Section: ENT

Original Research Article

# A COMPREHENSIVE STUDY OF NECK SPACE INFECTIONS

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*Received* : 24/12/2024
*Received in revised form* : 05/02/2025
*Accepted* : 22/02/2025

*Keywords:*
*Neck space infections, Peritonsillar abscess, Ludwig's angina, Multiple space involvement.*

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DOI: 10.47009/jamp.2025.7.1.165

Source of Support: Nil,
Conflict of Interest: None declared

*Int J Acad Med Pharm*
2025; 7 (1); 842-848

## Abstract

**Background:** Deep neck space infections are dreadful infections with considerable mortality. Unlike abscesses elsewhere in the body, these are prone for fatal complications due to proximity of aerodigestive tract and major vasculature of neck. Neck space infections are usually due to excessive growth of normal flora, mostly of polymicrobial in origin, these are commonly seen in low socioeconomic group with poor oral hygiene and nutritional disorders. There is a rise in recent past due to diabetes, HIV etc. The clinical presentation depends on the deep neck space affected. Management of these infections need best understanding of anatomy of neck spaces, with the advent of better diagnostic modalities, newer antibiotics and improved methods of managing critically ill patients, fatality due to neck space infections have come down. With an insight into prevention of these dreadful infections, patient education regarding oral and dental hygiene has to be strengthened. **Materials and Methods:** This study is a prospective observational study carried out in the department of otorhinolaryngology, Osmania medical college and hospital, Hyderabad, Telangana over a period of two years in all patients with history and symptoms suggestive of deep neck space infections. Data was collected including detailed history, local and systemic examination, Laboratory, Microbiology, Radiological Investigations, Management etc Data was analysed and expressed in percentages and fractions. **Result:** It was observed that the maximum number of cases were seen in the age group of 11-20 years at 26.6%, followed by 21-30 age group at 22.34%, 17% between 31-40 years and 10.63 between 51- 60 years. The male to female ratio is 1:0.592. Of all the neck space infections, peritonsillar space infection was found to be the highest 35 cases, next common was 32 cases of Ludwigs angina. Deep neck space infections (DNSI) with multiple space involvement were noted in 16 cases out of 94. Only 24 cases (25.5%) have shown a proper etiological agent. Rest all were idiopathic without any striking etiological agent. Of these 24 cases, 21 cases were Ludwig 's angina. 19 cases of 21 cases showed dental infection as etiological agent. Our study showed that medical treatment was sufficient to cure DNSI in 40 cases (42.5%). **Conclusion:** Out of all deep neck space infections, peritonsillar infections are common followed by submandibular space infections. Most common mode of presentation is with dysphagia. The commonest organism isolated is staphylococcus followed by streptococcus, with least resistance to Ciprofloxacin and Metronidazole. Complication rate is very low with proper antibiotics and timely surgical intervention.

## INTRODUCTION

Deep neck space infections are dreadful infections in the body with considerable mortality. Unlike abscesses elsewhere in the body, these are prone for fatal complications due to proximity to aerodigestive tract and major vasculature of neck.

**Potential neck spaces:** The three layers of deep fascia encircling viscera, neurovascular bundle, glands, and muscles of neck, create potential spaces in neck which can be classified as 1-8:

**1. Spaces involving the entire length of neck.**
I. Retropharyngeal space. 2. Prevertebral space. 3. Paravertebral space. 4. Visceral vascular space (within the carotid sheath).

**II. Spaces above the hyoid bone.**
I. Submandibular space. 2. Parapharyngeal space. 3. Masticator space. 4. Parotid space. 5. Peritonsillar space.

**III. Spaces below the hyoid bone.**
Anterior visceral space (pretracheal space).


ISSN (O): 2687-5365; ISSN (P): 2753-6556

**Etiology and Pathogenesis:** Aetiology of deep neck space infections varies depending on the space involved. In general, the neck spaces get involved by various portals of infection. They are:

- Tonsillar and pharyngeal infections.
- Dental infections.
- Upper aerodigestive tract trauma.
- Sialadenitis.
- Infections of temporal bone. That is Bezolds apicitis, Petrous apicitis
- Congenital cysts and fistulas.
- Retropharyngeal lymphadenitis — common in children.
- Pott's disease.
- Infected metastatic neck nodes.
- Intravenous, subcutaneous drug injections.

The individuals at risk of developing neck space infections are immunocompromised individual like patients with:

- Diabetes mellitus10.
- Sexually transmitted diseases predominantly HIV.
- Steroid therapy for recent organ transplantation.
- Chemotherapy.
- Chronic ailment like tuberculosis, alcoholic hepatitis.
- Drug addicts injecting into various areas of neck.
- Poor socioeconomic status with nutritional deficiency disorders and poor hygiene status.

**Investigations**

General work up of neck space infections includes detailed history and thorough physical examination with an insight into etiological factors.

The initial laboratory examination should consist of:

- Complete blood picture with differential count.
- Erythrocyte sedimentation rate.
- Serum electrolyte levels. Calcium levels.
- Coagulation parameters.
- Blood culture if there is evidence of septicaemia with gram staining.
- Aspiration of pus if there is abscess and it is subjected tbr smear for microscopic examination, culture and drug sensitivity. Smear for KOH mount should be done if there is any suspicion of fungal infections.
- Blood sugar levels.
- Renal parameters including blood urea and serum creatinine.
- Battery of serological tests to find out sexually transmitted diseases if there is any, which includes AIDS, Hepatitis B.

Radiological investigations: These have to be tailored to the individual patient depending on the spaces involved. They are X-ray films. High KV X-rays describe well soft tissue anatomy of neck.

Lateral neck X-ray films: In Ludwig's angina, posterior displacement of tongue and encroachment of airway can be assessed, which gives a clue of necessity of tracheostomy. In retropharyngeal space infections, it stands as a single most important study. Normally retropharyngeal space should be no more than one third of width of C2 vertebra. If it is more than that, it is considerable. According to Wholey and colleagues, retropharyngeal space measuring greater than 7mm in both children and adults and measurements of the retro tracheal space greater than 14mm in children and 22mm in adults are suggestive of a pathological process. Another useful sign is loss of normal cervical spine lordosis or curvature with straightening of cervical vertebral column.

Antero posterior X-ray neck films including mandible: These can be useful in case of parotid and masticator space infections. It gives an idea of swelling in relation to mandible, lateral or medial to it with amount of displacement of soft tissues. Presence of multiple air bubbles in X-ray films indicate necrotizing fasciitis which is a separate entity and necessitates emergency surgical management.

Ultrasound Neck: It is an important diagnostic tool in neck space infections. Role of ultrasound in neck space infections is, it can find out deep seated loculi, which are the cause of repeated abscesses. It can comment about displacement of major vessels, guiding the surgical management. It can differentiate an abscess from nearly enlarged lymph nodes in acute lymphadenitis. Compared with CT and MRI it is economical, can be done at Bedside and give valuable information if done in expert hands.

Computerised tomography (CT) and Magnetic resonance imaging: They are quite helpful in delineating the site and extent of involvement of infections and in differentiating cellulitis from abscess formation, contrast enhanced CT will help in determining the relationship of infectious process to the cervical vasculature. It can demonstrate whether or not the internal jugular vein is patent.

**Management**

It can be divided into: 1. Conservative management 2. Surgical management

Method of management depends on the stage of disease at the time of presentation4, like the stage of cellulitis or abscess. In general, conservative management includes:

- Parenteral antibiotics, preferably broad-spectrum antibiotics with coverage for anaerobic bacteria
- Nutritional support and the maintenance of hydration status in the form of administering Intravenous fluids.
- Analgesics and antipyretics.
- Maintenance of oral hygiene.
- Monitoring vitals as spikes of temperature indicate episodes of septicaemia.
- Watch for progression of symptoms like dysphagia and dyspnoea which may guide for surgical management.

**Surgical management:** Mosher said of deep neck infections "Pus in the neck calls for the surgeon's best judgement, his best skill and often for all of his courage". It depends on the spaces involved and extension of disease.[12]


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Principles of surgical management by incision and drainage:

- Adequate exposure.
- Breaking all loculi and let out the pus.
- Thorough wash of the space with betadine, drains are kept and wound left open with dressing. Management of these infections needs surgeon's best skills and courage as said by Mosher, the pioneer of neck space infections.

**Complications:** Deep neck space infections may lead to complications which are rare in present era25, due to availability of broad-spectrum antibiotics. They are: Osteomyelitis (Subluxation of vertebra): It is seen in retropharyngeal and prevertebral space infections especially in potts disease, that is tuberculosis of cervical spine.[1-3]

**Mediastinitis:** This complication can be due to delayed diagnosis and management of prevertebral and retropharyngeal space infection and involvement of carotid sheath. X-ray chest may show mediastinal widening with air fluid level if abscess formation is noted. Management includes apart from intravenous broad-spectrum antibiotics, thoracic drainage of mediastinal abscess which carries extremely high mortality rate.[4-6]

**Horner's syndrome:** Due to involvement of cervical sympathetic chain, in case of carotid sheath involvement in neck space infections, this results. The symptomatology includes ptosis, myosis, anhidrosis, enophthalmos. Management of these infections needs best understanding of neck fascia and anatomy of neck spaces. But because of lack of universally accepted definition of fascia, there is much ambiguity regarding the anatomy. Described by Levitt as, it is the terminology that is confusing, not the anatomy.[7,8]

With the advent of newer antibiotics and improved methods of managing critically ill patients, fatality of neck space infections has come down. Still there is much scope for further work in this regard, to standardise the nomenclature of anatomy of neck spaces, to reduce incidences, for earlier diagnosis and better management.[9]

## MATERIALS AND METHODS

This study is a prospective observational study carried out in the department of otorhinolaryngology, Osmania medical college and hospital, Hyderabad, Telangana over a period of two years in all patients with history and symptoms suggestive of deep neck space infections. A sample size of 94 patients with history, symptoms suggestive of deep neck space infections were included in the study. Patients with neoplasms of oral, nasal and Pharynx were excluded from the study. Data was collected including detailed history, local and systemic examination, Laboratory, Microbiology, Radiological Investigations, Management etc Data was analysed and expressed in percentages and fractions.

## RESULTS

Our study consists a total of 94 cases.

**Sex Incidence:** Male 59 and Female 35 cases were noted.

**Table 1: Sex distribution**

| Gender | N | % |
|---|---|---|
| Male | 59 | 63 |
| Female | 35 | 37 |
| Total | 94 | 100 |

**Age Incidence:** In common to all infections, the age incidence ranges from 10 months baby of submandibular cellulitis to 65 years with right quinsy. The highest incidence of neck space infections was noted in 11 - 20 yrs age group.

**Table 2: Age distribution**

| Age (years) | N | % |
|---|---|---|
| <10 | 11 | 11.7 |
| 11-20 | 25 | 26.6 |
| 21-30 | 21 | 22,34 |
| 31-40 | 16 | 17 |
| 41-50 | 7 | 7.44 |
| 51-60 | 10 | 10.63 |
| >60 | 1 | 1.06 |
| Total | 94 | 100 |

Of all the neck space infections, peritonsillar space infection was found to be the highest 35 cases, next common was 32 cases of Ludwigs angina. Deep neck space infections (DNSI) with multiple space involvement were noted in 16 cases out of 94. Of this combination of Ludwigs angina with pretracheal space involvement was noted frequently. Irrespective of any neck space infections, apart from features of septicaemia, the specific clinical feature commonly found was dysphagia.

**Table 3: Location of the DNSI**

| Location of the DNSI | N | % |
|---|---|---|
| Peritonsillar | 35 | 37.23 |


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| | | |
|---|---|---|
| Submandibular | 32 | 34.04 |
| Parotid | 3 | 3.1 |
| Parapharyngeal | 5 | 5.3 |
| Retropharyngeal | 1 | 1.01 |
| Pretracheal | 1 | 1.01 |
| Multiple spaces | 16 | 17.02 |
| Necrotising fasciitis | 1 | 1.01 |
| Total | 94 | 100% |

**Etiological factors:** Only 24 cases (25.5%) have shown a proper etiological agent. Rest all were idiopathic without any striking etiological agent. Of these 24 cases, 21 cases were Ludwig 's angina. 19 cases of 21 cases showed dental infection as etiological agent. The other etiological agents noted were parotitis for one case, trauma for one case and submucous fibrosis for one case. The inference of these observations was most of the times DNSIs were idiopathic. Nearly 75% of patients belonged to low socioeconomic group which may be because of poor nutritional status and poor oral and dental hygiene.

**Observations in specific to each space infection:**

**Ludwig's angina:** Out of 94 cases 32 cases of Ludwigs angina or submandibular space infections were noted, which was second highest number of cases. Of these 32 cases, the highest numbers of cases, a total of 11 cases were noted in the common age of incidence 0 to 10 years. The incidence of Ludwigs angina gradually decreases with increasing age maximum in 0 to 10 years age group. Incidence in males was slightly higher than females, carrying not much significance. Out of 32 cases only one case was noted with unilateral disease which unlikely, stressing the frequent bilateral nature of this disease.

**Table 4: Age incidence of Ludwigs Angina**

| Age in years | N | % |
|---|---|---|
| 0-10 | 11 | 34.37 |
| 11-20 | 8 | 25 |
| 21-30 | 5 | 15.6 |
| 31-40 | 3 | 9.37 |
| 41-50 | 2 | 6.25 |
| 51-60 | 3 | 9.37 |
| >60 | 0 | 0 |
| Total | 32 | 100 |

**Table 5: Sex incidence of Ludwigs Angina**

| Gender | N | % |
|---|---|---|
| Male | 19 | 59 |
| Female | 13 | 41 |
| Total | 32 | 100% |

In the total 32 cases of submandibular space infection, 18 (56%) were subsided by conservative management and 14 cases (44%) were managed by surgical management. The inference of this finding is nearly half of the cases of Ludwigs can be treated by medical management. In the relation to age incidence, to our surprise in 0 to 10 years, out of 11 cases 8 cases got relieved by medical management. Only 3 cases underwent I&D, most of paediatric cases of Ludwigs angina can be treated by medical management, avoiding surgical treatment.

**Peritonsillar space infection:** This is the commonest type of neck space infections noted in the study with a total of 35 cases of total 94 cases with higher incidence in males (21) than in females (14). Peritonsillar space infections showed maximum incidence in distribution of 21-30 cases, out of 35 cases 18 were cured by medical management and 17 cases needed I&D giving the inference that nearly half of the cases will be cured by medical management alone. The cases were found to give good response to I/V antibiotics in two days.

**Table 6: Age incidence of Peritonsillar space infection**

| Age in years | N |
|---|---|
| 0-10 | 0 |
| 11-20 | 10 |
| 21-30 | 11 |
| 31-40 | 8 |
| 41-50 | 2 |
| 51-60 | 3 |
| >60 | 1 |
| Total | 35 |

**Table 7: Sex incidence of Peritonsillar space infection**

| Gender | N | % |
|---|---|---|
| Male | 21 | 60 |


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| | | |
|---|---|---|
| Female | 14 | 40 |
| Total | 35 | 100% |

**Parotid abscess:** Only 3 cases were noted in our study. All the cases needed surgical management with varied age distribution

**Parapharyngeal abscess:** 5 cases were noted in our study. These cases were, in the age group of 10-20 years. 0f these 5 cases, 3 cases were cured by 1/V antibiotics alone and surgical management in two cases.

**Organism isolated:** Of total 94 cases, only 51 cases underwent I&D due to abscess formation. The results of pus culture and sensitivity report of 38 cases are

**Table 8: Pus Culture & Sensitivity Results**

| Organism isolated | N | % |
|---|---|---|
| Sterile | 19 | 50 |
| Staphylococcus | 11 | 29 |
| Streptococcus | 5 | 13 |
| E.coli | 2 | 5.5 |
| Pneumococcus | 1 | 2.5 |
| Total | 38 | 100% |

The anaerobic culture could not be done due to non-availability of facilities. The observations drawn from these results were 50% showing sterile results. This can be due to antibiotic usage prior to admission given by local physician and trial of conservative Rx including 1/V antibiotics, prior to I&D. The remaining results were showing highest incidence of staphylococci organism followed by streptococcus. The cases which had E. coli as organism were multiple neck infection with other chronic ailments.

Other chronic ailments: Out of 94 cases, 19 cases were founded to be with other diseases. 11 patients had diabetes; 4 cases had anaemia. Two cases of Hepatitis B were noted and 2 cases of HIV were noted. Patients with diabetes had multiple neck space infection and the patients with diabetes were considered high risk group for DNSI. Out of two HIV cases one died of septicaemia.

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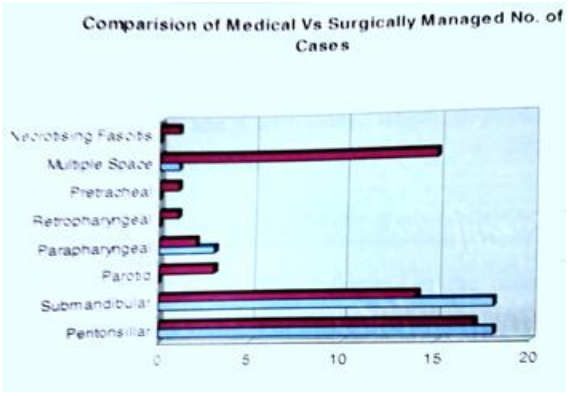
Number of days of hospital stay: Our study showed an average hospital stay of 5.7 days with maximum number of days of 26 days was a 45 years female, with multiple neck abscess with anaemia.

**Mortality rate:** Two deaths were reported in our study. One case was an HIV case with multiple neck abscess died of septicaemia. Other case was a 4 years old child with neglected retropharyngeal abscess with stridor. These observations are showing a very low mortality rate 0.02%.

**Antibiotics:** We commonly opted for the regimen of Ciprofloxacin + Metronidazole for adults and Ampicillin + Metronidazole for paediatric age group avoiding Quinolones in children. Only in 26 (27.5%) cases of the total number in study, there was necessity to change the antibiotic to Cephalosporins, Aminoglycosides

**Table 9: Drug sensitivity shown by different organism to commonly used antibiotics**

| | Staphylococcus | Streptococcus | E .coli | Pneumococcus |
|---|---|---|---|---|
| Ciprofloxacin | 83.3% | 80% | 0% | Sensitive |
| Ampicillin | 50% | 80% | 50% | |
| Gentamicin | 66.6% | 80% | 50% | Sensitive |
| Cefotaxim | 83.3% | 40% | 0% | Sensitive |
| Amikacin | 33.3% | 40% | 100% | |




The inference of above observations was except E. coli, there was maximum sensitivity to Ciprofloxacin shown by all organism with next best antibiotic could be Cefotaxime.

**Surgical management:** In surgical drainage. we opted for Betadine gauze inside wound. Rubber drains and glove strips were less satisfactory due to improper maintenance of drainage and increasing hospital stay.

Comparison of Medical Vs Surgical Managed cases

**Complication:** The commonest complication we have observed is Neck contractures due to healing by secondary intension of incision sites with minimal residual dysphagia for few days. Rest of the text book1 described complications; we did not come across.


ISSN (O): 2687-5365; ISSN (P): 2753-6556

## DISCUSSION

Incidence: In this study of 94 cases of DNSI, 59 males (62.75) and 35 females (37.3%), with predisposition to male sex, which is comparable with study of Paulo and Carlo9 (1995 to 2003), Italy, who showed the similar observation.

**Age incidence:** In study of Paulo and Carlo the age of distribution ranged from 2 years to 90 years, like in this study with wide age distribution ranging from 10 months to 65 years. The age group with maximum incidence was noted to be 11 — 20 years in this study, unlike Paulo and Carlo study, which showed 20 — 60 years as the common age group for DNSI.

**Site incidence:** This study showed peritonsillar infection as the commonest type of DNSI, which is in similarity with major number of studies, like Sichel and Dano study,[10] Israel (2002), Lyudmila and Boyanova of Bulgaria (2006) except Paulo and Carlo study showing lateral pharyngeal and submandibular infections as commonest types.[11]

**Socioeconomic status:** All studies universally accepted the occurrence to be more in low socioeconomic group which was the same in this present study.

**Etiological agent:** According to Paulo and Carlo study, upper airway infections and odontogenic infections,[12-15] were the two most common cases of DSN1 and 26.9% without any etiological reason. Our study showed that 74.4% cases (70 cases) were without any etiological reason. Rest 24 cases had a striking etiological factor, 19 cases (80%) of which had dental infection as etiological agent predominantly predisposing to submandibular space infections.

**Other chronic ailments:** Our study showed only 19 cases with other chronic ailments as a secondary cause. Huang et al suggested that presence of underlying systemic disease increases risk for developing deep neck infections.[16] Of this diabetes was the most common ailment found to be in 11 cases (11.7% of total cases). Unlike Paulo and Carlo study which showed still more occurrence of diabetes with DNSI reaching to 40%. Chen et al observed that diabetes not only increases risk for deep neck infections, it also increases risk of severe form of disease with higher rate of hospitalization and increased duration of hospitalization.[17] Diabetes increases frequency of multispace involvement.[9] The other immunocompromised diseases like AIDS and Hepatitis B were found to be less in this study. Only 2 cases of AIDS and 2 cases of Hepatitis B were noted. This can be because of tertiary care hospitals maintained exclusively for AIDS and related diseases which are treating these patients.

**Diagnostic methods:** Detailed history and clinical examinations stood as the mainstay of diagnosis in our study. The radiological investigations specially x-ray film's lateral view and AP view of Neck helped to know encroachment of airway to take a decision for securing airway and presence of air bubbles prompted anaerobic infection necessitating I/V antibiotics covering anaerobes. Only in one case we had difficulty in identifying deep seated abscess for which ultrasound was used. CT scan though not done routinely was taken for two patients with multiple DNSI. In majority high KV X-ray films were sufficient for diagnosing and assessing the progress of DNSI.[18]

**Treatment:** Our study showed that medical treatment was sufficient to cure DNSI in 40 cases (42.5%) which reached nearly 50% in Ludwigs's angina, 55% in peri tonsillitis and 60% in parapharyngeal infections. Especially in paediatric age group of submandibular space infections 70% of the cases were cured by medical treatment alone. These results are in similarity to study done by Guillermo et all18, Spain (1994 to 1997) which showed 90.3% cases cured with Medical treatment only and study of Sichel, Jean and Dano of Jerusalem, Israel (2002) which showed 100% of cases (study contained 11 cases of paediatric age group) cured by medical treatment alone, This is stressing the importance of medical management of DNSI as the changing trend in treating these dreadful infections at least to be considered strongly in paediatric age group. Surgical Management included incision and drainage with placement of Betadine-soaked gauze in the wound which showed best results.

**Antibiotics used:** Our study used Ciprofloxacin and Metronidazole regimen as mainstay with good results supported by culture and sensitivity reports. This observation was supported in turn by study done by Lyudmila, Boyanova of Sofia, Bulgaria (2006) on anaerobic bacteria in 118 patients with DNSI with their drug sensitivity which showed that the resistance rates to metronidazole were noted accounting to only 2.5%, strongly recommending metronidazole as a part of regimen.

**Organisms identified:** In this study staphylococcus was frequently isolated organism in 11 out of 19 cases, which showed positive culture followed by streptococcus. This is in agreement with other studies like Paulo and Carlo.

## CONCLUSION

This prospective study of deep neck space infections done at Government ENT hospital, Koti, Hyderabad revealed.

1. Deep neck space infections are in decreasing trend due to advent of anti-biotics with admission rate of accounting to 2% of total inpatients.
2. These infections have male sex predominance, which can be due to their habits and poor oral hygiene.
3. The common age group found to be affected is 10-20 years.
4. Out of all deep neck space infections, peritonsillar infections are common followed by submandibular space infections.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5. Most common mode of presentations irrespective of space involved is with dysphagia.
6. Mostly these neck space infections are idiopathic. Dental infections are noted to be common etiological factors especially for submandibular space infections.
7. Contrary to common belief, these DNSIs affect all people with more severity in people with diabetes, increasing the hospital stay and possibility for complications
8. History and clinical examinations are of greater importance in diagnosis, supported by x-ray films which still have major role in diagnosis and management of DNSI. Ultrasound is an excellent tool in this regard to diagnose deep seated loculi.
9. The commonest organism isolated was staphylococcus followed by streptococcus, with least resistance to Ciprofloxacin and Metronidazole.
10. Medical treatment is of paramount importance in DNSIs which by itself can cure more than 50% of DNSIs, thus avoiding traumatic painful management. Especially in paediatric age irrespectictive of any space infection, medical treatment has greatest role in curing the diseases. The antibiotic regimens to be recommended are Ciprofloxacin and Metronidazole in adult and Ampicillin and Metronidazole in children.
11. Incision and drainage is the mainstay of surgical treatment with wide exposure, finger dissection and use of Betadine solution impregnated gauze for placement in the wound.
12. Complication rate is very low with proper antibiotic coverage and timely surgical intervention. The common complication is fibrotic contractures of neck and residual dysphagia in surgically treated patients.
13. Oral and dental hygiene has to be stressed by patient education, which can itself prevent more than 60% of deep neck space infections.

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ISSN (O): 2687-5365; ISSN (P): 2753-6556