COMPARISON OF DEEP NECK INFECTIONS IN CHILDREN AND ADULTS FROM DIAGNOSIS TO TREATMENT A CROSS-SECTIONAL RETROSPECTIVE STUDY

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ABSTRACT

Background: Although deep neck infections (DNI) are less common today with the use of antibiotics and oral care, they carry a serious risk of morbidity and mortality, especially when complications develop. These infections spread in potential cavities created by the layers of the deep neck fascia. Since the process of DNI in children and adults may differ, it was aimed to examine the patients in two groups children and adults. Demographic characteristics, clinical findings, diagnosis and treatment processes of children and adults with DNI were presented and compared. In addition, another aim of the study was to examine the differences between the most common deep neck infections in the study.

Methods: The medical files of 166 patients aged 1-78 years diagnosed with DNI were scanned retrospectively. In our study, when the differences between adults and children were taken into account concerning DNI, the 9 most common diagnoses were compared in terms of age, complaints, examination findings, radiological imaging reports, complete blood count, C-Reactive Protein, erythrocyte sedimentation rate, surgical procedures, medical treatment, hospitalization time and mortality rates.

Results: The three most common causes of DNI were dental problems, lymphadenitis and tonsillitis. When the imaging methods requested for diagnosis were examined, it was seen that 52.4%(n=87) of those performed were computed tomography and 43.4%(n=72) ultrasonography. During treatment, all patients received prophylactic antibiotherapy. Tracheostomy was performed in 9 of 15 patients who developed respiratory distress during follow-up.

Conclusions: Although the decreasing frequency of DNI, technological developments and increasing awareness, it still carries a serious risk of mortality and morbidity due to its potential and important complications. Due to inadequate dental and oral care, dental problems are still the most important factor in the aetiology of DNI. The reduction of morbidity and mortality depends on rapid diagnosis and appropriate treatment selection.

KEYWORDS Deep Neck Infection, Tracheostomy, Submandibular Abscess, Necrotising Fasciitis

Introduction

Although deep neck infections (DNI), first described by Galen in the second century, are less common today with the use of antibiotics and improvements in oral care. But they still carry a serious risk of morbidity and mortality, especially when complications develop [1, 2]. These infections spread in potential cavities created by the layers of the deep neck fascia [3].

It is mostly seen in submandibular, parapharyngeal and retropharyngeal regions. While dental causes are the most common reason in adults, upper respiratory tract infections with acute tonsillitis are the main causes in children [4, 5]. In addition, airway obstruction, sepsis, jugular vein thrombosis, mediastinitis and carotid artery rupture are important complications of DNI. Therefore, DNI’s early diagnosis and treatment plan are important, as the mortality rate can reach 30% when complications are observed [6, 7]. Since the process of DNI in children and adults may differ, it was aimed to examine the patients in two groups, children and adults.

Demographic characteristics, clinical findings, diagnosis and
treatment processes of children and adults with DNI were presented and compared. In addition, another aim of the study was to examine the differences between the most common deep neck infections in the study.

**Methods**

This cross-sectional retrospective study was conducted at a local University Medical Faculty Hospital in Diyarbakir, Turkey. This study was carried out by scanning the medical files of 166 patients aged 1-78, who were diagnosed with DNI in the Otorhinolaryngology Clinic between May 2013 and June 2019, and subsequently hospitalized and treated. In addition, patient files were scanned retrospectively from the hospital system after obtaining the necessary consent.

The patient's gender, age, symptoms, examination findings, radiological imaging reports, complete blood count, C-Reactive Protein (CRP), erythrocyte sedimentation rate (ESR), surgical procedures performed, medical treatment applied, and duration of hospitalization. Diagnostic information scanned from the patient files was recorded. Inclusion criteria for the study were created from this information. Patients with full access to this information from the files were included in the study regardless of age and gender. In the study, patients under the age of 18 were evaluated as children; those 18 and over were evaluated as adults. When the differences between adults and children concerning DNI were taken into account; the most common 9 diagnoses in this study were peritonsillar abscess (PTA), submandibular abscess (SMA), submental abscess (SMeA), submandibular abscess + submental abscess (SBMaA + SMeA), parapharyngeal abscess (PFA), abscess in more than two areas (AMTA), Ludwig's angina (LUA), necrotizing fasciitis (NEF), and submandibular cellulitis (SMC).

The data were evaluated via the SPSS 22.0 package program. The relationship between variables, whose measurement level was categorical, was examined by the Pearson Chi-Square test. Next, the Kruskal-Wallis H test was used for multiple group comparisons where the measure level of more than two variables was proportional or equidistant. Finally, the Mann-Whitney U test was used in pairwise comparisons in groups where significance was detected.

**Results**

Sixty-six (39.8%) of the patients were female, and 100 (60.2%) were male. Sixty (36.1%) of the 166 patients were children under 18 years (CG), and 106 (63.9%) were adults over 18 years (AG). The CG average age was 7.25 ± 4.57 years, whereas for the AG, the mean age was 37.05 ± 15.02 years. (Table 1)

While the hospital stay was 6.78 ± 3.44 days in the CG, it was 9.00 ± 6.93 days in AG. When the two groups were examined in terms of the most common symptoms and findings, swelling (n = 156), neck pain (n = 138) and fever (n = 131). (Table 2)

The most common etiologic factors for DNI in the CG were dental (n = 21), lymphadenitis (n = 13) and tonsillitis (n = 2). In the AG group, the most common etiologies were dental problems (n = 27, 45%), SMC (n = 14, 23.3%) and SMA + SMeA (n = 5, 8.3%).

When the most common diagnoses in terms of age were examined, it was observed that only SMC was significantly higher in NEF (60%) and LUA (35.3%) than in other diagnostic groups (p = 0.000). Diabetes Mellitus was the most common comorbidity and was present in 21.08% (n=35) of the patients. During the follow-ups in the AG group, 2 diabetic patients (1.2%) died. (Table 2, Table 3)

In this study, the 9 most frequently observed diagnoses as applied to tracheostomy requirement and death were compared with each other in terms of age, length of hospital stay, imaging, laboratory tests, symptoms and findings, aetiology, and treatment modality.

When the most common diagnoses in terms of age were examined, it was observed that only SMC was significantly higher in NEF (median: 34 years) (p = 0.001). (Table 3) (Figure 1)

When the diagnoses and length of hospital stay of PTA are compared (mean: 5.3 days) to LUA (mean: 14 days, p = 0.000) and NEF (26.4 days, p = 0.001); according to SMC (mean: 6.62 days) LUA (mean: 14 days, p = 0.000) and NEF (26.4 days, p = 0.001); it was observed that SMA (mean: 7.13 days) was significantly shorter than LUA (mean: 14 days, p = 0.000) and for the ESR in the CG and 36.81 ± 20.32 in the AG group. While CRP was 6.54 ± 3.61 in the CG, it was evaluated as 10.41 ± 6.5 in the AG group. (Table 2)

The culture was not requested in 24 patients with cellulitis formation. There were 20 patients with no growth in culture. Culture results showed 46% aerobic, 16% anaerobic, and 19% polymicrobial growth. The most common aerobic and anaerobic bacteria grown in culture were Staphylococcus aureus, Streptococcus viridans, Streptococcus pyogenes, Streptococcus Anginosus, Klebsiela pneumoniae, Peptostreptococcus species and Anaerobic bacteria (not otherwise specified).

When the imaging methods requested for diagnosis were examined, it was seen that 52.4% (n = 87) of the patients had computed tomography (CT) and 43.4% (n = 72) ultrasonography (USG). It was determined that no imaging method was requested for 4.2% (n = 7) of patients, who were followed-up after receiving a diagnosis of PTA. While the numbers for USG (n = 29, 48.3%) and CT (n = 29, 48.3) imaging were equal in the CG, the number of CT scans used during diagnosis was greater in the AG when compared to that for USG (n = 43, 40.6%) (n = 58, 54.7%). (Table 2)

The three most common diagnoses in the CG were SMA (n = 27, 45%), SMC (n = 14, 23.3%) and SBMaA + SMeA (n = 5, 8.3%).

The three most common diagnoses in the CG were SMA (n = 40, 37.7%), LUA (n = 14, 13.2%) and SMC (n = 10, 9.4%). In terms of diagnosis, SMA (n = 67, 40.4%), SMC (n = 24, 14.5%) and LUA (n = 17, 10.2%) were the most common diagnoses. (Table 2)

In the treatment, all patients received dual antibiotherapy (ceftriaxone + metronidazole). In addition to antibiotherapy, incisional drainage and drainage were performed when necessary. In the CG group, 66.7% (n = 40) were treated with incisional drainage, 26.7% (n = 16) with only antibiotherapy (ceftriaxone + metronidazole) and 6.7% (n = 4) with surgical drainage. In the AG group, 67.92% (n = 72) received only incisional drainage, 16.04% (n = 17) only antibiotherapy (ceftriaxone + metronidazole) and 16.04% (n = 17) surgical drainage. 67.47% (n = 112) of the total patients were treated with incisional drainage and dual antibiotherapy. (Table 2)

Tracheostomy was performed in 9 of 157 patients who developed respiratory distress during follow-up. All patients who underwent tracheostomy were in the AG group. Tracheostomy number was found to be significantly higher in NEF (60%) and LUA (35.3%) than in other diagnostic groups (p = 0.000). Diabetes Mellitus was the most common comorbidity and was present in 21.08% (n=35) of the patients. During the follow-ups in the AG group, 2 diabetic patients (1.2%) died. (Table 2, Table 3)

In this study, the 9 most frequently observed diagnoses as applied to tracheostomy requirement and death were compared with each other in terms of age, length of hospital stay, imaging, laboratory tests, symptoms and findings, aetiology, and treatment modality.

When the most common diagnoses in terms of age were examined, it was observed that only SMC (median: 7 years) occurred at a statistically significantly earlier age than LUA (median: 34 years) (p = 0.001). (Table 3) (Figure 1)

When the diagnoses and length of hospital stay of PTA are compared (mean: 5.3 days) to LUA (mean: 14 days, p = 0.000) and NEF (26.4 days, p = 0.001); according to SMC (mean: 6.62 days) LUA (mean: 14 days, p = 0.000) and NEF (26.4 days, p = 0.001); it was observed that SMA (mean: 7.13 days) was significantly shorter than LUA (mean: 14 days, p = 0.000) and for the ESR in the CG and 36.81 ± 20.32 in the AG group. While CRP was 6.54 ± 3.61 in the CG, it was evaluated as 10.41 ± 6.5 in the AG group. (Table 2)
# Table 1: Age and gender data of patients.

| Gender      | Child (n=60)(36,1%) | Adult (n=106)(63,9%) | Total (n=166) |
|-------------|---------------------|----------------------|---------------|
| Male        | 41                  | 59                   | 100 (60,2%)   |
| Female      | 19                  | 47                   | 66 (39,8%)    |
| Age (years ± mean) | 7,25 ±4,57          | 37,05±15,02          | 26,28±18,90   |

# Table 2: Deep neck infection data of children and adults.

| Symptom                  | Child(n=60)(36,1%) | Adult(n=106)(63,9%) | Total(n=166) |
|--------------------------|--------------------|---------------------|--------------|
| Fever                    | 44                 | 87                  | 131          |
| Throat ache              | 3                  | 12                  | 15           |
| Swelling                 | 58                 | 98                  | 156          |
| Neck pain                | 53                 | 85                  | 138          |
| Difficulty swallowing    | 5                  | 26                  | 31           |
| Trismus                  | 10                 | 27                  | 37           |
| Respiration difficulties | 3                  | 12                  | 15           |
| Medialized uvula-tonsil   | 1                  | 6                   | 7            |
| Fistulization of the skin| 1                  | 3                   | 4            |
| Etiological factors      |                    |                     |              |
| Dental problems          | 21                 | 45                  | 66 (39,8%)   |
| Lymphadenitis            | 13                 | 6                   | 19 (11,4%)   |
| Tonsillitis              | 2                  | 7                   | 9 (5,4%)     |
| Undetected etiology      | 23                 | 44                  | 67 (40,04%)  |
| Sialadenitis             | 0                  | 3                   | 3 (1,8%)     |
| Infected branchial cyst  | 1                  | 0                   | 1 (0,6%)     |
| Tiroiditis               | 0                  | 1                   | 1 (0,6%)     |
| Radiology                |                    |                     |              |
| Ultrasoundography        | 29 (48,3%)         | 43 (40,6%)          | 72 (43,4%)   |
| Computed tomography      | 29 (48,3%)         | 58 (54,7%)          | 87 (52,4%)   |
| No radiologic invest.    | 2 (3,3%)           | 5 (4,7%)            | 7 (4,2%)     |
| Diagnosis                |                    |                     |              |
| Peritonsiller abscess    | 3 (5%)             | 7 (6,6%)            | 10 (6,03%)   |
| Submandibular abscess    | 27 (45%)           | 40 (37,7%)          | 67 (40,4%)   |
| Submental abscess        | 2 (3,3%)           | 4 (3,8%)            | 6 (3,6%)     |
| SBMaA+SMBMeA             | 5 (8,3%)           | 5 (4,7%)            | 10 (6,03%)   |
| Parotid abscess          | 0                  | 3 (2,8%)            | 3 (1,8%)     |
| Parapharyngeal abscess   | 0                  | 6 (5,6%)            | 6 (3,6%)     |
| Abs. at more then 2 space| 3 (5,0%)           | 7 (6,6%)            | 10 (6,03%)   |
| Ludwig angina            | 3 (5,0%)           | 14 (13,2%)          | 17(10,2%)    |
| Nekrotizanfascitis       | 0                  | 5 (4,7%)            | 5 (3%)       |
| Retropharyngeal abscess  | 2 (3,3%)           | 2 (1,9%)            | 4 (2,4%)     |
| Submandibular cellulitis | 14 (23,3%)         | 10 (9,4%)           | 24 (14,5%)   |
| Bukkal cellulitis        | 1 (1,7%)           | 2 (1,9%)            | 3 (1,8%)     |
| Tiroid abscess           | 0                  | 1 (0,9%)            | 1 (0,6%)     |
| Treatment                |                    |                     |              |
| Incisional drainage only | 40 (66,7%)         | 72 (67,92%)         | 112 (67,47%) |
| Surgical Drainage        | 4 (6,7%)           | 17 (16,04%)         | 21 (12,65%)  |
| Antibiotherapy only      | 16 (26,7%)         | 17 (16,04%)         | 33 (19,87%)  |
| (ceftriaxone + metronidazole) |                 |                     |              |
Table 3 Statistical data of the most common diagnoses identified in this study.

| Diagnosis       | PTA (n=10) | SMA (n=9) | SMeA (n=7) | SBMaA + SMeA (n=6) | PFA (n=6) | AMTA (n=10) | LUA (n=17) | NEF (n=5) | SMC (n=24) | Total | p   |
|-----------------|------------|-----------|------------|-------------------|-----------|-------------|------------|-----------|------------|-------|------|
| Frequency       | 1(10%)     | 2(22%)    | 2(28%)     | 0                 | 0         | 4(40%)      | 2(12%)     | 4(80%)   | 12(50%)   | 24    | 0.001|
| Age (median) (years) | 30         | 21        | 28         | 16.50             | 32.50     | 24.50       | 38         | 47        | 7         | 4    | 0.001|
| Hospital stay (median) (day) | 3.3        | 7.13      | 6.66       | 6.9               | 9.16      | 6.9         | 14         | 26.4      | 6.62      | <0.001|
| Laboratory (median) | 11500      | 13000     | 14860      | 10750             | 10350     | 12470       | 14500      | 16800     | 14985     | 0.238|
| WBC (µ/mm³)     | 6.51       | 6.58      | 7.75       | 9.61              | 40.78     | 4.00        | 10.76      | 1075      | 5.89       | 0.055|
| ESR (mm/hr)     | 31.50      | 32.00     | 41.50      | 32.00             | 35.00     | 39.00       | 39.00      | 25.00     | 40.50     | 0.671|
| CRP (mg/dl)     | 0          | 2(11.8%)  | 5(33%)     | 7                | 2(11.8%)  | 4(66%)      | 2          | 3(12.5%)  | 0          | <0.001|

with respect to the expression of symptoms from the standpoint of an etiological examination, SMA (n = 44, 65.7%) and SBMaA + SMeA (n = 8, 80.0%) were significantly more frequent where the causes were dental in origin, with lymphadenitis found to be significantly more common in SMC (75%), and tonsillitis more common in PTA (90%) (p = 0.000, p = 0.000, p = 0.000). In particular, the causes determined in relation to NEF and LUA were found to be fewer than those that could not be determined (p = 0.000). (Table 3)

For diagnosis, USG was used as an imaging method in SMC (87.5%), SBMaA + SMeA (70%) and SMeA (66.7%) (p = 0.000). A significantly higher rate of CT was used in NEF (100%), LUA (88.2%), AMTA (80%), and PFA (100%) (p = 0.000). (Table 3)

Tranoral incisional drainage was used for peritonsillar abscesses and localized abscesses with dental origin. Tonsillectomy was recommended for all patients in elective conditions after peritonsillar abscess treatment. When the patient’s mouth opening was sufficient after incisional drainage, the relevant clinic extracted the problematic tooth. In treatment, incisional drainage, in combination with antibiotherapy, was found to be statistically significant in PTA (100%), SMA (94.0%), SMeA (100%), SBMaA + SMeA (100%) (p = 0.000). However, it was found that surgical debridement was performed with antibiotherapy in NEF (100%) and LUA (52.9%). In the treatment of SMC (100%), it was found that the use of antibiotherapy only was sufficient (p = 0.000). (Table 3)

Discussion

The most important factors in the process followed from diagnosis to treatment in DNI; were the anatomy of the neck fascia, Ludwig’s angina (LUA), necrotizing fasciitis (NEF), and submandibular cellulitis (SMC). / white blood cell (WBC), C-Reactive Protein (CRP), erythrocyte sedimentation rate (ESR)

Figure 1 Diagnosis distribution by age groups.

NEF (mean: 26.4 days, p = 0.000). (Table 3)

There was no statistically significant difference between the median values of WBC, ESR, CRP and the diagnoses. (p = 0.238, p = 0.671, p = 0.055). (Table 2)

When symptoms and findings were compared with nine diagnoses, a significant difference was found between the other symptoms and findings and diagnostic groups except for fever (p = 0.136) and skin fistulization (p = 0.077). In PTA, a sore throat was seen in all patients (p = 0,000), trismus (n = 6, 60%) was most common in PTA (p = 0.000) and swallowing difficulties were significantly higher in PTA (n = 9, 90%) than other diagnoses (p = 0,000). Neck swelling was found least in PTA (10%) (p = 0,000). Neck pain was found least in SMA (10%) (p = 0,000), trismus (p = 0.136) and skin fistulization (p = 0.077). In SMA, the most common symptom was swelling (p = 0,000) and swallowing difficulties were significantly more common in SMA (94.0%) and SMeA (100%) (p = 0,000). In SMA, the most common symptom was swelling (p = 0,000) and swallowing difficulties were significantly more common in SMA (94.0%) and SMeA (100%) (p = 0,000). In SMA, the most common symptom was swelling (p = 0,000) and swallowing difficulties were significantly more common in SMA (94.0%) (p = 0,000, p = 0,000, p = 0,000). In particular, the causes determined in relation to NEF and LUA were found to be fewer than those that could not be determined (p = 0,000). (Table 3)

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the potential spaces created by this fascia, the location of these potential spaces, and the means of accessing these areas during surgery [8, 9].

Thanks to increased awareness of antibiotics and oral hygiene, although the incidence of DNIs has decreased, the mortality rate can be up to 50% when it occurs, especially when complications develop [1, 2, 10]. In our clinic, we reviewed the diagnoses, follow-up and treatment processes of 166 patients aged 1-78 diagnosed with DNI with a high risk of mortality and morbidity and hospitalized.

Studies conducted on DNI revealed that patients consisted mostly of men with the condition seen less frequently in children than adults. Although it can be observed at any age, it is more common in adults in the 3rd and 5th decades [11-13]. In children, the average age of occurrence was 9.5 ± 5.3 years in a study by Polat et al. and 5.6 ± 3.1 years in a study by Belet et al. [14, 15]. Similar to many studies in the literature, in our patient group, 60.2% of the patients were male, and 63.9% were adults. While the mean age of the adults was 37.05 ± 15.02 years, the average age of the children was 7.25 ± 4.57 years.

The length of hospital stay varies depending on the presence of comorbid diseases and the severity of the existing pathology. However, when the literature is reviewed, it is thought that the length of time that children stay in hospital is less than that of adults, which may be related to the lower incidence of comorbid diseases in children. This point sheds additional light on the underlying aetiology [16,17].

Following the literature, our study found that adults (9.00 ± 15.02 days) stayed longer in the hospital than children (7.25 ± 4.57 days). Compared to other diagnostic groups, it was determined that a diagnosis of SMC, which is relatively less complicated, was observed at a significantly earlier age. In addition, diagnoses with a greater probability for the development of complications, such as LUA and NEF, were mostly seen in the adult group. The duration of hospital stay was significantly longer than in other sub-diagnosis groups.

Detecting pathologies in children at an earlier stage can be attributed to parents’ sensitivity to their children and earlier consultations with health care providers.

DNI causes symptoms such as fever, sore neck, swelling, difficulty swallowing, trismus and respiratory difficulties. In studies conducted, fever, pain and swelling are encountered most frequently in children and adults [18, 19]. Similarly, the most common symptoms for children and adults were fever, pain and swelling. Since trismus is seen more frequently in PTA and high respiratory distress in NEF and LUA, it can be concluded that both symptoms and findings are important in diagnosis.

Poor oral dental care and comorbid and immunosuppressive diseases are conditions that accompany DNIs [13]. From an etiological standpoint, it has been observed that problems of dental origin were more prominent in recent studies. Dental pathologies in 44.6% of patients (n = 1380) in a meta-analysis of 3091 diseases in 2017. Pharyngotonsillitis was seen to rank second at 14.2% (n = 440) [20].

When adults and children were examined separately in terms of aetiology, it was seen in some studies that tonsillopharyngitis in children was the primary cause and dental causes were second [18, 21]. In our study, dental causes were the primary cause identified in both groups, following the literature. Dental causes in relation to the submandibular region were also significantly higher among the sub-diagnosis groups. It is thought that this difference in the children’s group may be attributable to levels of socioeconomic development, with the submandibular region exposed to more infections due to its location.

In the case of acute phase reactants, serum concentrations increase in ESR and CRP values in response to inflammation and increase in DNIs together with WBC [18, 21, 22]. In our study, it was found that CRP, ESR and WBC values were above normal in both adults and children, but no statistically significant differences were observed in the sub-diagnosis groups of CRP, ESR and WBC relative to each other.

Since head and neck infections are potentially life-threatening, the diagnosis phase should be short to plan treatment. Therefore, the selection of imaging methods and the correct interpretation of findings are very important [23]. In a study on imaging methods, it was stated that USG provides sufficient information about the location and extent of the inflammation and can be used as the primary imaging method, while CT can be used in patients who are worse clinically and thought to have deeper levels of infection [24]. In addition, it was stated that USG can be used in the treatment phase - the abscess drainage accompanied by USG shortens the length of hospital stay and may be an alternative to incisional drainage in the drainage of deep neck abscesses [25]. When we examined our diagnostic imaging methods, it was observed that the number of patients where CT and USG were used was equal in children.

In contrast, in adults, the number of patients who received CT was greater than the number who received USG. Our study determined that USG was used in the cellulitis stage, particularly in the earlier stage of cellulitis, where the complications of DNIs are fewer and that it was used in clinically more severe cases, especially in abscess formation. After evaluating the symptoms and findings resulting from this, USG can be considered the primary imaging method.

With respect to those areas where DNI shows the most common involvement, it is seen that the submandibular region is more common in adults. In a study by Adovica et al., consisting of 263 patients, it was shown that the submandibular region was most frequently affected due to dental problems, and in a study by Patil et al., the submandibular region was most frequently involved. In a study by Huang et al. it was noted that the most frequently affected area in children was the parapharyngeal region. Kaya et al. stated that their study involved the submandibular region as the most common [13, 18, 21, 26]. Similar to previous studies, our study found that the most frequently affected area in adults and children was the submandibular region. Given that the biggest cause of submandibular infections is poor oral hygiene and dental diseases, oral and dental health can be considered important in our region.

Regardless of the stage of infection, antibiotic combinations, including aerobic and anaerobic bacteria, are recommended in treatment. In studies conducted, starting treatment for lymphadenitis and cellulitis with appropriate antibiotics is recommended. When an abscess occurs, surgical drainage is recommended. In a 1034 disease series published by Prabhu et al., 115 (11.12%) patients have treated with ceftriaxone + sulbactam and lincomycin. All the remaining patients were treated with a combined surgical approach in the form of broad-spectrum antibiotics and surgery [27, 28]. In our patients, dual antimicrobial (ceftriaxone + metronidazole) was initiated in most patients; combined treatment of incisional drainage and antibiotic therapy was seen in 67.47%. While only antibiotic therapy was sufficient in 19.87% of patients, 12.65% were treated with surgical de-
bridement and antibiotherapy. While dual antibiotherapy was sufficient for treating patients in the SMC group, surgical debridement with dual antibiotherapy was required for patients diagnosed with LUA and NEF. Incisional drainage was applied to the abscesses in the submandibular region together with dual antibiotherapy. Regarding the health institution, it was thought that antibiotherapy delivered as early as possible would be sufficient for treatment.

The airway is very important in this patient group, and opening a tracheostomy can be life-saving, especially when respiratory distress develops [29]. In our patients, tracheostomy was performed in 9 of 15 patients, who developed respiratory distress, and all of the patients who underwent tracheostomy were in the adult group.

The mortality rate increases when complications develop [30]. In a meta-analysis conducted in Spain in 2017, 0.97% of 3091 patients died [20]. In our study, 1.2% of our patients died. Our patient, who was diagnosed with Ludwig’s angina and passed away, had respiratory distress at the first admission, so a tracheostomy was performed with incisional drainage. Broad-spectrum antibiotics were started. The patient, who had a known history of diabetes and coronary angiography, died while in the coronary intensive care unit due to myocardial infarction. Debridement was performed with rapid drainage in our patient, who died with the diagnosis of necrotizing fasciitis. A tracheostomy was opened. After the surgical area was washed with hydrogen peroxide, sterile gauze pads impregnated with nitrofurazone and rifampicin were spread over the area. Because of mediastinitis, pleural lavage was performed by the thoracic surgery clinic, and a thorax tube was inserted. Repeated surgical debridements were repeated in the follow-ups. Daily dressings were applied to the wound with sterile gauze-impregnated nitrofurazone and rifampicin after the wound was washed with hydrogen peroxide. Our diabetic patient died due to multi-organ failure after sepsis while being followed up in the intensive care unit.

Although progress has been made in oral and dental health since the end of the 20th century, it is not yet possible to say that this progress has been fully reflected in the world population.

In addition, despite advances in preventive and therapeutic applications, dental problems remain the most common childhood disease. That is because; The fact that the importance of oral and dental health is not fully understood worldwide can be viewed as a need that can be postponed under most conditions. The subject is not sufficiently inclined, particularly in low and middle-income countries [31-33].

This research was conducted in a developing country, Turkey, in the southeastern Anatolia region of it, which is relatively behind in terms of development level compared to other regions. As a result, it can be thought that patients who apply to our clinic, in comparison to other regions, give less importance to oral and dental health and seek treatment later in health institutions due to the conditions created by the socio-cultural development level. With awareness to be increased about oral and dental health, many deep neck infections of dental origin, which can still cause significant fatal complications, can be prevented, and the lives of many children and adults can be saved. It is possible to avoid hospitalization and treatment costs. Retrenchment is possible economically as well as manpower.

Limitations
For more precise data and generalizable results, there is a need for studies with a certain number of patients in each diagno-

sis group in which the number of patients is homogeneously distributed. In addition, large-scale multicenter studies are required to reflect the results obtained in a certain geographical region or country.

Conclusion
Although the frequency of DNI has decreased, and despite technological developments and increasing levels of awareness, DNI still carries a serious risk of mortality and morbidity due to its important and potential complications. The frequency of causes, which are dental in origin in the aetiology, show that the importance of oral and dental health is still not fully realized. The reduction of morbidity and mortality depends on rapid diagnosis and appropriate treatment selection.

Declarations
Funding
This research did not receive any specific grant from public, commercial, or not-for-profit funding agencies.

Conflict of interest
The authors have no competing interests.

Ethical approval
Ethics committee approval (Date: 22/12/2020) - No:32 was obtained from local University Non-Interventional Clinical Research Ethics Committee.

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