

*Original Article***Predisposing Factors for the Complications of Deep Neck Infection**

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**Abstract****Introduction:**

The advent of antibiotics and the improvement in dental hygiene have made the occurrence of deep neck infections less frequent than in the past. Nevertheless, the complications of these infections are often life threatening. The purpose of this study was to review the clinical findings in deep neck infections and identification predisposing factors of these complications.

**Materials and Methods:**

In this study, 147 patients with deep neck infections were studied in Imam Khomeini Hospital, Ahvaz, from 1997 to 2009. During the treatment, 24 cases of life threatening complications took place. Linear and logistic regressions and chi-square analysis were used to determine the association of the complications of deep neck infections with clinical parameters and longer hospitalization.

**Results:**

Analysis showed that patients with older age, patients with involvement of more than two spaces, involvement of cervical spaces, lymphadenitis, septic sore throat, congenital cyst as a source of abscess, odynophagia, dysphagia are those who require longer hospitalization ( $P<0.05$ ). Complications are more likely to take place in patients with involvement of more than two spaces, involvement of cervical spaces, septic sore throat and odynophagia ( $P<0.05$ ).

**Conclusion:**

Patients with involvement of more than two spaces or with underlying disease are at high-risk of deep neck infection complications and should be monitored more closely during hospitalization.

**Keywords:**

Complication, Hospitalization, Infection

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### **Introduction**

Deep neck infections can originate from different parts of the neck like teeth, salivary glands, paranasal sinuses, pharynx and adenotonsil tissue. The life-threatening infections which are originated from teeth or upper aerodigestive tract may intrude into potential spaces that are covered by neck fasciitis. Infective involvement of these spaces has substantially declined by antibiotics consumption (1,2).

Nevertheless, the risk of the mortality and morbidity is not unlikely especially when the complications exist. In a study of 196 cases presenting deep neck infections, 15 patients had been afflicted by deadly complications (2). These include mediastinitis, empyema, pericardial effusion and jugular vein thrombosis. Neck necrotizing fasciitis can cause dyspnea, delirium, mediastinitis, pericardial tamponade, DIC, and neuropathy which is responsible for 64% of mortality cases that is 15% higher than isolated neck involvement. Today, the main source of neck infections in children and adults are tonsil and dental infections, respectively (3). In this research we studied influential factors in developing and progressing neck abscesses and their relationship with complications and length of hospitalization time.

### **Materials and Methods**

In our study which has been done retrospectively, 147 cases of deep neck infections that were under treatment in the Imam Khomeini Hospital of Ahvaz from 1997 to 2009 were studied and abscess cultures were performed for all of them. Twenty four of them were afflicted by life-threatening complications during treatment. By two methods of linear regression and logistic regression, clinical parameters including longer hospitalization and occurrence of complications were studied. The cases with dermal infections, infections associated with external neck wounds or head and neck tumors were excluded. Diagnostic criterion for all patients was 10cc syringe aspiration after being visited by otolaryngologists or assistants except

suspects of retropharyngeal abscesses and deeper spaces involvement which were recognized by contrast-enhanced CT. As a primary treatment, surgery (incision and drainage) was performed for all cases and intravenous antibiotics (penicillin, metronidazole ± ceftriaxone) were prescribed until receiving the result of the cultures. Based on Lee and his colleagues, variables were selected for study which include dependent and independent variables mentioned below:

Gender, age, abscess locality, numbers of involved spaces, fever above 38° C, swelling of the neck, trismus, dysphagia, odynophagia, duration of symptoms, WBC>15000, underlying diseases, bacteria caused abscesses, primary infections and complications (mediastinitis, sepsis, dyspnea) (4).

In addition, primary infections were recognized by physical exam and taking cultures as well as secretion smears under aerobic circumstances in microbiology laboratory of Imam Khomeini Hospital of Ahvaz.

### **Results**

#### *Clinical and demographic data*

In the present article, 147 cases of deep neck abscess were evaluated that include 79 males (53.74%) with average age of 39.63±16 as well as 65 females (44.21%) with average age of 42.80±13. the most frequent symptom was the swelling of the neck (128 cases, 87.1%) and the rest were trismus (79 cases, 53.7%), dysphagia (45 cases, 30.6%) and odinophagy (43 cases, 29.3%).

#### *Origin of infections*

The main reason for neck infection was dental causes (74 cases, 50.3%) while 24 cases (16.3%) occurred after pharyngitis, 23 cases (15.6%) were afflicted after lymphadenitis and 9 cases (6.1%) occurred as the consequence of congenital cervical cyst infections.

#### *Bacteriology and underlying diseases*

Results of bacterial cultures for 40 cases (27.21%) were positive. Among positive cultures, *Positive coagulase staph* was the

most significant pathogen (31 out of 40, 77.5%), *Negative coagulase staph* was in second rank (7 cases, 17.5%) and then *β-hemolytic streptococcus* as well as *Enterobacter* (each one 12.5%), *α-hemolytic streptococcus* (7.5%), *Klebsiella* and *Non hemolytic streptococcus* (each 5%) and finally *Pseudomonas* (2.5%). Forty five cases out of 147 ones (30.61%) had underlying diseases including diabetes (28 cases) (19%), immunodeficiency following the consumption of immunosuppressive medicines (10 cases) (6.8%), drug addiction (7 cases) (4.8%).

#### *Spaces involved in deep neck infections*

The most common spaces involved were submandibular space (102 cases, 35%), pterygomandibular space (51 cases, 17.64%), buccal space (34 cases, 11.76%), submental space (20 cases, 6.92%), parapharyngeal space (19 cases, 6.57%), peritonsillar and retropharyngeal space (for each one 5.88%), masseter space (13 cases, 4.49%), sublingual (10 cases, 3.46%), paratracheal (3 cases, 1.03%) and finally, canine, temporal and sternocleidomastoid sheet abscess (each one 1 case, 0.346%). Twenty four patients had been afflicted by life-threatening complications and 8 of them died and for 4 of them tracheostomy was done due to dyspnea caused by neck deep

space involvement and trismus. Four of them got fasciitis while 2 of them had mediastinitis. All of them died due to multiple organ failures and septic shock. Seven patients with complications were afflicted by necrotizing fasciitis that under intensive and appropriate antibiotics were treated.

Four cases had positive culture that one of them was *Negative coagulase staph* as well as one which was *α-hemolytic streptococcus* and the rest were *Enterobacter*. Thirteen patients from the cases which developed complications had underlying diseases; 10 cases were diabetic, 2 of which were addicted to drugs, 1 had immunodeficiency. Six died (6 out of 8 patients who died had accompanying underlying diseases).

Factors relevant to length of hospitalization include: gender, odynophagia, dysphagia, number of involved spaces, involving temporal and peritonsillar spaces, congenital cysts, suppurative pharyngitis and lymphadenitis.

Factors associated with complications include: number of involved spaces, pharyngitis, odynophagia, temporal, peritonsillar, sternocleidomastoid sheet space involvement and presence of underlying diseases.

**Table 1:** Summary of patients afflicted by life-threatening complications

Cases	Age/Sex	Space	No. of involved spaces	Cause of the primary infection	Culture	Complications	Underlying diseases	Outcome
1	30/M	5	1	1	3	5	3	Treated
2	65/F	10	1	4	3	2	1	Treated
3	43/M	1.3.9.10	3	4	3	5	1	Treated
4	43/F	1.3.4	3	1	3	5	1	Treated
5	37/F	8	1	4	3	3	4	Treated
6	23/M	1	2	1	3	1	1	Expired
7	30/M	1.2.3.4.7	3	1	3	2	3	Treated
8	60/M	1.2	3	1	3	2.5	1	Expired
9	64/M	1	1	1	3	1.2.3.5	4	Expired
10	45/M	8	1	9	3	2	1	Treated
11	65/M	9.8.13	3	4	3	2	4	Treated
12	20/M	8	1	9	3	2	4	Treated
13	30/M	1.3.4	3	1	3	1.2.3	4	Treated
14	28/F	1.13	3	10	3	1.2	2	Expired
15	34/M	3.9.10	3	4	3	2.3	2	Treated
16	30/M	1.2.3.6.9	3	1	3	5	1	Treated
17	40/M	8.9.10	3	4	3	3.5	4	Expired
18	40/M	1.3.4	3	1	1	1.5	1	Expired
19	41/F	1.3.6.9.11	3	4	3	2.5	4	Treated
20	54/M	1.2.3.4.6.10	3	1	3	1.2	1	Expired
21	43/M	1/2	2	4	7	5	1	Treated
22	50/M	13	1	1	8	1.2.5	1	Expired
23	22/M	1/2	2	1	3	2.5	3	Treated
24	38/M	10/8	2	4	8	2	4	Treated

Involved spaces: 1. submandibular, 2. sub mental 3. petriigo mandibular 4. buccal 5. canin 6. sublingual 7. temporal 8. retropharangyal 9. parapharyanx 10. peritonsillar 11. master 12. Sternocleidomastoid sheet abscess 13. parateraceal.

No. of involved spaces: 1. one space 2. two spaces 3. more than two spaces  
primary infection: 1. dental infection 2. congenital cysts 3. lymphadenitis 4.

pharyngitis 9. hematom 10. dermal diseases

Culture: 1. *Negative staph coagolase* 3. no bacterial grows 7. *α-hemolytic streptococcus* 8. *Entro bacter*

Complications: 1. septic shock 2. dyspnea 3. mediastenit 5. necrotizing fasciitis

Underlying diseases: 1. diabetes 2. immunodeficiency; 3. drug addiction 4. without underlying disease.

**Table 2:** Results of regression analysis of variables causing longer hospitalization

Variables	Standardized coefficients (Beta)	t	P
Sex	0.267	3.156	0.002
No. of involved spaces (more than two spaces)	0.174	2.034	0.044
Temporal spaces abscess	0.261	3.114	0.002
Peritonsillar space abscess	0.224	2.653	0.009
Odinophagy	0.304	0.674	0.000
Dysphagia	0.229	2.713	0.008
Congenital cysts	-0.175	-2.046	0.043
Pharyngitis	0.193	2.270	0.025
Lymphadenitis	-0.232	-2.753	0.007

**Table 3:** Results of regression analysis of variables causing complications

Variables	P	Adjusted odds ratio	95% confidence interval
No. of involved spaces (more than two spaces)	0.00	874.4	1.918-12.388
Pharyngitis	0.013	6003	844.317-9.1
Temporal abscess	0.010	834	896.402-11.1
Peritonsillar abscess	0.024	626.3	087.186-0.1
Sternocleidomastoid sheet	0.049	71411	026.016-135.1
Odinophagia	0.037	6352	558.059-61
Underlying diseases	0.000	5.875	2.269-15.213

### Discussion

Before initiation of antibiotic era, most of the deep neck infections were due to the complications of pharyngeal infections (4,5) but in this study, the source of infection in only 22 cases (14.96%) was in pharynx and tonsils. Some studies show a considerable prevalence of deep neck infections due to dental infections (22.7-43%) (6-9). In a similar way, the recent study demonstrates that the most prevalent reason for neck infections is dental source (50.3%) that may be due to delay in treatment as the consequence of dental services expenses as well as in reflections toward oral hygiene in comparison to pharyngotonsillitis. The studies show that sever deep neck infections like necrotizing mediastinitis and secondary

neck necrotizing fasciitis are caused by dental infections (4). In our survey 11 patients (50%) out of 24, who were afflicted by complications, had dental infections. Generally, these findings demonstrate a reduction in pharyngotonsillitis incidents as well as an increase in dental infections and immunodeficiency incidents as the reasons of deep neck infections.

A collection of aerobic and anaerobic bacteria are involved in creating such infections. Anaerobic bacteria like *Peptostreptococ*, *Bactereroid*, *Protella*, *Fuzobacterium* and *Actinomyces* and aerobic bacteria like *Streptococcus* especially *Viridians* and *Staphylococcus aureus* can be mentioned. On the other hand, gram negative bacteria were found in hospital infections (10).

This study showed that *Positive coagulase staph* is the most (16 cases, 40%) prevalent pathogen among positive cultures and on the second rank is the *Negative coagulase staph* (17.5%) which is different from Lee's study in Korea that introduced the *Klebsiella* as the most prevalent pathogen (4), and Parhiscar's research in New York which claimed that the most predominant pathogen was *Streptococcus viridians* (8) and Regueiro Villarin's one in Spain that pronounced  $\beta$ -hemolytic streptococcus as the most prevalent pathogen (11) and also Wang's study that *Klebsiella pneumonia* was mentioned as the most prevalent pathogen (2). But it somehow contradicted the study done in 2006 by Ragal who declared that Cocci were prevailed in aerobic cultures although the species of Cocci were not determined (12).

Generally, *Streptococcus viridians* is the most relevant pathogen to dental infections; in this study, 55.8% of cases with positive culture results, had dental infections while *Positive coagulase staph* is an unusual one.

*Streptococcus* is a very sensitive microorganism; its growth in casual mediums is far-fetched and needs special conditions which were not available in our laboratory.

Unfortunately, using only aerobic cultures in a less equipped laboratory and noticing this fact that *Streptococcus viridans* (positive in dental infections) is very sensitive, we cannot judge accurately about actual prevalence of influential pathogens in neck infections.

In this research, the most frequently underlying disease is diabetes (27 cases) which is in compliance with many other studies (2,7,9,12). *Klebsiella pneumonia* was positive in cultures of two diabetic patients because the virulence of *Klebsiella* is determined by function of host microphages (12) and the function of microphages vanishes in hyperglycemic condition (13) so for such patients controlling the blood sugar play the key role in the treatment process.

Moreover, the study shows that presence of underlying diseases increases the possibility

of being complicated by more than 5 times. Although in this study like Lee's research diabetes was not the substantially predisposing factor in complicated deep neck infections, according to what mentioned above, diabetic patients should be considered as the risky patients during treatment (4).

In this study, 61 (41.5%), 41 (21.89%) and 45 cases (30.61%) had one, two and more than two involved spaces, respectively, and involving more than two spaces is a significantly predicting factor to get deep neck infection complicated ( $P=0.001$ ) that is similar to Lee's statistics (4).

The predominantly involved space in this study was submandibular and then pterygomandibular.

Which is consistent with Ragal, Meher (12,14) Gandomi and Reguero Villarin (9,11) who introduced the submandibular space as the most prevailing one while disagrees with Parhiscar's and Huang's studies which announced parapharynx as the prevalent space (8,15).

The period of being diagnosed in females (16-22 days) is longer than males (10-16 days) and this difference was statistically meaningful ( $P=0.001$ ).

It seems that females seek for treatment later compared to males that is due to particularly cultural conditions of the province but generally the length of hospitalization for both genders is the same while obviously complications are more in males ( $P=0.005$ ). Moreover, lymphadenitis as the primarily cause of deep neck infection is more prevalent in females ( $P=0.007$ ).

In Lee's study, there was no sign relevant to length of hospitalization as well as complications. But in Wang and his colleagues' research neck swelling and respiratory problems in females were high-risk factors for deep neck infections (2,4). In addition, Chen and his colleagues announced that cases with an underlying disease, swelling of the neck and delay in visit had positive relationship with deep neck infection (16). Mortality rate in our study was 5.44% which was considerably higher in comparison to Lee's study who reported

1.9%. We didn't find a particular reason for that; of course owing to our studying on only cases for which taking cultures were performed, and taking into consideration that results of these cultures pursued more seriously, it can be claimed that the prevalence of complications and death is higher than the real predominance; although in some studies the death rate reported up to 40-50% (2,7).

### **Conclusion**

The complications of deep neck infections are so life-threatening that recommended for high-risk groups like diabetic patients and cases who have more than two involved spaces as well as some deep neck spaces involvement and having some medical symptoms like sore throat and dysphagia in their hospitalization period, having to be considered more seriously.

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