 (85.72%)	10 (90.91%)	6 (35.29%)	
Swelling in the neck				
Yes	7 (53.84%)	11(100%)	17 (68%)	0.07
No	6 (46.15%)	0 (0%)	8 (32%)	

DNI: Deep neck infection

days (min 9- max 32 days), and the average duration of antibiotic use in cases diagnosed with retropharyngeal abscess was found to be longer than in cases diagnosed with peritonsillar abscess which was statistically significant (p=0.009) (Table 2). Leukocytosis was found in 88.5% of all cases, a high C-reactive protein level was found in 80%, and a high sedimentation level was found in 82.8%.

Neck ultrasound was performed in 45.7% of the cases, two-way direct neck radiography was performed in 45.7%, and contrast-enhanced CT was performed in 80%. CT revealed abscess in 77% of the cases and phlegmon in 23%, and the abscess size was two cm or more in seven of the cases (33.3%). In our study, 100% agreement was observed between the findings detected on CT and surgical findings.

Treatments, Isolated Microorganisms, and Prognosis

In our study, fifteen cases (42.8%) recovered with antibiotic treatment alone. Surgical drainage was performed on an average of 4.26±6.26 days of hospitalization (minimum: 1 day, maximum: 25 days) in 20 cases (57%) who did not respond adequately to antibiotic treatment and had an abscess detected on CT. Of the cases that underwent surgical drainage, 9 were diagnosed with peritonsillar abscess, 7 with retropharyngeal abscess, and 4 with parapharyngeal abscess. Microorganisms were isolated in 7 (35%) of 20 pus samples taken from the cases. The causative agent was *Staphylococcus aureus* in three cases, *Staphyloccocus hominis* in one case, *Klebsiella pneumoniae* in one case, *Rothia mucilaginosa* in one case, and *Rothia dentocariosa* in one case. The cases were given double or triple combinations of cefotaxime, clindamycin, and gentamicin. The most frequently preferred combination in treatment was cefotaxime and clindamycin, with a rate of 94.2%. When the demographic characteristics, treatments, clinical signs and symptoms, and laboratory findings of the cases treated with antibiotics alone and the cases treated with antibiotic treatment and surgical drainage were compared, no difference was detected between the two groups (p=0.05) (Table 3). In two cases with peritonsillar abscess, recurrence occurred after an average of five months (5.7%), and tonsillectomy was performed along with antibiotic treatment. No complications or mortality were observed in our study.

Discussion

In our study, the demographic characteristics, clinical findings, microbiological and radiological findings, complications, and treatment responses of 35 cases diagnosed with DNI were evaluated. DNIs are infections involving the neck fascia and its potential spaces, and their frequency has decreased significantly with the widespread use of antibiotics. However, early diagnosis and appropriate treatment are important as it can lead to fatal complications

Table 2. Clinical and laboratory findings according to abscess locations

	Peritonsillar abscess n=7	**Retropharyngeal abscess n=11**	**Parapharyngeal abscess n=17**	**p-value**
Average age (Mean ± SD) (min-max) months	107.41±60.25 (22-215)	68.18± 44.64 (9-156)	35.43±20.69 (14-70)	**0.008**
Length of hospital stay (Mean ± SD) (min-max) days	6.19±2.69 (2-11)	13.5±5.11 (4-23)	13.29±8.42 (5-25)	**0.003**
Antibiotic duration (Mean ± SD) (min-max) days	16.65±6.03 (9-30)	22.45±7.02 (10-32)	20±8.31 (11-30)	**0.009**
Cases that underwent surgical drainage Age (Mean ± SD) (min-max) months	142.567±53.52 (83-215)	57.57±41.62 (9-96)	24.75±14.38 (14-45)	**<0.001**
Leukocyte count (mm^3) (Mean ± SD) (min-max)	15100±7668.28 (5970-40600)	12580±6259.98 (7320- 25000)	15800±5616.69 (8480-25000)	0.824
Sedimentation rate (mm/h) (Mean ± SD) (min-max)	45±19.71 (16- 88)	45±25.02 (18-87)	30±38.09 (11-120)	0.914
C-reactive protein (mg/dL) (Mean ± SD) (min-max)	8±9.46 (0.1- 34)	7.102±5.595 (0.1-16)	10.70±16.09 (0.18± 4)	0.721

such as mediastinitis, airway obstruction, jugular vein thrombosis, pericarditis, pleural empyema, and arterial erosion (5). In most studies in the literature, it has been stated that deep neck infections are more common in boys than in girls (6,7). In our study, 60% of the cases with DNI were male (n=21). As a result of the decrease in the frequency of upper respiratory tract infections in children as they get older and the lymph nodes in the retropharyngeal region atrophy, peritonsillar infections are generally seen in older children, and retropharyngeal and parapharyngeal infections are generally seen in young children (7,8). In most studies, the most common deep neck infection in the childhood age group is peritonsillar, and it is more common between the ages of 4 and 12. In our study, the most common infection in the peritonsillar region was found (9,10).

Unlike adults, deep neck infections in children usually develop after upper respiratory tract infections such as pharyngitis, tonsillitis, and suppurative lymphadenitis, and less commonly after dental infections (4). In our study, consistent with the literature, the most common cause of the infection deep neck infection was an upper respiratory tract infection in 68.6% of the cases, a complication of dental infection in 11.4%, and no cause could be identified in 20%. (4,11,12). Symptoms and clinical findings of deep neck infections in children vary depending on age and location of infection. Cases generally present with symptoms and findings such as irritability, poor feeding, high fever, swelling in the neck, pain in neck movements, dysphagia, pushing in the uvula, and torticollis (5,13). In many studies, the most common symptom was high fever, followed by neck

Table 3. Comparison of demographic, clinical and laboratory findings of cases treated with antibiotics and cases treated with antibiotic treatment and surgical drainage

	Cases receiving antibiotic treatment (n=15)	Antibiotic treatment and Cases that underwent surgical drainage (n=20)	p-value
Area of infection **Peritonsiller n (%)** **Parafarengeal n (%)** **Retrofarengeal n (%)**	 8/15 (53.33%) 3/15 (20%) 4/15 (26.66%)	 9/20 (45%) 4/20 (20%) 7/20 (35%)	0.856
Average age, mean ± SD (min-max) months	88.55±66.52 (9-215)	70.2±39.48 (22-156)	0.3498
Sex **Male n (%)**	 8/15 (53.3%)	 13/20 (65%)	
Length of hospital stay, mean ± SD (min-max) days	8.53±3.66 (5-16)	11.05±7.26 (2-25)	0.2286
Antibiotic use duration, mean ± SD (min-max) days	17.53±5.57 (11-32)	20.35±8.01 (9-35)	0.2522
Number of cases with fever, n (%)	15/15 (100%)	18/20 (90%)	0.2188
Number of cases with neck pain, n (%)	10/15 (66.6%)	15/20 (75%)	0.6020
Number of cases with neck swelling, n (%)	10/15 (66.6%)	15/20 (75%)	0.6020
Number of cases with limited mobility, n (%)	8/15 (53.3%)	9/20 (45%)	0.6375
Number of cases with dysphagia, n (%)	5/15 (33.3%)	8/20 (40%)	0.6967
Number of cases with tonsillopharyngitis, n (%)	10/15 (66.6%)	15/ 20 (75%)	0.6020
Number of cases with pushing in the uvula, n (%)	2/15 (13.3%)	4/20 (20%)	0.6171
Leukocyte count/ mm^3, mean ± SD (min-max)	13924.67±4930.99 (5970-23940)	17769±7516.4 (9500.40600)	0.0949
CRP (mg/dL) Mean ± SD (min-max)	7.26±6.85.44 (0.18- 22.2)	10.46±11.74 (0.1- 43)	0.3557
Sedimentation (mm/hour) Mean ± SD (min-max)	46.27±22.67 (11-87)	42.7±27.15 (15-120)	0.6830

swelling (14,15). In a study conducted by Chang et al. (8) between 1996 and 2007, it was stated that neck swelling was observed in 67% and 94% of cases with retropharyngeal and parapharyngeal abscess, respectively, and in 4.8% of cases with peritonsillar abscess. In our study, neck swelling was detected in all cases with retropharyngeal abscess and in 47% of cases with peritonsillar abscess. Retropharyngeal abscess has a more complicated course in young children and long treatment is required (3,12,16). In retropharyngeal abscesses, serious complications such as abscess extending to deep neck compartments, empyema, pleural effusion, mediastinitis, pericarditis, and pericardial effusion may develop (3,17). In our study, the average hospital stay of patients with retropharyngeal and parapharyngeal abscess was found to be significantly longer than that of children with peritonsillar abscess. In the diagnosis of deep neck infection in children, radiological imaging methods are used due to the difficulties in determining the localization, borders, relationship with vital structures, and size of the infection focus, as well as history and clinical findings. Although ultrasonography is used to evaluate lymphadenitis and peritonsillar abscess, it is less effective in identifying deep neck infections and results may vary depending on the experience of the physician performing the ultrasonography. CT is the most commonly preferred imaging method for the diagnosis of deep neck infections.

Differentiating cellulitis or abscess allows to accurately examine the relationship between adjacent structures and main vessels, helps to determine the necessity of drainage of the abscess, and significantly reduce the surgical risk (18). Studies have reported that findings detected by contrast-enhanced CT in DNI show 95% sensitivity and 82% specificity for evidence of abscess in surgical drainage (2,14,19,20). In our study, contrast-enhanced CT was performed in 80% of the cases, and abscess was detected in 77% of these cases and phlegmon was detected in 23%. In all cases in which abscess was detected on CT and surgical drainage was performed, CT findings were found to be compatible with surgical findings.

Although the factors in DNI in children vary according to age, the most frequently responsible microorganisms are staphylococci and streptococci. As age increases, Gram-negative and anaerobic factors become more common. It is rarely caused by anaerobic bacteria such as *Haemophilus influenzae, Bacteroides* spp., *Peptostreptococcus* spp., and *Fusobacterium* spp. It has been reported that the most frequently isolated microorganism in pus samples taken from 510 children diagnosed with deep neck infection during a 15-year period in India was *Staphylococcus aureus* (21%) and methicillin-resistant *S. aureus* (MRSA) was detected in 9% (3). In the literature, culture positivity varies between 52.9% and 66% (3,10,13). In our study, microorganisms were isolated in 35% of 20 pus samples, the most common agent was methicillin-sensitive *S. aureus*. Our low culture growth rate can be explained by the fact that 80% of the cases used antibiotics before applying to our clinic.

Treatment of deep neck infections is primarily systemic therapy effective against isolated bacteria. However, since the causative microorganism cannot always be detected, if beta-lactamase inhibitors and anaerobic agents are considered as empirical treatment, it is recommended to apply a combination of beta-lactamase inhibitors and anaerobic effects. In our study, intravenous antibiotic treatment was given, frequently containing a combination of cefotaxime and clindamycin. Surgical treatment rates of cases vary between 17% and 70% (1,2,9,15,21). Woods et al. (16) reported that patients who underwent surgical drainage stayed in the hospital longer than those who received medical treatment. In our study, no difference was found in terms of length of stay. It has been reported that complications such as airway obstruction, respiratory distress, mediastinal abscess, empyema, jugular vein thrombosis, and septic shock develop at a rate of 2.2-20% depending on DNI, and mortality varies between 7.1% and 15% (3,22). No complications or mortality were observed in our study.

Study Limitations

Relapse rates of DNI have been reported between 1.8% and 25.3% (23). In our study, two cases with peritonsillar abscess developed recurrence after an average of five months, and tonsillectomy was performed in the cases. The most important limitations of our study are that it is retrospective and the number of cases is not large. Studies that include more cases and multicenter prospective follow-up and records will contribute to the literature.

Conclusion

Deep neck infections should be considered in the differential diagnosis in children presenting with high fever and neck swelling. Most cases improve with antibiotics, but in cases that do not respond to treatment, surgical intervention should be performed without delay.

Ethics

Ethics Committee Approval: The approval for this study was obtained from the Ethics Committee for Clinical Research, Faculty of Medicine, Uludağ University (date: 09.01.2019, approval number: 2011-KAEK-26).

Footnotes

Conflict of Interest: No conflict of interest was declared by the authors.

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