DISSERTATION ON

"A COMPREHENSIVE STUDY ON THE CLINICAL SPECTRUM, BACTERIOLOGICAL PROFILE, DIAGNOSIS AND MANAGEMENT OF DEEP NECK SPACE INFECTION – OUR EXPERIENCE"

Dissertation submitted in partial fulfillment of the regulations for the award of the degree of

M.S.DEGREE BRANCH – IV
OTORHINOLARYNGOLOGY

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MADRAS MEDICAL COLLEGE
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THETAMILNADU DR. M.G.R. MEDICAL UNIVERSITY
CHENNAI

MAY 2022

BONAFIDE CERTIFICATE

This is to certify that this dissertation entailed **"A COMPREHENSIVE STUDY ON THE CLINICAL SPECTRUM, BACTERIOLOGICAL PROFILE, DIAGNOSIS AND MANAGEMENT OF DEEP NECK SPACE INFECTION – OUR EXPERIENCE"** submitted by **Dr.BEEMA SALIM S F,** appearing for M.S. ENT., Branch IV Degree examination in May 2022 is a bonafide record of work done by her under my direct guidance and supervision in partial fulfillment of regulations of the Tamil Nadu Dr. M.G.R. Medical University, Chennai, Tamil Nadu, India.

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This is to certify that, Dr.Beema Salim S F, postgraduate student (2019 - 2022) in the Upgraded Institute of Otorhinolaryngology, Madras Medical College and Rajiv Gandhi Government General Hospital, Chennai, has done this dissertation titled **"A COMPREHENSIVE STUDY ON THE CLINICAL SPECTRUM, BACTERIOLOGICAL PROFILE, DIAGNOSIS AND MANAGEMENT OF DEEP NECK SPACE INFECTION – OUR EXPERIENCE**" under my guidance and supervision in partial fulfillment of the regulations laid down by the Tamil Nadu Dr. MGR Medical University, Chennai for M.S. Branch – IV Otorhinolaryngology Degree Examination.

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DECLARATION

I, Dr.Beema Salim S F, solemnly declare that the dissertation titled "**A COMPREHENSIVE STUDY ON THE CLINICAL SPECTRUM, BACTERIOLOGICAL PROFILE, DIAGNOSIS AND MANAGEMENT OF DEEP NECK SPACE INFECTION – OUR EXPERIENCE"** is a bonafide work done by me at, Madras Medical College and Rajiv Gandhi Government General Hospital, Chennai under the guidance and supervision of **Prof.Dr.N.SURESH KUMAR, MS, DLO,** Professor of Department of Otorhinolaryngology, Madras Medical College. This dissertation is submitted to the Tamil Nadu Dr.MGR Medical University towards the partial fulfilment of the requirements for the M.S. Branch – IV, Otorhinolaryngology degree examination.

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CERTIFICATE – II

This is to certify that this dissertation work titled **"A COMPREHENSIVE STUDY ON THE CLINICAL SPECTRUM, BACTERIOLOGICAL PROFILE, DIAGNOSIS AND MANAGEMENT OF DEEP NECK SPACE INFECTION – OUR EXPERIENCE"** of the candidate **Dr.BEEMA SALIM S F**, with registration Number 221914008 for the award of M.S in the branch of Otorhinolaryngology. I personally verified the urkund.com website for the purpose of plagiarism check. I found that the uploaded thesis file contains from introduction to conclusion pages and result shows 7 percentage of plagiarism in the dissertation.

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TABLE OF CONTENTS

INTRODUCTION

Deep neck infection refers to an infection in the potential spaces and fascial planes of the neck, either with abscess formation or cellulitis. They are diseases of great importance due to their relative frequency, challenging nature and potential for serious complications.They are potentially lethal disease condition and constitute a medical and surgical emergency.

Although the widespread availability and usage of antibiotics have reduced their incidence, but deep neck space infections still remains a potentially harmful condition. These infections can lead on to life-threatening complications like upper airway obstruction, mediastinitis, jugular vein thrombosis, venous septic emboli, pseudo aneurysm or rupture of the carotid artery, adult respiratory distress syndrome, septic shock, and disseminated intravascular coagulopathy. Patients with underlying diseases are more prone to develop complicated deep neck infection and more attention must be given to such high risk groups. Diabetes mellitus is recognised as the one of the most common associated systemic disease in deep neck infections.

The understanding and thorough knowledge of the regional anatomy of the neck and the different fascial planes and spaces it constitute are basic to know the disease extension and is essential for the treatment planning. The fascial planes forms the dissection tunnels that need to be followed surgically to unlock the neck.

AIMS OF THE STUDY

1. To evaluate the clinical presentation and etiology of patients with deep neck space infections in our hospital.

2. To analyze the associated systemic diseases/ comorbidities with respect to its impact on deep neck space infections.

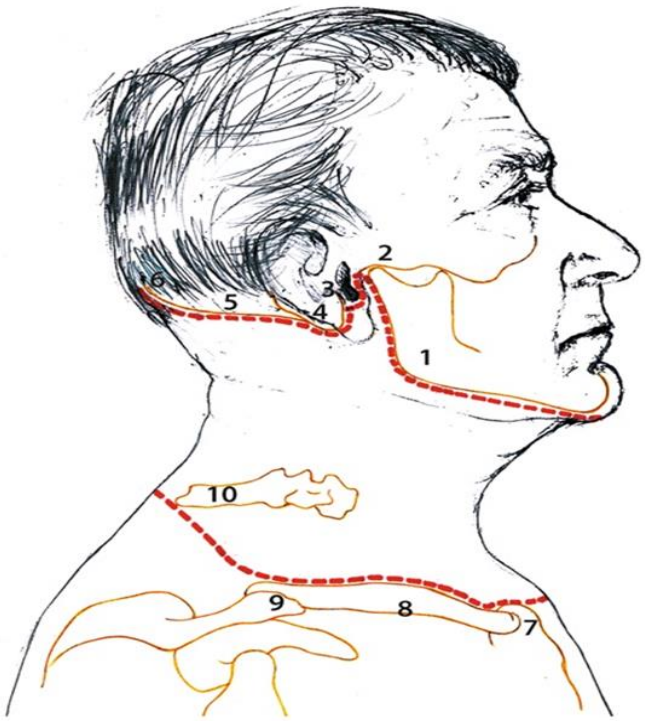
3. To demonstrate the aerobic and anaerobic microbiology of the deep neck space infection and to analyze its sensitivity to antibiotics.

4. To study the different diagnostic modalities, management, complications and the final outcome of the condition..

ANATOMICAL LAYOUT

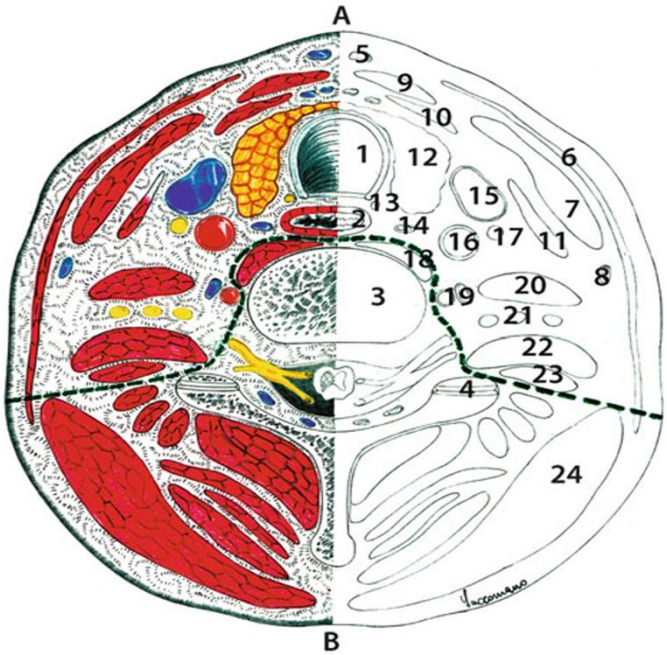
THE NECK

The neck, a structure of transit and union, is the mobile part of the trunk that connects the head with the chest. The neck extends superiorly along the inferior and posterior borders of the mandible, the posterior part of the zygomatic arches, the anteroinferior borders of the external auditory canals, the mastoid apex, the superior nuchal line, and the external occipital protuberance. Inferiorly, the neck extends up to the sternum and clavicles, the acromioclavicular joints, and an imaginary line joining the acromioclavicular joints to the spinous process of the seventh cervical vertebra.



The neck can be roughly divided by a line extending from the transverse vertebral processes to the anterior edge of trapezius muscle into two parts:

- Posterior or nuchal region (osteo-muscular) – acts as a shock absorber and support to the bony framework with head at the top.
- Anterior or trachelian region(muscular–fascial)- holds the internal organs, the respiratory and upper digestive tract, several lymph nodes, important blood vessels, veins and nerves.



A- Trachelian region **B- Nuchal region**

FASCIAL LAYERS OF THE NECK

The neck has superficial and deep fascial layers. These fascial layers or the cervical fascia are made up of fibrous connective tissue. They encloses the neck and creates potential spaces. They act as a barrier for the spread of the infections but once they are breached, they favors the spread. The cervical fascia is broadly divided into superficial and deep layers, of which deep fascia is further divided into three sub layers.

SUPERFICIAL CERVICAL FASCIA

The superficial cervical fascia is a thin layer of fascia that invests the platsyma muscle and is penetrated by small cutaneous vessels. It is the layer that is seen immediately deep to the skin. The area enclosed by this fascia is not included as deep neck space. This layer extends from the epicranium to thorax and axilla. The potential space formed between the superficial cervical fascia and the deep cervical fascia allows for the free movement of the skin and the platsyma over the deep structures of the neck.

DEEP CERVICAL FASCIA

The deep cervical fascia is also known as the fascia colli . It lies deep to the platsyma muscle and deep to the superficial layer.This layer is further divided into three sub layers:

- Superficial layer of deep cervical fascia / Investing layer
- Middle layer of the deep cervical fascia/ Pretracheal fascia
- Deep layer of the deep cervical fascia/ Prevertebral fascia

SUPERFICIAL LAYER OF DEEP CERVICAL FASCIA

The superficial layer of the deep cervical fascia also known as the investing layer/ general layer, is arising from the ligamentum nuchae and the spinous process of the cervical vertebrae posteriorly. It encircles the neck as a collar and invests the whole neck and also encloses the sternocleidomastoid, trapezius, omohyoid and the infrahyoid muscles. This layer is attached,

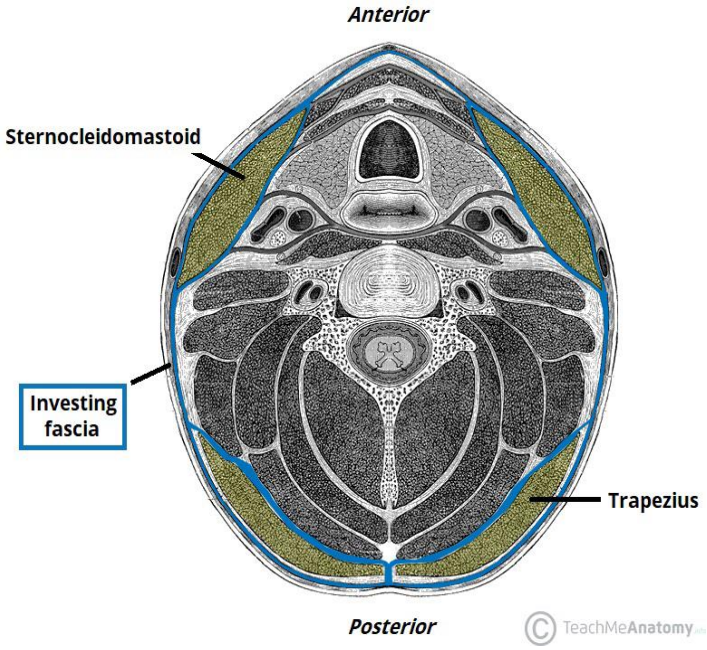
- superiorly to the external occipital protuberance, superior nuchal line of the occipital bone, the mastoid process, the zygomatic arch, the inferior border of the mandible.

- Inferiorly it is attached to the jugular notch of the manubrium, the clavicle, the acromium, and the spine of the scapula.

- Posteriorly it is attached to the ligamentum nuchae and the seventh cervical vertebrae.

- Anteriorly, it crosses the midline and becomes continuous with its counter part. In the midline it joins with the symphysis menti and the hyoid bone also.

This layer forms the the roof of the anterior and the posterior triangles of the neck. The fascia encloses both the parotid and the submandibular glands. Above the suprasternal notch the fascia splits and encloses the suprasternal space of Burns. It also splits to enclose the supraclavicular space above the middle thirds of the clavicle. Most importantly it encases all of the nodal zones of the neck.

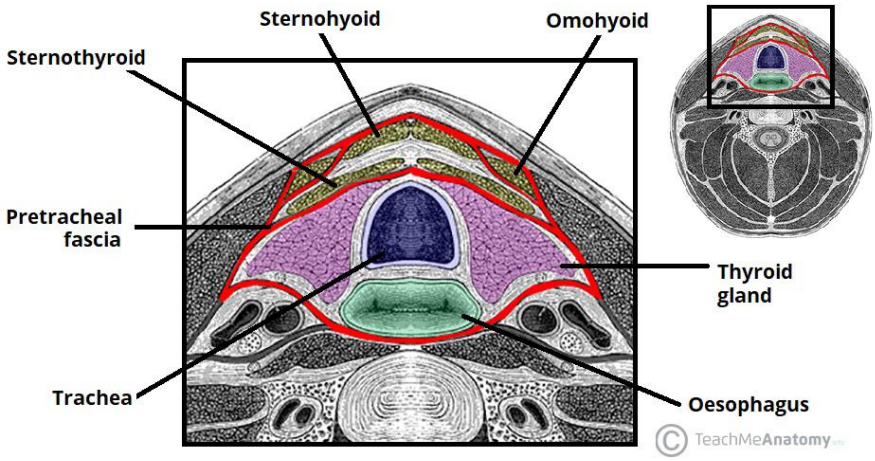


MIDDLE LAYER OF THE DEEP CERVICAL FASCIA

The middle layer of the deep cervical fascia is also known as the pretracheal or the visceral layer. This layer is derived from the

investing layer. Superiorly this layer is attached to the hyoid bone, oblique line of the thyroid cartilage and the cricoid cartilage. Inferiorly the layer fuses with the superior mediastinal fascia and finally blends with the arch of aorta. Laterally the fascia is continuous with the carotid sheath deep to the sternocleidomastoid muscle. The middle layer can be further divided into two parts

- Muscular compartment- encasing the infrahyoid muscles
- Visceral compartment – containing the trachea, thyroid gland, pharynx, and the upper esophagus.



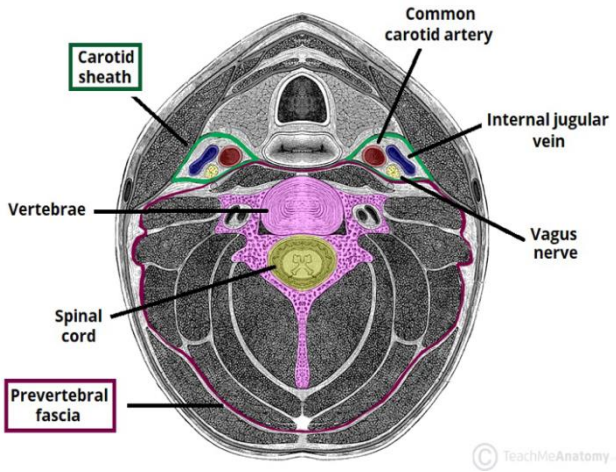
DEEP LAYER OF THE DEEP CERVICAL FASCIA

The deep layer of the deep cervical fascia is also known as the prevertebral fascia. It surrounds the posterior neck muscles, the scalene muscles and the vertebrae. This layer is the posterior limit of

neck dissection and is the floor of the posterior triangle. The deep layer extends from the base of skull to the third thoracic vertebrae and fuses with the anterior longitudinal ligament in the posterior mediastinum.The cervical plexus and the brachial plexus lies behind this fascia and is pierced by the four cutaneous branches of the cervical plexus. As the trunks of the brachial plexus and the subclavian artery passes laterally between the scalenus anterior and medius, they carry with them covering of the prevertebral fascia called the axillary sheath which extends laterally into the axilla.

ALAR FASCIA

The alar fascia is a part of the deep cervical fascia and it is a supplementary layer present anterior to the prevertebral fascia. This fascia extends from the base of skull to the level of the second thoracic vertebrae. The alar fascia lies between the deep and the middle layer of the deep cervical fascia.



CAROTID SHEATH

The carotid sheath is derived from the investing layer of the deep cervical fascia. It is wedged between the three layers of the deep cervical fascia. This fascia is attached to all the layers of the deep cervical fascia by loose areolar tissue. The carotid sheath extends from the skull base above to the arch of aorta below.The sheath contains the internal jugular vein, the vagus nerve and the common carotid artery/internal carotid artery.The ansa cervicalis is seen embedded to the anterior wall of the carotid sheath. The sheath is seen overlapped by the anterior border of the sternocleidomastoid muscle.

DEEP SPACES OF THE NECK

The anatomical compartments formed between the fascial layers of the neck constitute the deep spaces of the neck. The infection of this potential deep spaces of the neck are called as the deep neck space infections. The fascial planes initially act as an effective barrier against the spread of the infection but later on can act as the potential route for spread of the infection. The deep neck spaces can be divided into three categories based on their relation to the whole of the neck and the hyoid bone.

Spaces occupying the whole of the neck

1. Prevertebral space
2. Danger space
3. Retropharyngeal space
4. Carotid space

Spaces above the level of hyoid bone

1. Parapharyngeal space
2. Peritonsillar space
3. Parotid space
4. Masticator space
5. Maxillary space
6. Mandibular space

Spaces below the level of hyoid bone

1. Anterior visceral space
2. Suprasternal space of burns
3. Supraclavicular space

DEEP NECK SPACES AND ITS INFECTIONS

PREVERTEBRAL SPACE

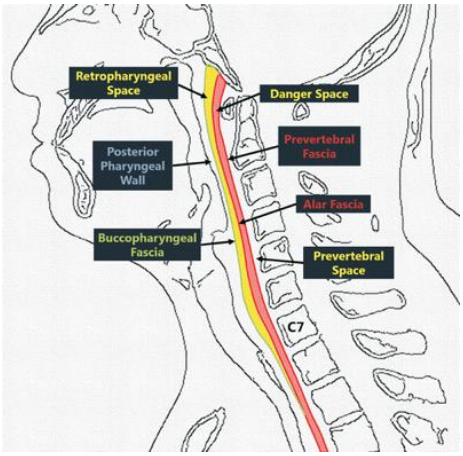
The prevertebral space is located between the prevertebral fascia and the vertebral column. This space extends from the skull base to the coccyx. Laterally it is bounded by the transverse process of the vertebrae. The space is further divided into anterior and posterior compartments. The anterior compartment has the anterior cervical vertebral bodies extending from the transverse process of one to another. The posterior compartment contains the posterior spinal elements. The contents of the prevertebral space are:

- Dense areolar tissue
- Paraspinous, prevertebral and scalene muscles
- Vertebral artery and vein
- Brachial plexus, phrenic nerve
- Vertebral body

Infection of this space occurs due to the extension of the tuberculosis infection from the spine (Potts spine) or from the spread of infection from the retropharyngeal space.

The prevertebral space infection can cause osteomyelitis of spine and spine instability.

If surgery is done, then the abscess is drained externally with long term drainage in most cases.



DANGER SPACE

Also known as alar space. The danger space extends from the skull base till the diaphragm level. It is bounded anteriorly by the alar fascia and posteriorly by the prevertebral fascia. Laterally the space is limited by the fusion of the alar and the prevertebral fascia with the transverse process of the vertebrae. The space contains loose areolar tissue. The space communicates with the retropharyngeal space, prevertebral space and the mediastinum. The infection from this space can spread readily to the thorax as it offers little resistance to the spread of infection and can cause mediastinitis, hence the name danger space. The space can be only seen if it is distended due to collection within it.

RETROPHARYNGEAL SPACE

The retropharyngeal space extends from skull base till the level of tracheal bifurcation. The boundaries of the space are:

Superiorly, skull base

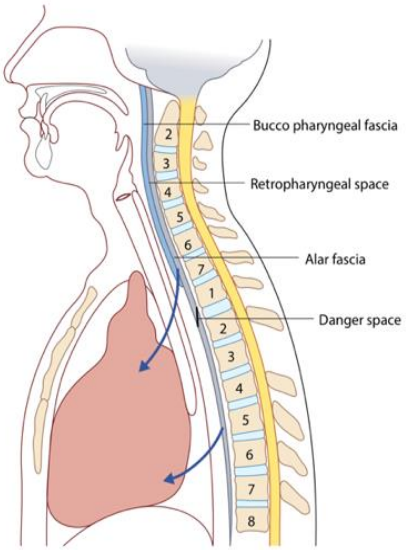
Inferiorly, posterior mediastinum at the level of carina

Medially, midline raphe of superior constrictor muscle

Laterally, carotid space and parapharyngeal space

Anteriorly, buccopharyngeal fascia, pharynx, upper esophagus

Posteriorly, alar fascia



The contents of the space are lymph nodes- Henle nodes(midline nodes) and Rounveir (lateral nodes), connective tissue and fat.The retropharyngeal space communicates with the parapharyngeal space, danger space, carotid space and superior mediastinum.

RETROPHARYNGEAL ABSCESS

It is a life threatening infection of the retropharyngeal space. In children this infection is more common due to the presence of the the retropharyngeal lymph nodes. Infection occurs due to the suppuration of this lymph nodes that usually occurs secondary to infection from the adenoids, nasopharynx, posterior nasal sinuses or the nasal cavity. In adults it most commonly occurs due the penetrating injury of the posterior pharyngeal wall or the cervical esophagus.

CLINICAL FEATURES:

Sore throat, fever, dysphagia, dyspnoea, muffled speech, croupy cough, torticollis and neck swelling.

Xray soft tissue lateral view of the neck shows widening of the prevertebral soft tissue shadow that is >7mm at C2 in children and adults and >14mm at C6 in children and >22mm at C6 in adults. There could also be straightening of the cervical spine. CECT neck shows hypodense lesion in the retropharyngeal space with peripheral ring enhancement.

TREATMENT

- Airway assessment and management with supplemental oxygen and tracheostomy/cricothyrotomy if required.
- Incision and Drainage of abscess done without anaesthesia as there is risk of rupture on intubation.

Trans oral route: Either needle aspiration or incision and drainage can be attempted. CT or USG guided aspiration can be done once the pocket is identified a vertical incision can be made with cautery.

Transcervical route: this technique is needed when the infection is extended inferior to the hyoid bone.Modified apron incision is put over the neck. Subplatysmal flaps are elevated, dissection is carried out to the anterior border of the sternocleidomastoid muscle which is retracted laterally to allow for the blunt opening and drainage of the abscess.

- For TB cases, full course of ATT should be given.
- Broad spectrum systemic antibiotics.

Complications: Airway compromise, bronchial erosion, mediastinitis, sepsis, ARDS, erosion into carotid artery and internal jugular vein.

CAROTID SPACE

The carotid space is a potential space created by the carotid sheath. It extends from the skull base to the mediastinum and merges with the connective tissue around the aortic arch.The space is bounded anteriorly and laterally by the sternocleidomastoid muscle, medially by the visceral space and posteriorly by the prevertebral space. The contents of the space are Carotid artery, Internal jugular vein,Vagus nerve, Ansa cervicalis and Cranial nerve IX, XI,XII.

The carotid space is considered as conduit for the infections to spread to the mediastinum and hence called as Lincoln highway.The infection of this space occurs secondary to the spread of infection from the adjacent fascial spaces. It can also occur directly by injection of drugs especially by intravenous drug users. The resultant thrombophlebitis can extend to the heart and lungs. The carotid artery may undergo thrombosis and can form an aneurysm, erode and can rupture.

PARAPHARYNGEAL SPACE

Others names are lateral pharyngeal space, pterygomaxillary space, pharyngomaxillary space, pterygopharyngeal space. Parapharyngeal space is an inverted pyramid shaped shape extending from the skull base(base of the middle cranial fossa/ petrous temporal bone) to the level of superior cornua of the hyoid bone. This space is bounded anteriorly by the pterygomandibular raphe, posteriorly by the prevertebral fascia, medially by the buccopharyngeal fascia and the superior constrictor muscle, laterally by the deep lobe of parotid gland, medial pterygoid muscle and the ramus of the mandible.

Styloid process and its attachment divides the parapharyngeal space into two compartments

Prestyloid compartment

- Muscular compartment
- Displaces the parapharyngeal fat posteromedially

Contents:

- Fat
- Lymph nodes
- Connective tissue
- Maxillary artery
- Auriculotemporal nerve
- Lingual nerve
- Inferior alveolar nerve

Poststyloid compartment

- Neurovascular compartment
- Lesions are neuroendocrine in origin
- Displaces the fat anteriorly

Contents:

- Carotid sheath contents
- Glossopharyngeal nerve
- Hypoglossal nerve
- Sympathetic chain
- Lymph nodes

Communicating spaces are Peritonsillar space, Parotid space, Submandibular space, Retropharyngeal space, Masticator space

Parapharyngeal space is hourglass shaped in coronal plane and is triangular spaced in axial plane. It is the epicentre around which other spaces are located hence acts as pivotal space for spread of infection.

Stylopharyngeal aponeurosis of Zuckerkandl and Testus : is formed by the joining of alar, buccopharyngeal and the stylomuscular fascia. It acts as a barrier to the spread of infection from the prestyloid to the poststyloid compartment

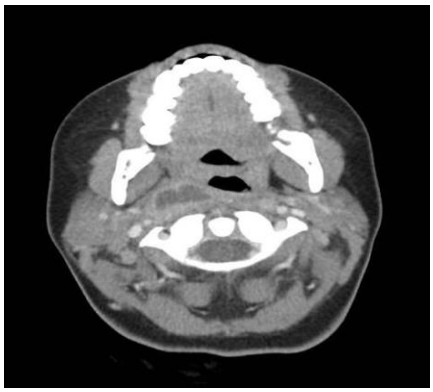
PARAPHARYNGEAL SPACE INFECTION

It can occur due to

- Bursting of the peritonsillar abscess, tonsillitis, adenoiditis, pharyngitis
- Dental infection of the lower last molar tooth.
- As a complication of chronic otitis media- Bezolds abscess, petrositis
- Extension of infections from the parotid, retropharyngeal, submandibular spaces
- Iatrogenic and traumatic injuries of neck

CLINICAL FEATURES:

- Fever, odynophagia, sore throat
- If prestyloid/ anterior compartment then there is a triad of symptoms – prolapse of the tonsil and the tonsillar fossa, trismus due to the spasm of the medial pterygoid muscle, external neck swelling behind the angle of mandible.



- If posterior compartment is affected there will be a bulge in the pharynx behind the posterior pillar with dysphagia, hoarseness of voice, unilateral nasal regurgitation and palsies of the palate or the larynx, tongue. Horners syndrome due to involvement of the sympathetic chain.

TREATMENT:

Aggressive broad spectrum antibiotics and close observation

Surgical drainage:

Transcervical approach: patient in supine position with shoulder roll, head turned to opposite side. Incision made on the side of the neck at the level of the hyoid bone or two finger breadth below the border of

the mandible. The parapharyngeal space and the pterygoid space are entered by retracting the submandibular gland anteriorly. Dissection should be done superiorly and medial to the posterior belly of the digastric muscle along the medial part of the ramus of the mandible. Usually a drain need to be placed.

Trans oral route: it is not the preferred route as there is a danger of injury to the great vessels which is passing through the space.

Complications: Meningitis, thrombosis of internal jugular vein and the carotid artery, mediastinitis, laryngeal edema, aspiration

PERITONSILLAR SPACE

Peritonsillar space is located medial to the superior constrictor muscle, lateral to the palatine tonsil, anterior to the palatopharyngeal fold and is posterior to the palatoglossal fold.

Contents are loose connective tissue, tonsillar branches of lingual, facial and ascending pharyngeal artery, minor salivary glands. Peritonsillar space communicates with the parapharyngeal space.

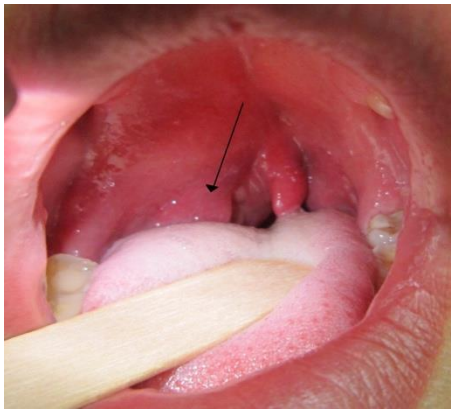
PERITONSILLAR ABSCESS/ QUINSY: is a collection of pus in the peritonsillar space. Usually it follows as a complication of acute tonsillitis. Here the crypts manga of the tonsil gets infected and sealed off. This leads to an intra tonsillar abscess which will burst open through the tonsillar capsule and causes peritonsillar abscess.

CLINICAL FEATURES: High grade fever, sore throat, unilateral throat pain with referred otalgia, dysphagia, odynophagia, muffled thick voice.

On examination,

- The anterior pillar, tonsils and the soft palate are congested and swollen.
- Uvula is edematous and swollen and is pushed to opposite side
- Slough can be seen covering the tonsil, soft palate and the anterior pillar
- Enlarged tender jugulodigastric nodes

Diagnosis is usually made based on the presentation and clinical examination of the oropharynx.



TREATMENT : Acute peritonsillitis usually responds well with antibiotics. Once abscess is formed then it requires needle aspiration, incision and drainage or tonsillectomy in addition to anti microbial therapy.

Incision and drainage: it is done at the point of maximum bulge above the upper pole of the tonsil or is made at the point of junction of anterior pillar with a line that is drawn along the base of the uvula.

Interval tonsillectomy: This means the removal of the tonsils 4-6 weeks following quinsy attack.

Tonsillectomy that is performed at the time of the attack is called quinsy tonsillectomy or hot tonsillectomy.

COMPLICATIONS: Laryngeal edema, parapharyngeal abscess, mediastinitis, pneumonia, lung abscess, carotid artery rupture, internal jugular venous thrombosis

PAROTID SPACE

The investing layer of the deep cervical fascia splits and encloses the parotid gland and gives rise to the parotid space. It extends from the level of mid squamous temporal bone to the angle of the mandible. The space is present lateral to the parapharyngeal space and carotid space, medial to the parotid fascia, anterior to the prevertebral space and posterior to the masticator space.

The contents are parotid gland, proximal part of the parotid duct, lymph nodes, facial nerve, retromandibular vein and branches of external carotid artery.

The parotid space is separated from the carotid space by the posterior belly of digastric muscle. The space communicates with the

parapharyngeal and masticator space. The communication between the parapharyngeal and parotid space is via the incomplete fascial envelope at the superomedial surface of the parotid gland.

The infection of parotid space occurs in dehydrated and debilitated patients with poor oral hygiene. They are prone to develop glandular ductal obstruction.

MASTICATOR SPACE:

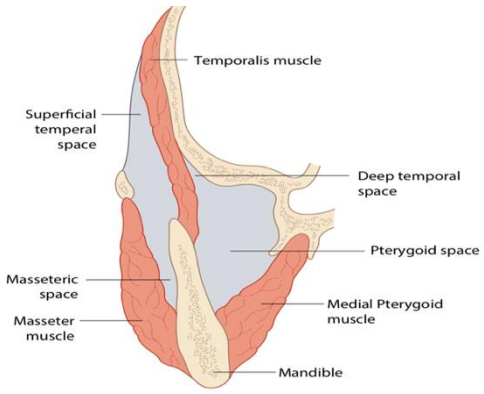
The masticator space lies inferior to the skull base. The space is bounded medially by the pharyngeal mucosa and the fascia medial to the pterygoid muscle.It is laterally bounded by the medial surface of the ramus of the mandible and the fascia overlying the masseter muscle.

Masseter muscle, medial and lateral pterygoid muscles, lower part of temporalis muscle, ramus and the posterior body of the mandible, inferior alveolar nerve, motor branch of V3, internal maxillary artery, pterygoid venous plexus are the contents of the space.

The space is further subdivided into 4 spaces

1. Superficial temporal space- superolaterally, bounded laterally by superficial temporal fascia, medially by the temporalis muscle, posteriorly by the fusion of temporalis fascia with the pericranium.

2. Deep temporal space – superomedially, bounded superiorly by superior and inferior temporal line, inferiorly by the zygomatic arch, medially by squamous temporal bone and skull base, laterally by the temporalis muscle.
3. Masseteric space – inferolaterally, bounded superiorly by zygomatic arch, inferiorly by the inferior border of the mandible, laterally by the masseter muscle, medially by the ramus of mandible.
4. Pterygoid space – inferomedially, bounded medially by the medial pterygoid muscle, laterally by the ramus of mandible, anteriorly by the pterygomandibular raphe, superiorly by the lower head of the lateral pterygoid muscle.



The masticator space communicates with the parotid space and the parapharyngeal space.

The infections of this space happens due to the odontogenic infection of the third mandibular molar. Or it can also happen due to the spread

of infection from the parotid space, submandibular, the peritonsillar space. Trismus is a common feature due to the oedema of the pterygoid muscles. Abscess can develop either, medial or lateral to the temporal muscle. Lateral abscesses are drained via a hairline incision that extends through the temporalis fascia. When the abscess is deep to the muscle then the incision should extend through the muscle as well. Medial abscesses are drained through an intra oral incision.

MAXILLARY SPACES

The maxillary spaces are subdivided into two spaces

1. Canine space
2. Buccal space

Canine space

The canine space is located between the anterior surface of the maxilla and levator labii superioris. The infection of this space happened as a result of the infection of maxillary canine teeth. The root of the teeth has to be long enough that its apex is above the insertion of the levator angulii oris muscle. It is drained via an intra oral stab incision.

Buccal space

The buccal space is an ovoid shaped space below the zygomatic arch and above the inferior border of the mandible. It lies between the buccinator muscle and the skin. The contents of the space are fat,

parotid duct, acessory parotid gland, facial and the buccal arteries and veins, buccal branch of facial nerve, trigeminal nerve.

The buccal space communicates with the canine space, infra temporal space, masticator space and the parapharyngeal space.

The infection of the buccal space happens due to infection of the maxillary molars. It can also be caused due to the hematogenous spread of H. Influenza. This was seen in the preimmunisation era. The infection presents as cheek swelling with trismus. It can drained through a skin incision made in the direction of the facial nerve branches with gentle deep blunt dissection. Intraoral incision and drainage can also be done.

MANDIBULAR SPACES

The primary mandibular spaces are three in number - Submental space, Sublingual space, Submandibular space

Submental space

The submental space is located between the anterior bellies of the digastric muscle and between the skin and the mylohyoid muscle. It is considered as the anterior extension of the submandibular space. The submental space contains the submental lymph nodes.

Sublingual space

The sublingual space lies between the lingual oral mucosa and the mylohyoid muscle. It communicates freely with the submandibular

space via the open posterior boundary. The space is located lateral to the intrinsic muscles of tongue, superior and medial to the mylohyoid muscle, anteriorly till the genu of the mandible and posteriorly connects freely with the submandibular space. The contents of the space are:

- Deep portion of the submandibular gland
- Wharton's duct
- Sublingual gland
- Anterior portion of the hyoglossus muscle
- Lingual nerve, artery and vein
- Hypoglossal nerve
- Chorda tympani

Submandibular space

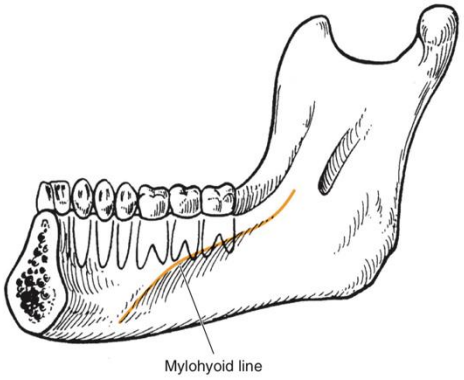
The submandibular space is located below and lateral to the sublingual space. It extends from the mylohyoid muscle superiorly to the hyoid bone inferiorly. The contents of the space are:

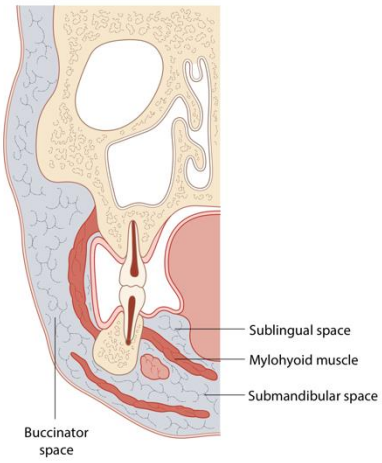
- Superficial part of submandibular gland
- Submandibular lymph nodes
- Anterior belly of digastric muscle
- Inferior portion of hypoglossal nerve
- Facial artery and vein
- Fat

The space communicates freely with the sublingual, submental and the parapharyngeal space.

LUDWIGS ANGINA

Other names are: Cynanche, Angina Maligna, morbus strangularis, carbunculus gangrenosus. It is a form of diffuse gangrenous cellulitis of the bilateral submandibular, sublingual and the submental spaces. The term coined by Wilheim Friedrich Von Ludwig- he described this condition in 1836. Ludwigs angina usually do not involve the lymphatic system and there is no abscess formation.

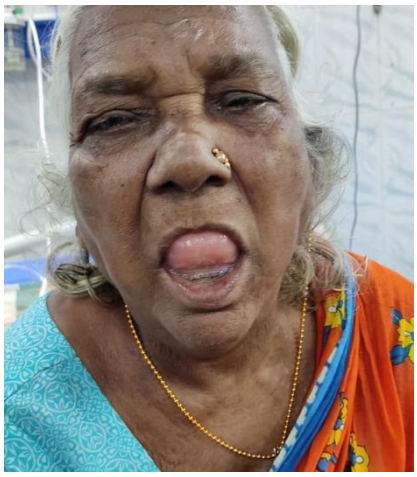


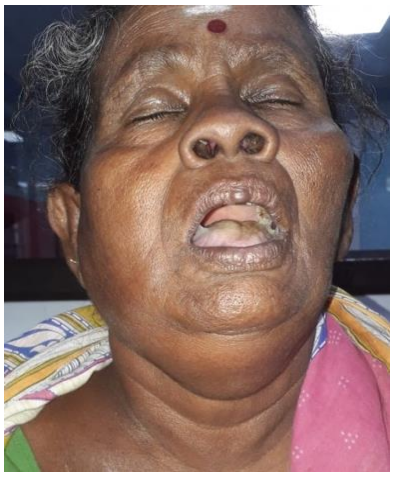


Etiology / pathogenesis: Dental infections are the most common cause of Ludwigs angina. Roots of the premolars that are above the mylohyoid line causes sublingual space infection and the roots of the molar tooth that extend below the line causes submandibular infection.

Other causes leading are spread from the parapharyngeal space, peritonsillar space, mandibular fracture, oral piercing or injuries, sialadenitis and in cases of oral malignancy.

Symptoms: swollen painful and elevated tongue, malaise, fever, dysphagia, dyspnea, neck swelling, otalgia, dysphonia, dysarthria, confused mental state, and stridor.





Signs: dyspnea, tachypnea, bull neck, woody induration and airway compromise.

GRODINSKY (1939) DIAGNOSTIC CRITERIA:

1. There must be cellulitis not an abscess of the submandibular and sublingual space that never involves only one space and usually is bilateral.
2. Produces gangrene with serosanguinous putrid infiltration but very little frank pus.

3. Involves connective tissue, fascia and muscles but not glandular structures
4. Spread by continuity and not by lymphatics.

Treatment: Even though abscess is not formed , Ludwigs angina is an exception in which incision and drainage is the choice despite absence of abscess.

Airway management is of prime importance. Elective awake tracheostomy is safer to be done.

Intravenous broad spectrum antibiotic along with generous fluid resuscitation is to be done.

Dental extraction is to be done if it is the source of the infection.

Surgery- incision and drainage: intraoral approach is used when abscess is localising to the sublingual space alone. External approach is done when the submandibular space is involved. A transverse incision is made extending between the angles of the mandible. Dependent drainage is done. Regular dressing is done till the pocket heals completely.

Complications: spread of infection to the parapharyngeal, retropharyngeal space, airway compromise, septicaemia, pneumonia, cavernous sinus thrombosis, descending necrotising mediastinitis.

ANTERIOR VISCERAL SPACE

Also known as pretracheal space. It extends from the hyoid bone till the superior mediastinum. The space is bounded by investing layer of deep cervical fascia anteriorly and by the buccopharyngeal fascia posteriorly.The contents of the space are pharynx, larynx, trachea, upper esophagus, thyroid gland, parathyroid gland. There is no direct communication with other spaces and the infection of this space occurs only by puncturing of the esophagus anteriorly or by the perforation in the retropharyngeal space. Infection of this space can result in severe laryngeal edema and airway obstruction. Early aggressive treatment is indicated to avoid airway compromise.

SUPRASTERNAL SPACE OF BURNS

The suprasternal space is located superior to the sternal notch between the clavicular heads. The contents of the space are sternal heads of sternocleidomastoid, jugular venous arch, interclavicular ligament and lymph nodes.

AETIO-PATHOGENESIS OF DEEP NECK SPACE INFECTION

- Odontogenic infections

Most of the odontogenic infections are localised, minor exacerbations from long standing decay or periodontal disease. It is at present the most common cause of infection in adults.

- Oropharyngeal infections
- Upper aero digestive tract trauma
- Acute rhinosinusitis- In paediatric age group, acute rhinosinusitis is the common cause for retropharyngeal lymphadenitis causing infection.
- Suppuration of nodes of Henle in Gillette space
- Potts disease of the spine
- Sialadenitis with or without duct obstruction
- Foreign body trapped in the upper aero digestive tract
- Penetration injury of posterior pharyngeal wall
- Congenital or acquired lesions such as branchial cleft cysts, thyroglossal duct cyst, laryngocele
- Bezolds abscess secondary to acute mastoiditis
- Secondary to petrositis, apicitis
- Necrotic malignant nodes
- Mandibular fracture

- Post tonsillectomy/ Styloid process excision
- Thyroid infections

CLINICAL FEATURES

The clinical features of the infection will depend upon the spaces that are involved. Fever, neck swelling , neck pain, difficulty in swallowing, painful swallowing are the main complaints that can occur. Spiking episodes of fever can indicate septicaemia and possibility of internal jugular vein thrombosis. Change in voice is a feature of peritonsillar abscess, parapharyngeal and retropharyngeal abscesses. Difficulty in breathing is a feature of airway compromise due to ludwigs angina or parapharyngeal or retropharyngeal infections.

MICROBIOLOGY

Deep neck infections are caused by a mixture of aerobic and anaerobic organisms.Peptostreptococcus, Streptococcus viridans, staphylococcus aureus, staphylococcus epidermidis, Klebsiella pneumonia are the most common organisms responsible. Odontogenic infections are caused by mainly mixed flora and anaerobic organisms. Staphylococcus aureus infection is most common in nose and the throat. Methicillin resistant staphylococcus aureus is seen to infect younger patients and especially in the lateral neck compartments.

Actinomyces are atypical and endogenous saprophytic organism of the oral cavity and the tonsil. It is characterised by a granulomatous reaction with central abscess formation and necrosis with sulphur granules. It most commonly affects the vicinity of angle of the mandible.

Streptococcus anginosus(milleri group) are known to produce tissue destroying enzymes which causes spread and infection along the planes.

Cat scratch disease caused by Bartonella Henselae presents as swollen tender cervical lymph nodes and late lesions may form an abscess also.

COMPLICATIONS

MEDIASTINITIS

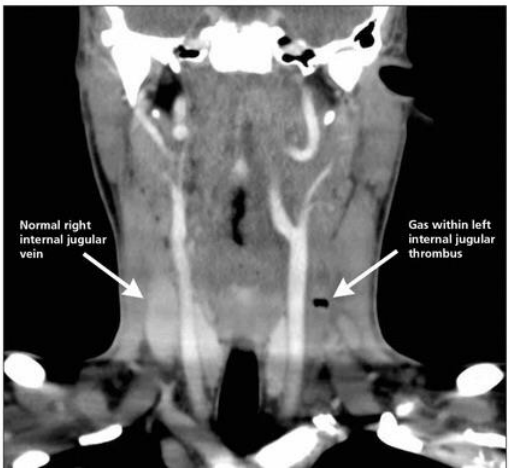
Mediastinitis is a rare complication of deep neck space infections with 30% to 40% of mortality rate. It occurs due to the spread of infection along the retropharyngeal or the prevertebral planes of the neck into the upper mediastinum. There will be diffuse neck edema with dyspnea, pleuritic pain on deep breathing, tachycardia, and pleural effusion. On chest X-ray we can see pleural effusion or mediastinal

widening. CT scans show presence of air fluid level or mediastinal fat stranding.

Treatment: Patient to be started on intravenous antibiotics. If the infection is limited only to the anterior superior mediastinum above the level of carina, transcervical drainage is done via bilateral cervicotomy. Thoracotomy might be needed in cases that has extend beyond the upper mediastinum as well those that involve more than a single mediastinal compartment.

LEMEIRRE'S SYNDROME

This is a rare thrombophlebitis of the internal jugular vein that is caused by the anaerobic gram negative organism, fusobacterium necrophorum. Usually it occurs due to the spread of infection into the carotid space. Bacterium is also thought to be spread through the tonsillar veins to the internal jugular vein. The bacterial endotoxins causes platelet aggregates and septic thrombi formation. Diagnosis is made by CECT neck where we could see filling defect in the internal jugular vein.Treatment is starting the patient on intravenous beta lactamase resistant antibiotics with or without heparin anticoagulation. Surgery is done to excise the jugular vein in patients with worsening clinical condition despite judicious medical treatment.



CAROTID ARTERY PSEUDOANEURYSM/ RUPTURE

Carotid artery aneurysm and its rupture presents with pulsatile neck mass with cranial nerves IX,X,XI,XII palsies with an expanding hematoma and ecchymosis of neck.Treatment option is to surgically ligate the carotid artery.

CAVERNOUS SINUS THROMBOSIS

Cavernous sinus thrombosis is life-threatening infection caused by retrograde spread of infection from the upper teeth or the paranasal sinuses through the valveless ophthalmic veins to the cavernous sinus. Symptoms are fever, orbital pain, proptosis, reduced extra ocular movements and dilated pupil with sluggish pupillary light reaction. The diagnosis is confirmed by MRI brain with contrast which shows dural enhancement in the area of cavernous sinus. Treatment: critical-care support, broad-spectrum intravenous antibiotics and anticoagulation therapy.

NECROTISING FASCIITIS

Necrotising fasciitis is a very severe complication of deep neck space infection that is more commonly seen in older people above the age of 60 years as well as in immunocompromised patients, especially those with poorly controlled diabetes status.The most common cause is odontogenic infection. The patient will present with rapidly progressive cellulitis with pitting neck edema and peau de appearance due to obstruction of the dermal lymphatics with or without subcutaneous crepitus. CECT neck reveals tissue gas with widespread, nonloculated hypodense areas without peripheral enhancement suggestive of liquefaction necrosis. Treatment: critical-care support, management of immunocompromising conditions, broad-spectrum intravenous antibiotics and surgical exploration. Intra operatively there will be foul odour with brown, watery fluid liquefied grayish fat and muscle that pull apart on finger pressure. Debridement to be done until bleeding, viable edge or vital nerves or vessels are reached. Wound has to be thoroughly irrigated, packed with gauze and is to be left open for a second-look procedure in 48-72 hours.

METHODOLOGY

HISTORY

History collection is an important aspect. The past history for immunodeficiency status and antibiotic allergies must be reviewed. Patients with HIV, hepatitis, diabetes, collagen vascular diseases, haematological malignancies and recent chemotherapy or steroid use are at increased risk of infection with atypical organisms and also rapidly progressive disease.

PHYSICAL EXAMINATION

- A thorough and complete head and neck examination needed
- Face and neck should be palpated properly to identify localising tenderness or fluctuance. Also helps to elicit crepitus caused by gas producing organism or trauma.
- Trismus/ difficulty in opening the mouth on examination indicated the presence of inflammation spread to parapharyngeal and masseteric space.
- Visualisation of alveolar swelling , loose , tender or broken teeth indicates an odontogenic source of infection.
- Floor of mouth to be checked for any visible edema that can cause posterior deflection of the oral tongue.

- The stensons and the wharton's duct has to be assessed for any purulent discharge and need to palpated for any obstructing stones.
- Oropharynx need to be examined to assess for any asymmetrical lateral or posterior wall swelling and/or uvular deviation, supratonsillar soft palate bulge, medial displacement of tonsil
- A complete cranial nerve examination
- Eye examination to check for mobility of the globe and/or an absent pupillary light reflex to rule out orbital inflammation and or a abscesses.

LABORATORY EVALUATION

BLOOD TESTS

Leukocytosis is almost always present .A lack of leukocytoosis may indicate a viral illness, immunodeficiency or tumor condition.Serial monitoring of the white blood cell counts helpful to assess the response to treatment.A basic electrolyte panel should be checked to see the glucose level and body hydration status.

IMAGING STUDIES:

PLAIN FILM RADIOGRAPHY: It is an inexpensive, rapid and easily available investigation that provides excellent information in select circumstances. Panoramic view of the jaw will help identify

odontogenic infections. Lateral neck films are useful to quickly evaluate the upper aero digestive tract in cases of epiglottitis and retropharyngeal abscess. Chest radiography is helpful in patients with dyspnea, cough and tachycardia to rule out aspiration and mediastinitis.

COMPUTED TOMOGRAPHY : Contrast enhanced computed tomography is the investigation of choice.It gives excellent visualisation of the bony as well as soft tissue structures of the head and the neck.The intravenous contrast helps to visualise the great neck vessels and also enhances the areas of inflammation.Also helps to assess whether the infection is contained within the lymph nodes or has it spread beyond and into the fascial planes.Abscess/ phlegmon appears hypodense with peripheral enhancement.Cellulitis appears hypodense with no peripheral enhancement.

MAGNETIC RESONANCE IMAGING: MRI scans are time consuming scans and may not be tolerated by patients who are in pain and for those having trouble in swallowing and mainly for those who cannot maintain their airway in supine position.MRI scans can provide additional details to rule out intracranial extension, to see in detail about parotid and prevertebral spaces.It also helps to evaluate the major vessels of the head and neck region.*Magnetic resonance*

angiography can give excellent evaluation of thrombosis and pseudo aneurysms.

ULTRASONOGRAPHY(USG): Ultrasonography is a non invasive, inexpensive technique with no radiation exposure. It can be used for targeted aspiration and for guided FNAC of neck nodes. USG can differentiate between cellulitis and abscesses that are drainable.

MANAGEMENT

1. AIRWAY MANAGEMENT

The foremost and initial management of consideration for any patient with deep neck space infection is to ***secure the airway.***

Airway complications are often anticipated in cases that are involving the floor of the mouth, parapharyngeal space and in retropharyngeal space.

Pulse oximetry shows normal reading until the airway is completely occluded. Fibre optic evaluation of the upper airway during initial evaluation will help. If airway is not grossly occluded then we can give a trial of medical management with,

- Use of oxygenated face tent with cool mist humidity
- Intravenous steroids
- Epinephrine nebulisers

If the patient has mild airway symptoms, and when on examination there is only mild edema with less than 50% obstruction at the level of glottis or supraglottis then patient will better respond to the medical therapy alone. But the patient need to kept in emergency suite/ ICU for direct observation.Urgent airway intervention is essential for cases with greater levels of dyspnea/ stridor or when there is more than 50% of airway obstruction. Initially intubation is attempted with good suction control. Tracheostomy is done when the patient is not expected to be extubated in 24 to 48 hours of intubation or when the surgical drainage procedures are likely to result in prolonged and significant airway edema.

2.FLUID RESUSCITATION

Patients with deep neck space infections present mainly with dehydration due to poor fluid intake which is due to significant dysphagia, trismus or odynophagia.

Tachycardia, dry pasty mucous membrane and decreased skin turgor will be seen in patients with fluid deficit. Dehydration is especially common in patients with peritonsillar or retropharyngeal abscesses and also this could be the main causative factor for sialadenitis infection of parotid space.Fluid resuscitation prior to surgery will also help to avoid anaesthesia related hypotension.

3.ANTIBIOTIC THERAPY

The patients are to be started on broad spectrum antibiotics. Later on based on culture and sensitivity reports, the antibiotics can be changed accordingly.

Both penicillin with or without metronidazole or clindamycin in penicillin allergic patients are effective in most of the cases.

It is to be noted here that prophylactic antibiotics before dental, oral as well as head and neck procedures will help to reduce the risk of developing deep neck space infections.

If the patient is clinically stable and has got abscess cavities that are less than 2.5 cm in diameter and is involving only single neck space then 48 to 72 hours of trial with empirical intravenous antibiotics can be done and is appropriate. If significant clinical improvement is seen with intravenous antibiotics after 48 to 72 hours then the therapy will be continued for 24 hours beyond and is followed up with an equivalent oral antibiotic.

4.SURGICAL MANAGEMENT

Principles of surgical management are

- Antibiotic availability in the pus filled spaces are often limited by the poor vascularity
- The treatment of fascial space infection depends upon open incision and dependent drainage.

- Fascial planes are contiguous and thus infection can spread from one space to another. Hence we need to open up all primary and secondary spaces and drains must be placed.
- The involved tooth being the nidus of infection has to be extracted, ideally at the time of incidence and drainage to make sure the complete resolution of the infection.

Surgical drainage is needed under the following circumstances:

1. When there is presence of air fluid levels with involvement of gas producing organisms.
2. When there is severe airway compromise.
3. When the patient fails to respond to 48 hours to 72 hours of empirical intravenous antibiotics/ with airway compromise
4. Impending airway compromise , spread of cellulitis down along the anterior triangle of neck
5. Presence of deep neck space infection complications like mediastinal spread

MATERIALS AND METHODS

Case details of patients admitted with deep neck space infections in the Department of Upgraded institute of Otorhinolaryngology, Rajiv Gandhi Government General Hospital from June 2020 to September 2021 were studied.

- A total of 40 patients admitted with complaints suggestive of deep neck space infections were included and studied.
- All patients underwent thorough history taking with emphasis on associated systemic illness and detailed physical examination.
- Appropriate laboratory investigations including complete hemogram, glycemic values, liver and renal function tests and electrolyte panel are done.
- Radiological investigations including CT neck with/ without contrast, X-ray neck, chest and USG neck were done to determine the extent, spread of the infection and to find out of complications if present.
- All patients were initially started on empirical intravenous antibiotics.
- Based on the severity of infection and the condition of the patient, conservative management or surgical intervention in the

form of needle aspiration or incision and drainage were done and pus drained was sent for culture and sensitivity analysis.

- The antibiotics were later on modified according to culture sensitivity reports and clinical responsiveness.
- Supportive therapy with intravenous fluid, analgesics, antipyretics, mouth washes were given to improve the general condition of the patient.
- The presentation and the course of the disease, the impact of associated systemic illness, the bacteriological profile and antibiotic sensitivity study, the modality of treatment chosen, the complications encountered and the final outcome of the patient studied.
- Results are presented in numbers and percentage.

INCLUSION CRITERIA :

1. Patients of age group 12 years to 80 years who are willing for admission and complete treatment and follow up
2. Patients who are willing for the study, able to understand the protocol and able to give informed consent
3. All patients with history and symptoms suggestive of deep neck space infections

EXCLUSION CRITERIA :

1. Patients of age less than 12 years, pregnant females, uncooperative patients
2. Patients with superficial cellulitis/abscess and infections of external neck wounds both surgical and traumatic
3. Patients not willing to complete treatment
4. Patients not willing for the study
5. Patients with associated head and neck malignancies

STUDY PLACE: Upgraded institute of otorhinolaryngology, RGGGH & MMC, Chennai.

STUDY PERIOD: June 2020 to September 2021

DESIGN OF THE STUDY: Prospective study

SAMPLE SIZE: 40

REVIEW OF LITERATURE

In the study by **Joon- Kyoo Lee et al** [4] **,**158 cases were studied from 1995 to 2004 regarding predisposing factors of complicated deep neck infections. Their study had male preponderance with ratio of 1.29:1. Neck swelling followed by neck pain were the most common symptoms. Odontological infections were the commonest. Diabetes seen in 27 cases. Parapharyngeal space was the most common site involved followed by submandibular space. Klebsiella pneumonia was the most common pathogen isolated and was seen in diabetic patients. 23 out of 158 patients developed complications. In their study, there was no correlation between clinical symptoms signs and duration of hospital stay.

In the retrospective comparative study between diabetic and non diabetic patients by **Huang tsun et al** [5]**,** done between 1997 to 2002, 185 patients were studied. 56 patients with diabetes mellitus were compared with 129 non diabetic cases. Parapharyngeal space was most commonly involved in both groups. Odontogenic infections and upper airway infections are the two most common causes of infection. Streptococcus was the most common organism isolated in the non diabetic group(43.7%). Klebsiella pneumonia was the most common organism isolated in the diabetic group (56.1%). Diabetic patients had

longer duration of hospital stay and more frequent complications. A higher percentage of multispace involvement was seen among diabetic patients.

In study by **Pablo Santos Gorjon et al** [6]**,** done retrospectively on 286 cases between January 1999 to December 2009, the mean age was 37.5 years. Ratio between the male and female was 1.2/1. Peritonsillar space was the most commonly affected space followed by submandibular space. In their study it was found that the time of admission was highly variable with short days in case of peritonsillar abscess and increased days in cases of retropharyngeal abscesses, and more in parapharyngeal abscess.They found that diabetic patients had delayed discharge of 4 days and 6 deaths happened in diabetic patient. The other comorbidities like hypertension, dyslipidemia did not lengthen the days of stay at hospital as well as the mortality rate. Imaging studies were made according to the location of infection. No imaging was done for 140 cases of peritonsillar abscesses. Most commonly used technique was CT. Regarding the treatment , they suggest that abscesses that are over 3cm do not resolve spontaneously and require surgical intervention.

In the study by **Kanika Rana et al** [7]**,** conducted on 50 patients at Maulana Azad Medical College Hospital, New Delhi, from September 2009 to September 2010, 29 (58%) were males and 21 (42%) were females. The average duration of symptoms following which patients presented was 15 days. Maximum patients were seen in less than 10 years (28%) of age and secondly was in the age group 30 - 40 years. The most common cause of infection was dental in origin seen in 48% patients. Then by tonsillar cause seen in 14% patients. Unknown etiology in 20%. The most common complaints were neck swelling and pain seen in 48 patients (96%) and 46 patients (92%) respectively. Submandibular abscess was the commonest abscess(60%) followed by parapharyngeal abscess. No growth in pus sample in 33 patients (66%). Staphylococcus aureus was seen most commonly. Incision and drainage done in 39 patients while 11 patients were treated with medical management. Antibiotics were given for 2 weeks on an average with mean duration of hospital stay of 14 days.

In the study by **Gaurav Kataria et al** [8], done retrospectively on 76 patients from October 2010- January 2013 showed that majority of patients were in the 31–40 age group, followed by the 41–50-year age groups. Males predominated their study(55%). Diabetes was seen in 11% of patients. Neck pain was the most common symptom in 88% of

cases. Odontogenic infection is the most common (34%) followed by tonsillar and pharyngeal infection(28%). The most common infection was ludwigs angina (29%) followed by peritonsillar abscess. Surgical intervention done in 89% of cases while emergency tracheostomy was done in 5.3% cases.

In a prospective study done by **Ashokan S et al**[9]**,** on 76 patients from year January 2012 to June 2013, the author studied and compared about the outcome between diabetic and non diabetic patients. In his study the male female ratio was 2:1. The most common aetiology was Odontogenic (68.4%) followed by tonsillar infection. Unknown aetiology in 34.2%. Commonest site was submandibular (64.2%), followed by parapharyngeal (26.6%) space. Preponderance of Klebsiella was noted in diabetic patients. Klebsiella species were seen to have maximum sensitivity to gentamicin, ciprofloxacin and cefotaxime and resistance to ampicillin. The complications were more common in diabetic patients(34.2%).The study quotes contrast enhanced computed tomography (CECT) as highly sensitive with positive predictive value of 82% and is commented to be useful to identify the extent of the DNI and distinguish cellulitis from abscesses.The mean hospital stay was more in diabetes than non diabetes patients.

In the retrospective study conducted by **Tiwana et al**[14], from January 2012 to January 2021, 222 patients of deep neck space infections were studied. Dental infection (52%) was the most common predisposing factor for deep neck space infections in adults followed by diabetes mellitus (28.2%). Multispace involvement was the most common presentation followed by parapharyngeal space involvement. The majority of the cultures were sterile (42.6%). The most common pathogen on cultures was Staphylococcus aureus (13.1% in adults and 47.4% in pediatric age group). Klebsiella pneumoniae isolates were found to 100% sensitive to amikacin and Piperacillin tazobactam.

In the study by **Pradip Khokle et al** [10], conducted from November 2013 to November 2015, on 52 patients, the majority were between 41-50 years with slight male preponderance.Out of the 52, 5 patients were diabetic, 2 had HIV, 1 had chronic renal failure.Neck pain was most common presenting complaint seen in 47 cases followed by neck swelling in 45. Other symptoms like dysphagia, dental ache, fever, trismus and torticollis were also noted. Most of cases were odontogenic (53.84%) in origin followed by tonsillo-pharyngitis (17.30%).Unknown aetiology was seen in 10% case. Submandibular space (34.61%) was the most common space involved followed by peritonsillar (21%), Ludwig's (17%). Drainage of the pus

was definite management in their study. Staphylococcus aureus was the most common organism isolated in 25 cases. Diabetic patients had Klebsiella pneumoniae as a common microorganism in the study. Out of the 52, 11 patients had complications of which stridor and respiratory distress were most common (7.69%) followed by skin necrosis and defect in 5.76%. For two cases emergency tracheostomy was done. 3 out of the 52 cases died due to sepsis, mediastinitis and pneumonitis.

In the study by **Atishkumar B.Gujrathi et al** [11]**,** done retrospectively on 270 patients from year 2013 to 2016 reveals male preponderance with majority of patients in age group of 21-30 years. Pain was the main complaint followed by neck swelling. Odontogenic infections were the most common etiology seen in 65 cases followed by pharyngotonsillitis in 36 cases. 98 cases were diabetic. Ludwigs angina (17%) was the most common diagnosis followed by submandibular and peritonsillar abscess. Streptococcus pyogenes were most commonly grown with 29 negative cultures. Incision and drainage was the main modality taken and tracheostomy done in 2 cases.

In 2017, a cross sectional study done by **Nirmal Kumar J et al**[12]**,** at Madras Medical College included 17 treated cases of deep

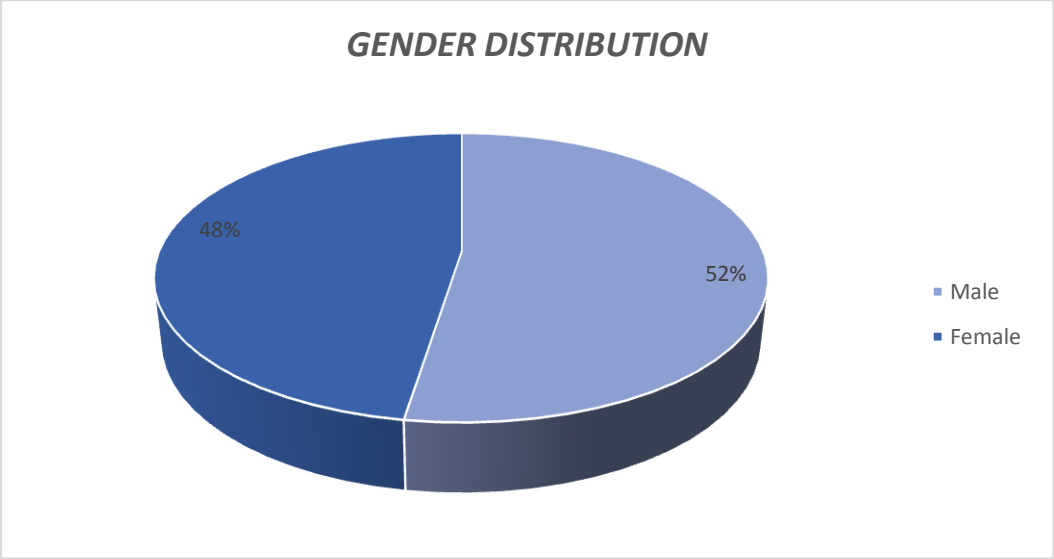
neck space infection , 12 males and 5 females. The most common cause of infection in his study was dental infections (64.7%).4 patients (23.5%) had unknown etiology. Cultures revealed Klebsiella species in 6 patients (46.1%).

In a prospective study on 50 patients by **Raju Naik et al** [13]**,** done from January 2021 to September 2021, the most common age group affected was 31-40(24%) with male preponderance (68%), most common presenting symptom is odynophagia(90%), followed by restricted mouth opening(80%).Diabetes mellitus(18%) is the most common associated systemic disease seen. Dental infections was the common etiology followed by recurrent tonsillitis. Ludwig's angina is the most common abscess followed by peritonsillar abscess. Single space infection is found in (47%), Radiological investigations was required in (80%) of cases. Pseudomonas is the commonest organism grown.

RESULTS

1.GENDER DISTRIBUTION

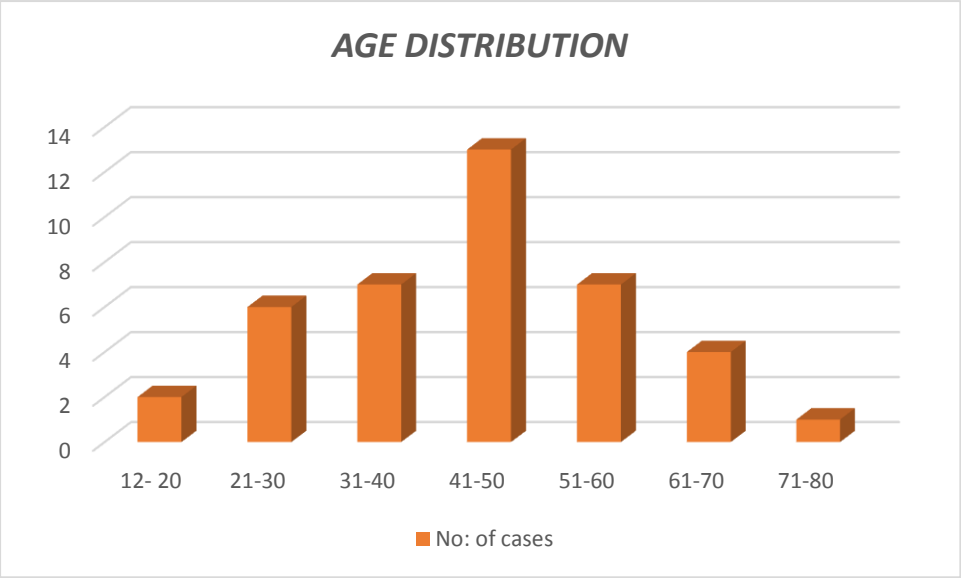
Males	*Females*
21(52.5%)	19(47.5%)



In our study of 40 patients of deep neck space infections, 21 cases were males and 19 cases were females. There is almost equal incidence of infection in both sexes with slightest male preponderance.

2.AGE DISTRIBUTION

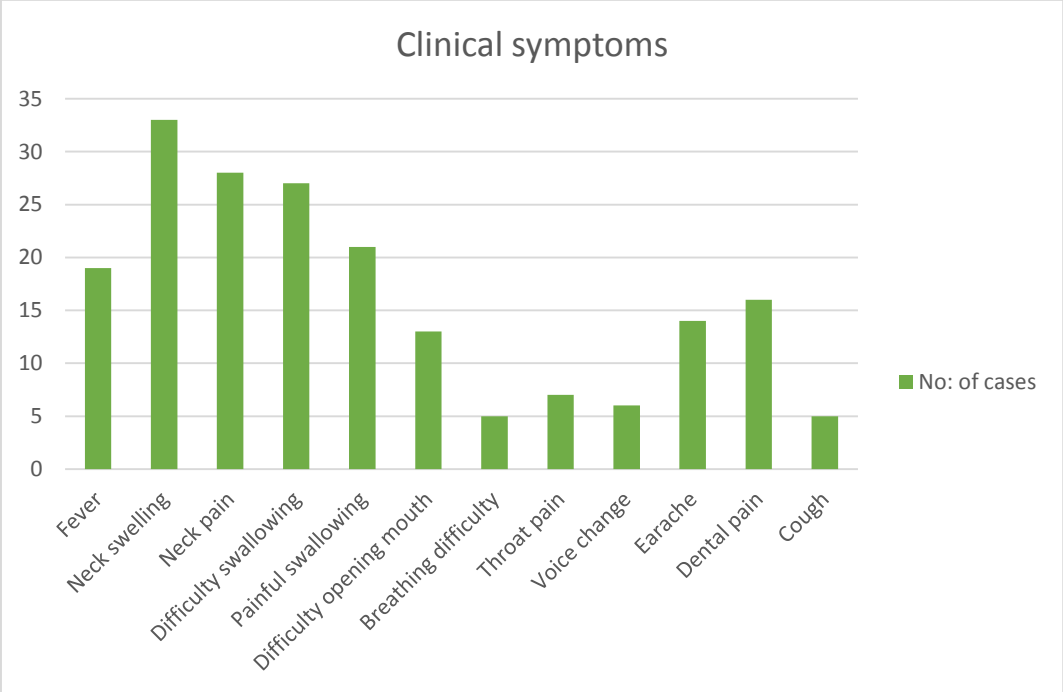
Age groups (in years)	No: of cases	Percentage
12-20	2	5%
21-30	6	15%
31-40	7	17.5%
41-50	13	32.5%
51-60	7	17.5%
61-70	4	10%
71-80	1	2.5%



In our study the minimum age of presentation is 14 years and the maximum age is 76 years. Majority of the cases were in the age group range of 41-50 years(32.5%) followed by in age groups 31-40 (17.5%) and 51-60 (17.5%) years. Least number of cases were seen in the age group of 71- 80years (2.5%).

3.CLINICAL FEATURES

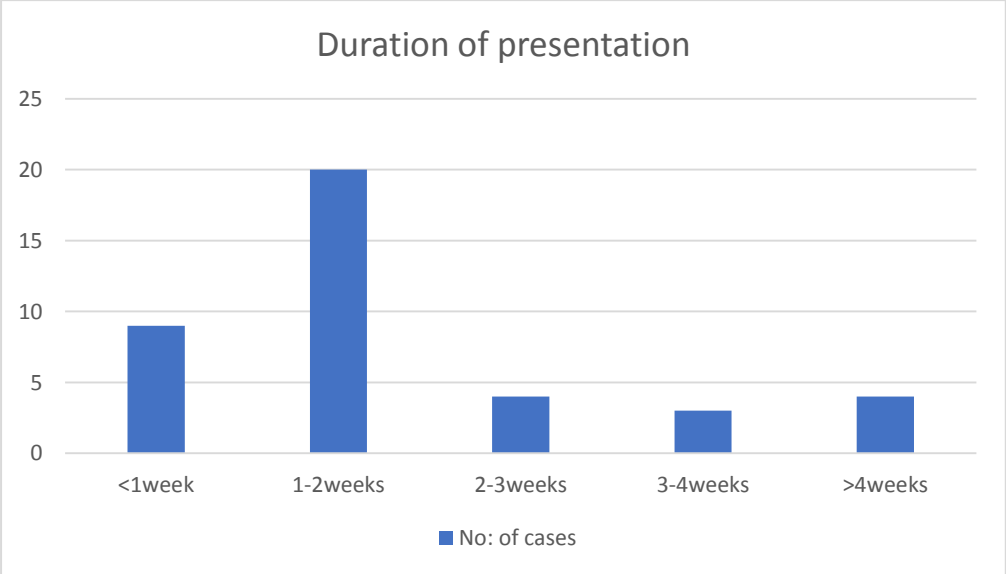
Clinical symptoms	***No: of cases***	***Percentage***
Fever	19	47.5%
Neck swelling	33	82.5%
Neck pain	28	70%
Difficulty swallowing	27	67.5%
Painful swallowing	21	52.5%
Difficulty opening mouth	13	32.5%
Breathing difficulty	5	12.5%
Throat pain	7	17.5%
Voice change	6	15%
Earache	14	35%
Dental pain	16	40%
Cough	5	12.5%



The most common symptom with which patients presented is neck swelling(82.5%) followed by neck pain(70%) and difficulty in swallowing (67.5%). Patients with dental caries had dental pain(40%). Fever(47.5%), painful swallowing(52.5%), trismus (32.5%) and earache(35%) were also seen in patients.

4.DURATION OF PRESENTATION

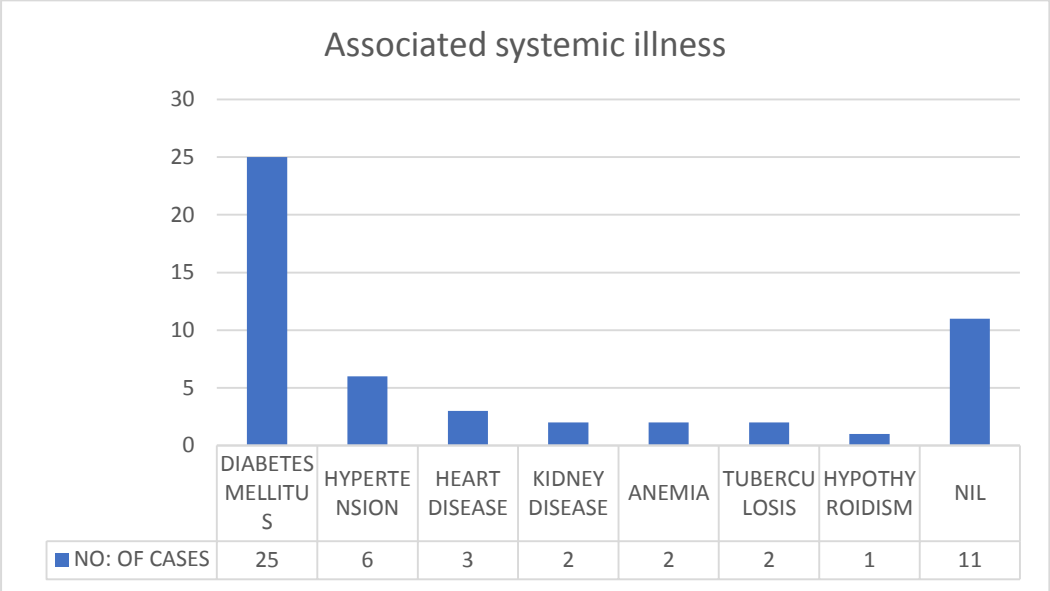
Duration	No: of cases	Percentage
<1week	9	22.5%
1-2weeks	20	50%
2-3weeks	4	10%
3-4weeks	3	7.5%
>4weeks	4	10%



Out of the 40 cases studied, 20 cases(50%) presented to us following 1-2 weeks of symptom onset. While only 9 cases (22.5%)presented within one week of symptom onset. 4 patients(10%) presented each after 2-3 weeks and more than 4 weeks of symptom onset.

5.ASSOCIATED SYSTEMIC ILLNESS

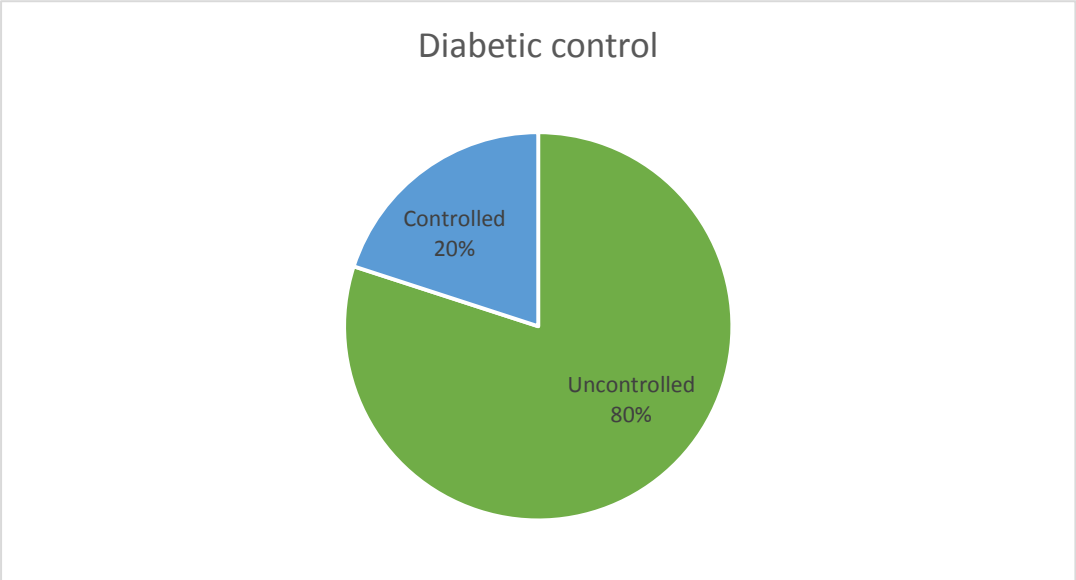
Systemic illness	*No: of cases*	*Percentage*
Diabetes mellitus	25	62.5%
Hypertension	6	15%
Heart disease	3	7.5%
Kidney disease	2	5%
Anemia	2	5%
Tuberculosis	2	5%
Hypothyroidism	1	2.5%
Nil	11	27.5%



Out of the 40 cases of deep neck space infections, 25 cases (62.5%) were having diabetes mellitus. 11 patients (27.5%) had no underlying systemic illness. 6 patients (15%) have hypertension, 3 (7.5%)with heart disease, 2 cases (5%) with kidney disease, anemia and tuberculosis.

6. DIABETIC CONTROL

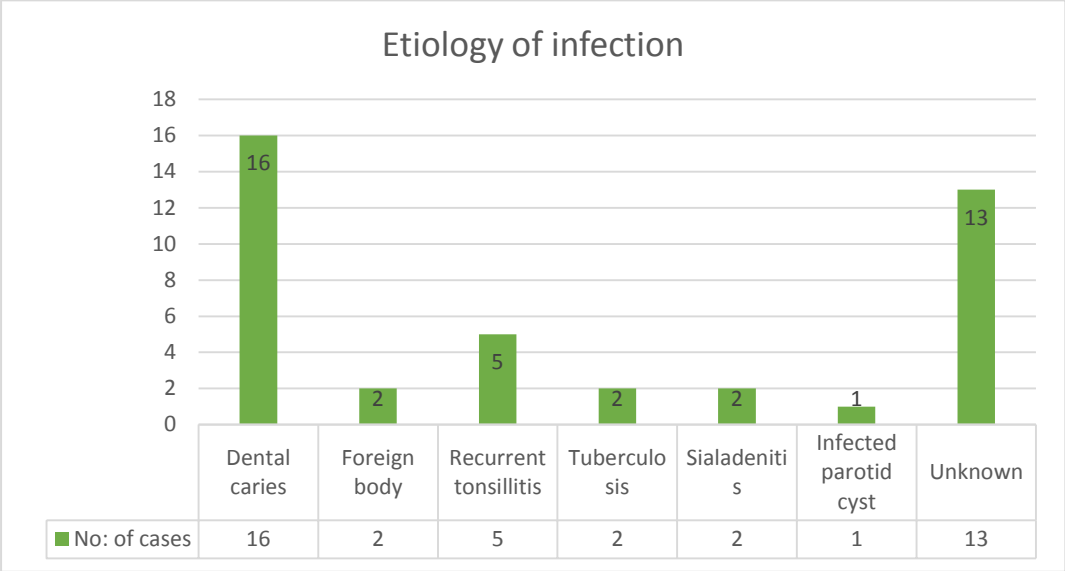
Uncontrolled	***Controlled***
20(80%)	5(20%)



Out of the 25 cases of diabetes mellitus in our study group, 20 patients (80%) had uncontrolled diabetes and only 5 (20%) of them had controlled disease.

7.ETIOLOGY OF DEEP NECK SPACE INFECTION

Etiology	No: of cases	Percentage
Odontogenic	16	40%
Foreign body	2	5%
Recurrent tonsillitis	5	12.5%
Tuberculosis	2	5%
Sialadenitis	2	5%
Infected parotid cyst	1	2.5%
Unknown	13	32.5%



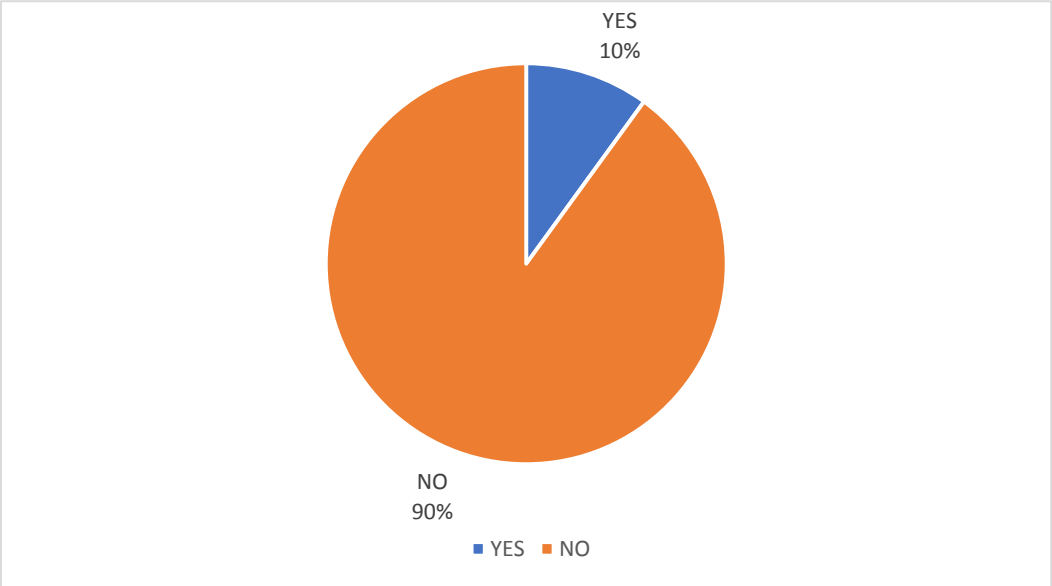
In our study, 16 cases (40%) of infection were odontogenic in origin, constituting the majority. While for 13 patients (32.5%)the exact etiology could not be elicited. Recurrent tonsillitis is responsible for 5 cases (12.5%)and tuberculosis in 2 cases(5%).

Among the 13 cases with unknown etiology, 6 were females and 7 were males. All patients consumed mixed diet and only 2 among

13 patients were smoker and alcoholic. No patients had habits of betel nut/ tobacco chewing. 8 patients out of 13 were diabetic and out of this 8, 7 patients were having uncontrolled diabetic status. Two cases had dental caries but not severe to be extracted.

8.PREVIOUS HISTORY

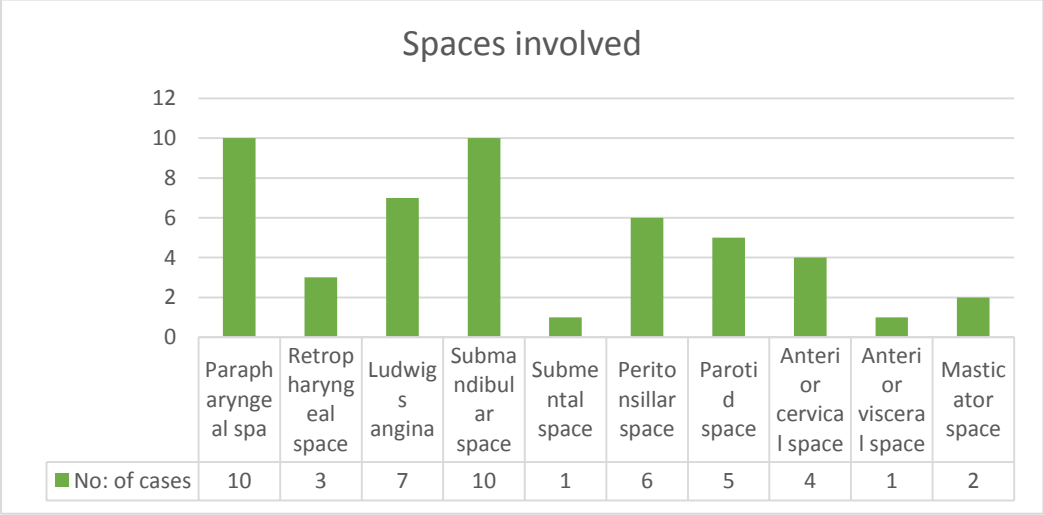
Past infection	***No: of cases***
YES	4(10%)
NO	36(90%)



In our study of 40 patients with deep neck space infections only 4 cases(10%) had a similar history of infection in the past. Majority (90%) of patients had no history of past infection of the same.

9.DIAGNOSIS OF SPACES INVOLVED

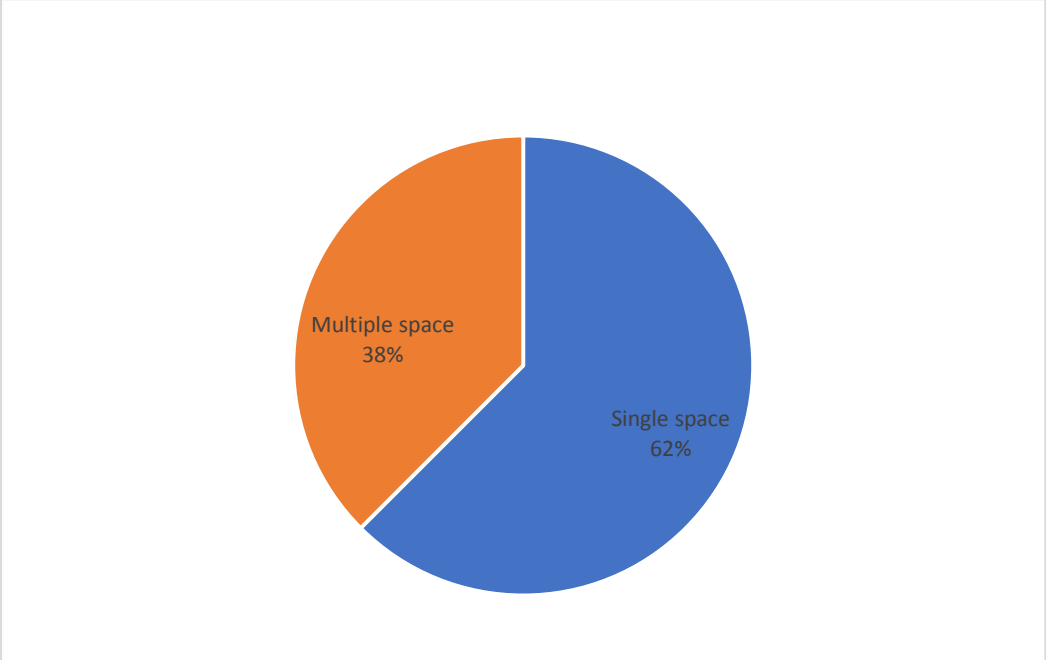
Sites of presentation	***No: of cases***	***Percentage***
Parapharyngeal space	10	25%
Retropharyngeal space	3	7.5%
Ludwigs angina	7	17.5%
Submandibular space	10	25%
Submental space	1	2.5%
Peritonsillar space	6	15%
Parotid space	5	12.5%
Anterior cervical space	4	10%
Anterior visceral space	1	2.5%
Masticator space	2	5%



Parapharyngeal (25%) and submandibular (25%) spaces are the most common spaces involved in our study with 10 cases each. Ludwigs angina was diagnosed in 7 (17.5%) patients. 6 (15%)patients were having peritonsillar space infection. 12.5% patients had parotid space infection,10% had anterior cervical space infection, 5% had masticator space infection and 2.5% had anterior visceral space infection.

10.NUMBER OF SPACES INVOLVED

Single/multiple spaces	No: of cases
Single space	25(62.5%)
Multiple space	15(37.5%)



In our study, 25 patients (62.5%) had only single space involvement and 15 cases (37.5%) had multiple space infections.

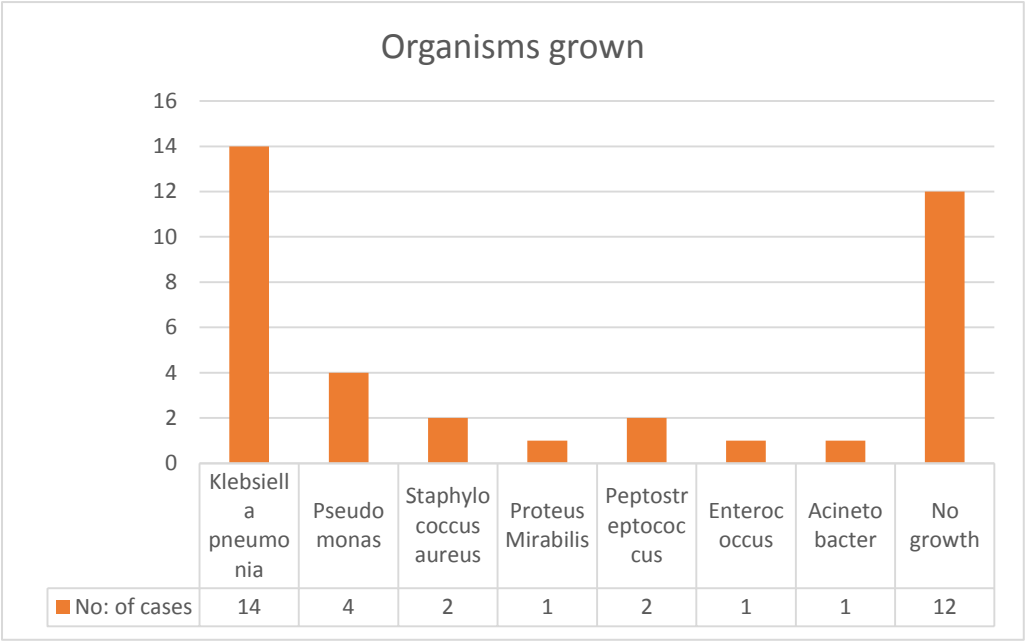
ASSOCIATION OF DIABETIC STATUS WITH NUMBER OF SPACE INVOLVED

Diabetic status	**Number of spaces involved**		**Total**	**P value**
	Single	**Multiple**		
Controlled	***5***	***0***	***5***	***0.027***
Uncontrolled	***9***	***11***	***20***	

The association between diabetic status with the number of spaces involved shows that uncontrolled diabetic patients had more incidence of multiple space involvement among the diabetic group with a significant p value of 0.027.

11.BACTERIOLOGY OF ORGANISMS

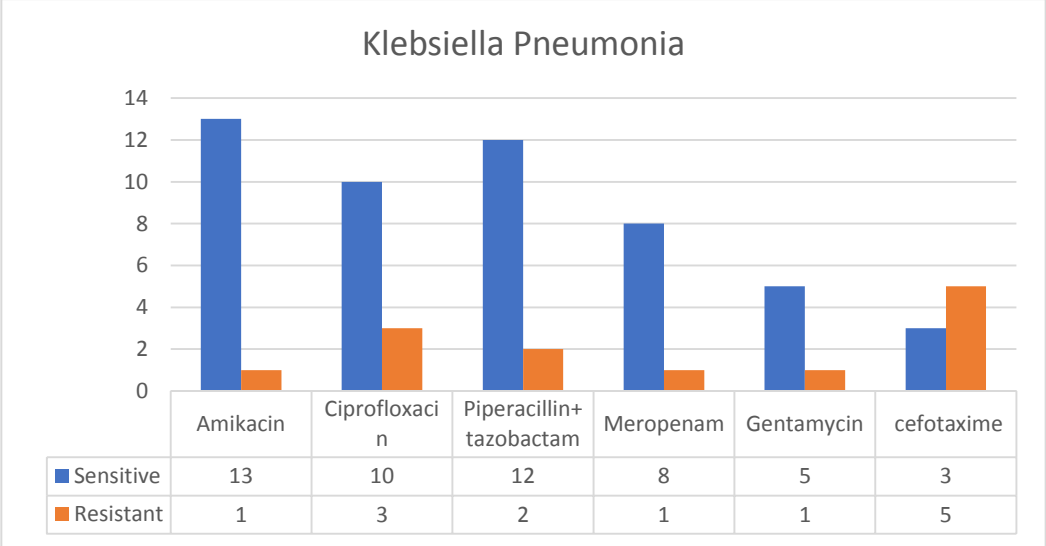
Organism grown	***No: of cases***	***Percentage***
Klebsiella pneumonia	14	37.8%
Pseudomonas	4	10.8%
Staphylococcus aureus	2	5.4%
Proteus Mirabilis	1	2.7%
Peptostreptococcus	2	5.4%
Enterococcus	1	2.7%
Acinetobacter	1	2.7%
No growth	12	32.4%



Out of the 37 samples sent, 14 (37.8%)samples came out as klebisiella pneumonia while 12(32.4%) samples showed no growth. 13 out of 14 Klebsiella positive samples were from uncontrolled diabetic patients. Only one case was isolated from non diabetic patient. Pseudomonas species growth were noted in 4(10.8%) samples. Anaerobic study showed peptostreptococcus growth in 2 (5.4%) samples both of Ludwigs patients.

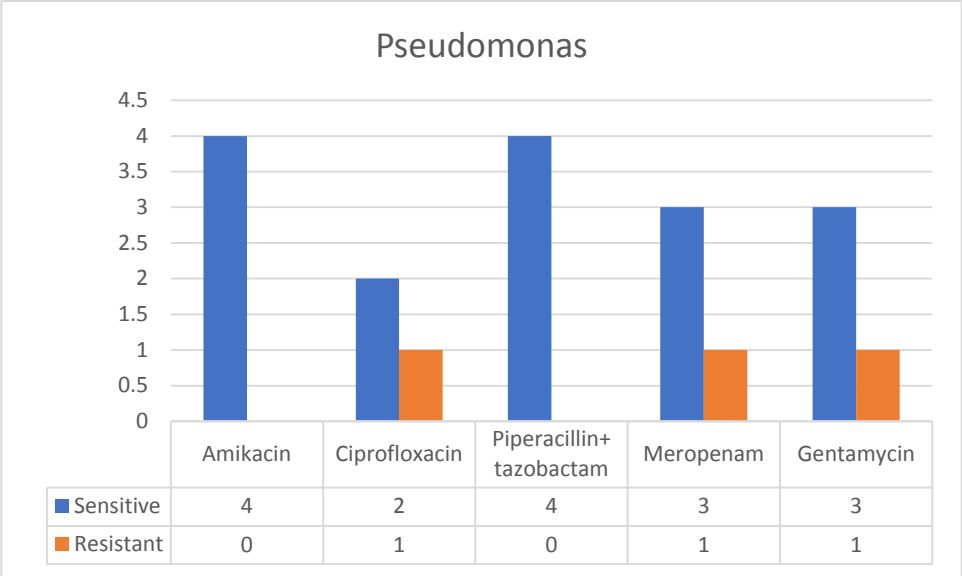
12.ANTIBIOTIC SENSITIVITY

Klebsiella pneumonia(14)	***Sensitive***	***Resistant***
Amikacin	13(92.8%)	1(7.14%)
Ciprofloxacin	10(71.4%)	3(21.42%)
Piperacillin+ tazobactam	12(85.7%)	2(14.2%)
Meropenam	8(57%)	1(7.14%)
Gentamycin	5(35.7%)	1(7.14%)
cefotaxime	3(21.4%)	5(35.7%)



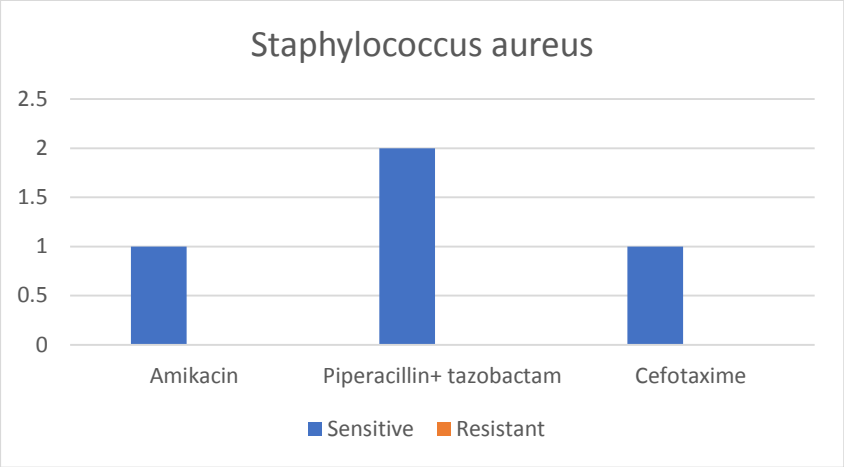
Klebsiella pneumonia grown in 14 out of the 37 samples sent shows maximum sensitivity to amikacin(92.8%), ciprofloxacin(71.4%) and Piperacillin tazobactam(85.7%). Sensitivity to Meropenam and gentamycin are 57% and 35.7% respectively. In our study klebsiella pneumonia shows more resistance of 35% to cefotaxime than sensitivity(21.4%).

Pseudomonas (4)	*Sensitive*	*Resistant*
Amikacin	4 (100%)	-
Ciprofloxacin	2 (50%)	1(25%)
Piperacillin+ tazobactam	4 (100%)	-
Meropenam	3 (75%)	1(25%)
Gentamycin	3 (75%)	1(25%)



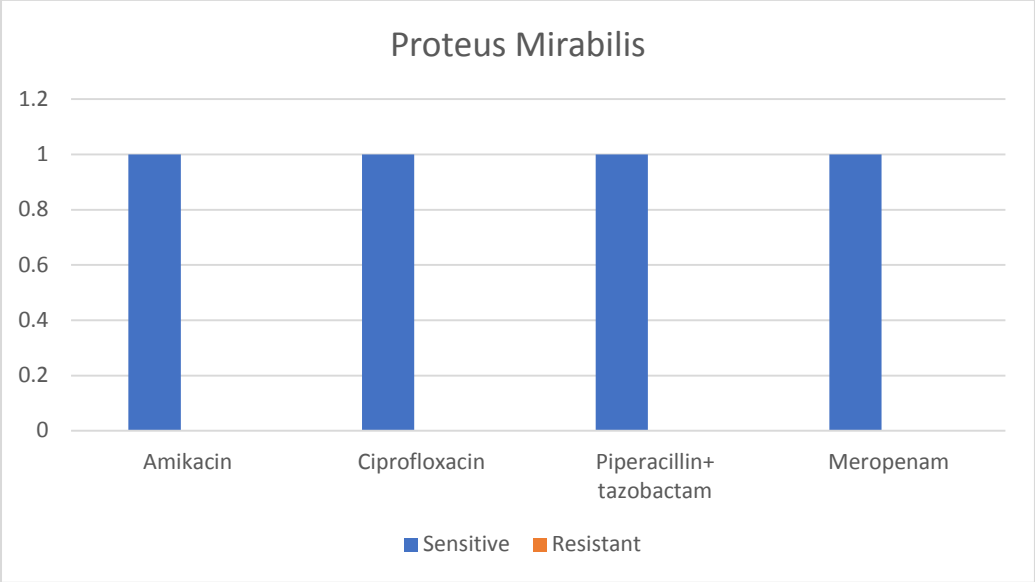
Out of the 37 samples sent, 4 cultures were positive for pseudomonas species. The antibiotic sensitivity of pseudomonas shows maximum of 100% of sensitivity to amikacin, Piperacillin taxobactam. 75% sensitivity was seen for Meropenam and Gentamycin and 50% for Ciprofloxacin.

Staphylococcus aureus (2)	*Sensitive*	*Resistant*
Amikacin	1(50%)	-
Piperacillin+ tazobactam	2(100%)	-
Cefotaxime	1(50%)	-



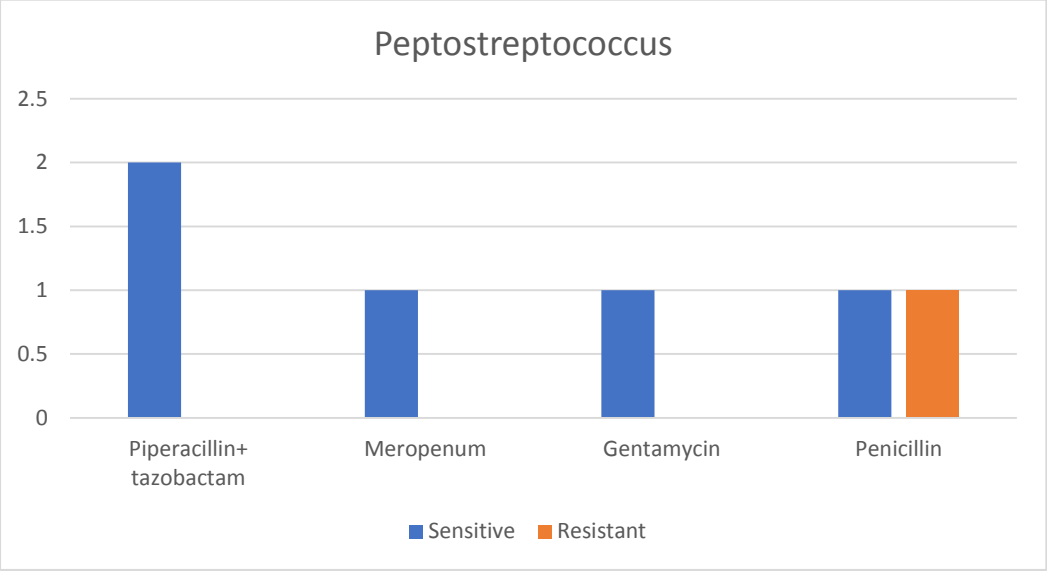
Out of the 37 samples sent, only 2 samples were positive for staphylococcus aureus. The samples were sensitive to amikacin, Piperacillin tazobactam, cefotaxime. The pathogen was not having resistance for any organisms that were studied.

Proteus Mirabilis (1)	***Sensitive***	***Resistant***
Amikacin	1 (100%)	-
Ciprofloxacin	1(100%)	-
Piperacillin+ tazobactam	1(100%)	-
Meropenam	1(100%)	-



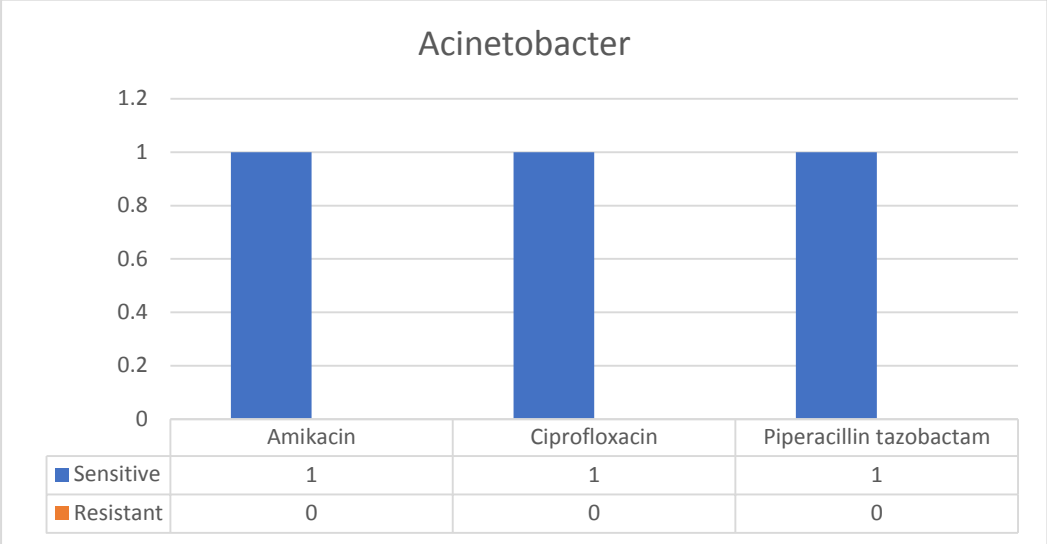
Proteus Mirabilis was grown only in one sample and it was seen to be sensitive to amikacin, ciprofloxacin, Piperacillin tazobactam and to Meropenam.

Peptostreptococcus (2)	***Sensitive***	***Resistant***
Piperacillin+ tazobactam	2(100%)	-
Meropenum	1(50%)	-
Gentamycin	1(50%)	-
Penicillin	1(50%)	1(50%)



Anaerobic organism peptostreptococcus was grown in 2 samples out of the 37. It showed sensitivity to Piperacillin tazobactam, gentamicin and Meropenam. One sample was sensitive to penicillin and one was resistant to penicillin.

Acinetobacter (1)	***Sensitive***	***Resistant***
Amikacin	1	-
Ciprofloxacin	1	-
Piperacillin tazobactam	1	-



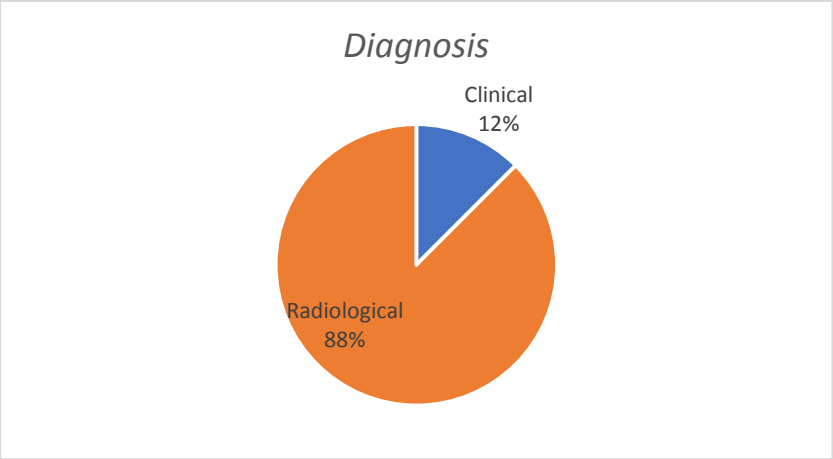
Acinetobacter was grown in a single sample out of the 37 and it showed sensitivity to amikacin, ciprofloxacin and Piperacillin tazobactam. The strain was not resistant to any antibiotics tested.

Enterococcus (1)	***Sensitive***	***Resistant***
Gentamicin	1	-
Penicillin	-	1

Enterococcus was grown in only one sample out of 37 samples. It shows sensitivity to gentamicin and resistance to penicillin.

13.DIAGNOSIS

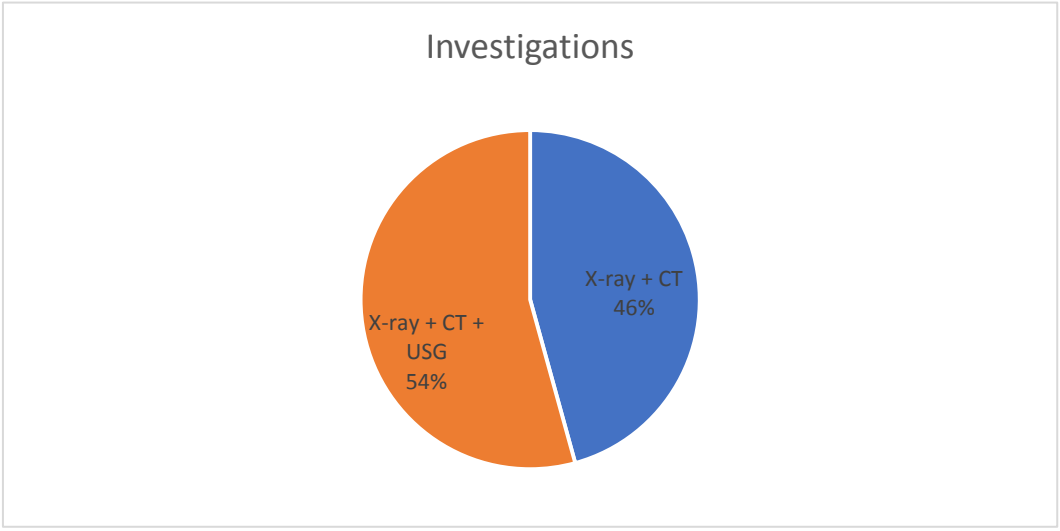
Clinical	***Radiological***
5(12.5%)	35(87.5%)



In our study, only 5 (12.5%) cases were clinically diagnosed while 35 (87.5%) had to undergo radiological investigations for studying extent and diagnosis.

14.RADIOLOGICAL INVESTIGATIONS

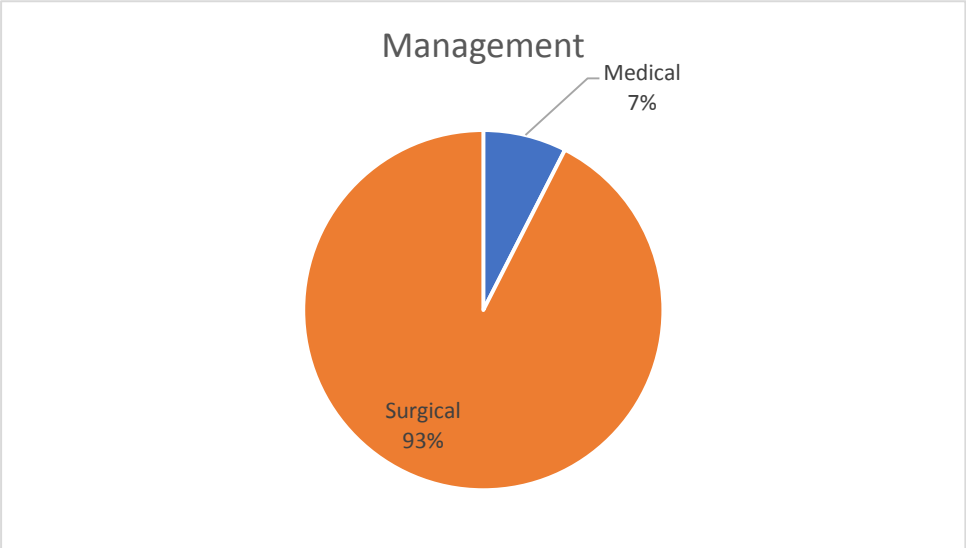
Investigations	*No:of cases*
X-ray + CT	16(40%)
X-ray + CT + USG	19(47.5%)



Of the 35 cases whom underwent radiological investigations, X-rays were taken for all, which included both X-rays of neck and chest. CT scan was done for all 35 (87.5%) cases. Ultrasonography was done along with X-ray and CT scans for 19 cases(47.5%).

15. MANAGEMENT

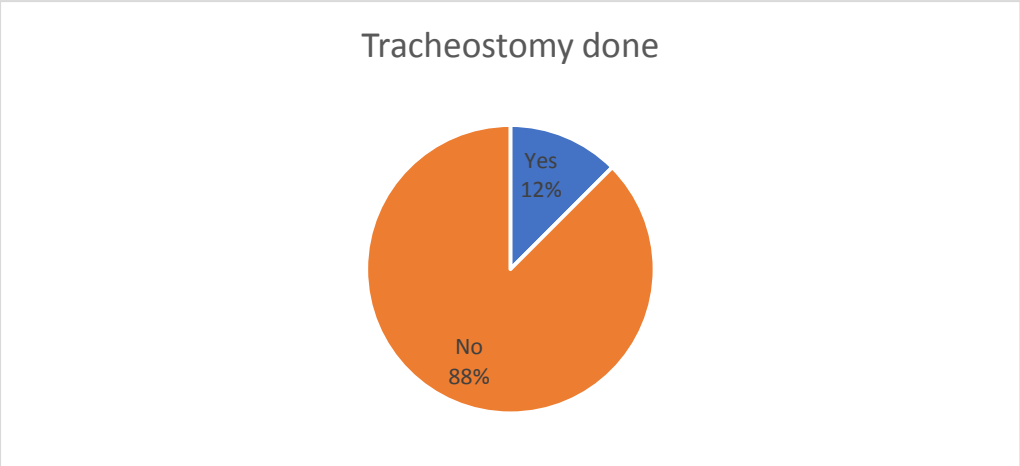
Medical	***Surgical***
3(7.5%)	37(92.5%)



Out of the 40 cases of deep neck space infection studied, 37 cases (92.5%)underwent surgical intervention and only 3 cases (7.5%) were treated conservatively.

16. NEED FOR TRACHEOSTOMY

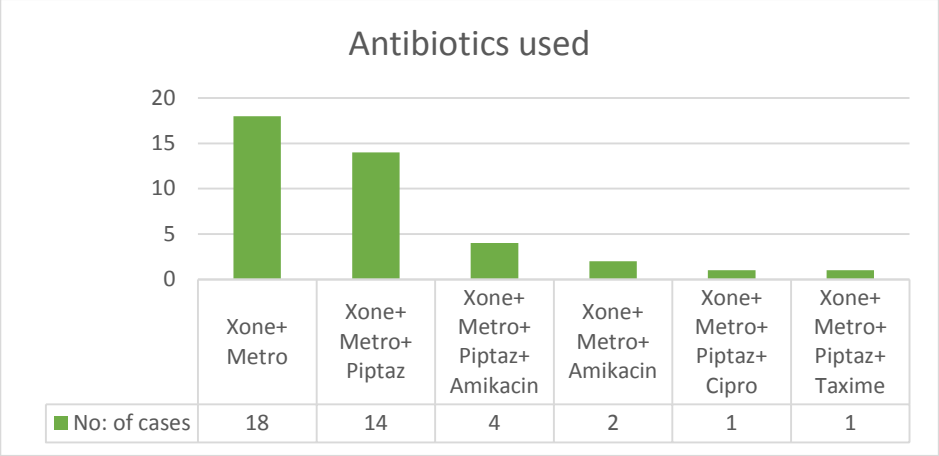
Tracheostomy done	No. of cases
Yes	5(12.5%)
No	35(87.5%)



Out of the 40 cases only 5 cases (12.5%) needed tracheostomy due to airway compromise. Out of the 5 cases, 4 were of Ludwigs angina and one case was of Parapharyngeal abscess.

17. ANTIBIOTICS USED

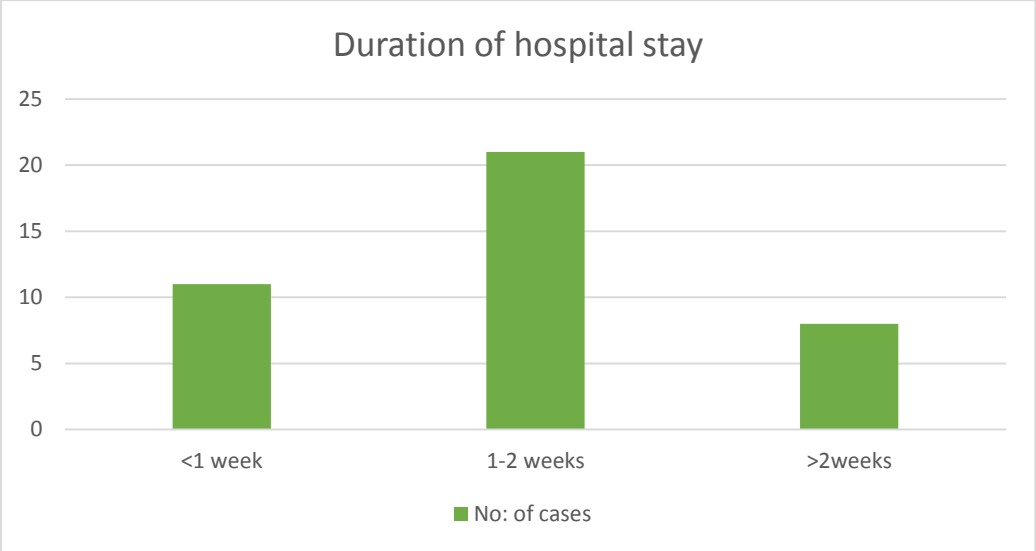
Antibiotics used	***No: of cases***
Ceftriaxone+ Metro	18(45%)
Ceftriaxone+ Metro+ Piptaz	14(35%)
Ceftriaxone + Metro+ Amikacin	2(5%)
Ceftriaxone + Metro+ Piptaz+ Amikacin	4(10%)
Ceftriaxone + Metro+ Piptaz+ Cipro	1(2.5%)
Ceftriaxone + Metro+ Piptaz+ Taxime	1(2.5%)



In our institution, we started the treatment of deep neck space infections with a third generation cephalosporin ceftriaxone and added metronidazole for the anaerobic coverage. Later, based on the culture studies, additional antibiotics were added. The combination of ceftriaxone and metronidazole (45%) were most commonly used followed by combination of ceftriaxone, metronidazole and piperacillin tazobactam (35%).

18. DURATION OF HOSPITAL STAY

Duration of stay	No: of cases
<1 week	11(27.5%)
1-2 weeks	21(52.5%)
>2weeks	8(20%)



21(52.5%) out of the 40 cases had to stay for a period of 1-2 weeks for the complete recovery and for the diabetic control. 8 patients (20%) were to stay for more than 2 weeks and this cases in particular were the ones with complications of the infection. 11 cases(27.5%) stayed for less than one week in hospital for recovery.

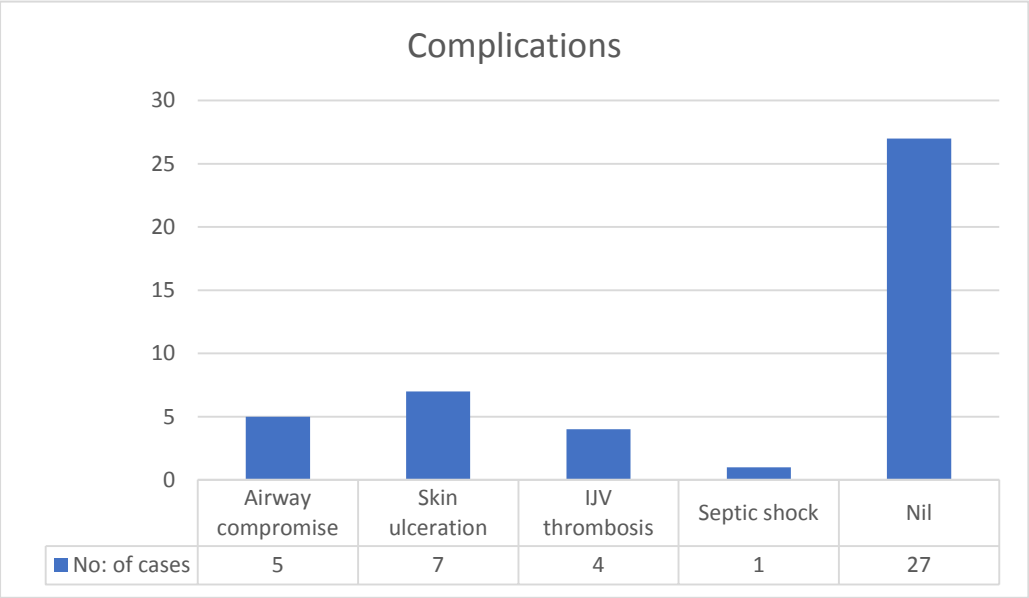
ASSOCIATION BETWEEN DIABETIC STATUS AND DURATION OF HOSPITAL STAY

Diabetic status	**Duration of hospital stay**			**Total**	**P value**
	<1week	**1-2weeks**	**>2weeks**		
Controlled	***4***	***1***	***0***	***5***	***0.004***
Uncontrolled	***2***	***11***	***7***	***20***	

From the association of diabetes status and the duration of hospital stay studied it is clear that the patients with uncontrolled diabetes has prolonged stay in the hospital. This finding is significant with a p value of 0.004.

19.COMPLICATIONS ENCOUNTERED

Complications	No: of cases
Airway compromise	5(12.5%)
Skin ulceration	7(17.5%)
IJV thrombosis	4(10%)
Septic shock	1(2.5%)
Nil	27(67.5%)



Out of the 40 cases studied, 27 cases (67.5%) had no complications. Out of the 13 cases (32.5%) with complications, 7 (17.5%) had skin ulceration and 5 (12.5%) had airway compromise necessitating tracheostomy. Interval jugular vein thrombosis was seen in 4 cases (10%). One patient (2.5%) went into septic shock. Out of the 17.5% of cases with skin ulceration, split skin grafting was done for two cases after pus drainage and wound debridement. 10% of cases who had internal jugular vein thrombosis were further evaluated with colour doppler study and were started on intravenous anticoagulants during hospital stay and discharged with oral anticoagulants.

Among the 13 cases with complications, 54% cases had skin ulceration, 31% had internal jugular vein thrombosis and 38.4% cases had airway compromise. Klebsiella pneumonia was the causative organism found in 57% of skin ulceration cases, 75% of internal jugular vein thrombosis cases and 80% of cases with airway compromise. The pus culture from the patient with septic shock also had klebsiella growth.

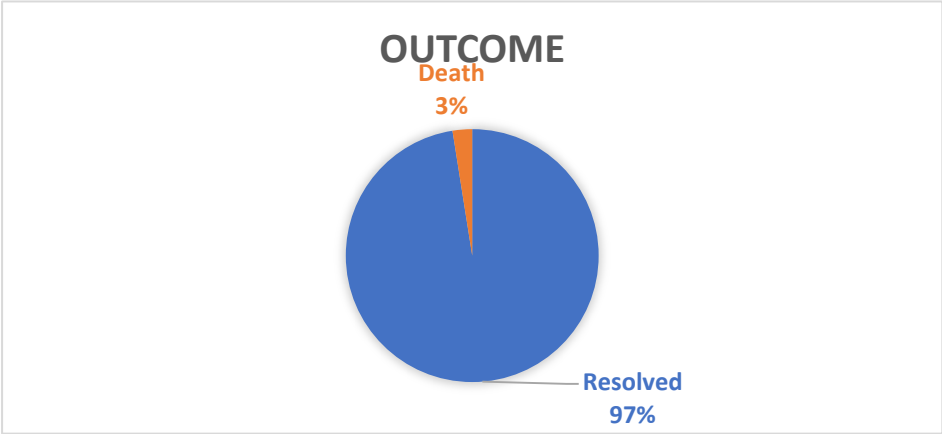
ASSOCIATION OF DIABETIC STATUS WITH COMPLICATIONS ENCOUNTERED

Diabetic status	**Complications**		**Total**	**P value**
	Yes	**No**		
Controlled	***0***	***5***	***5***	***0.027***
Uncontrolled	***11***	***9***	***20***	

From the association of diabetic status with complications encountered it was found that diabetic patients with uncontrolled diabetic status has got more incidence of complications which is a significant finding with p value of 0.027.

20. OUTCOME OF THE MANAGEMENT

Resolved	Death
39(97%)	1(3%)



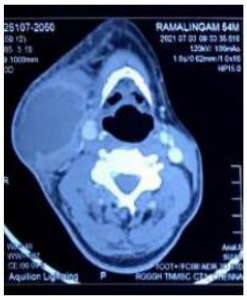
Out of the 40 cases treated, 39 cases resolved and were discharged in good general condition. Only one case of Ludwigs angina in our study expired in 3 days of admission due to septicaemia.

Anterior cervical space infection




At presentation *Post I and D/ wound debridement* *Post SSG*



At presentation *Post wound debridement* *Outcome*

Ludwigs angina




At presentation *Post Incision and drainage* *Outcome- resolved*




Parapharyngeal abscess

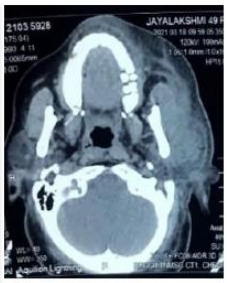


At presentation *Post I and D/ wound debridement* *Post SSG*

Parotid abscess





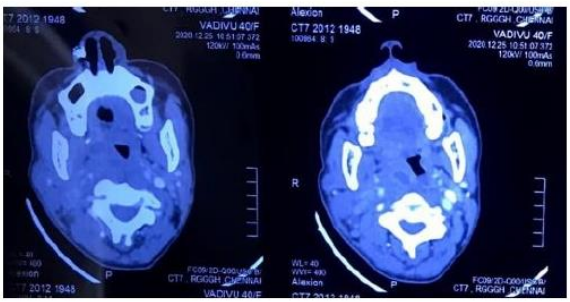


At presentation *Post I and D*

Anterior visceral space infection

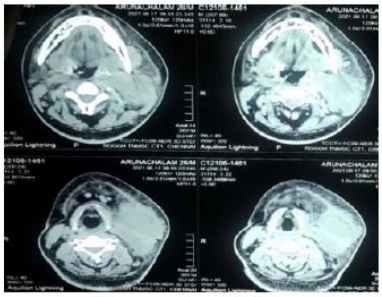

At presentation *After antibiotic therapy*

Parapharyngeal abscess

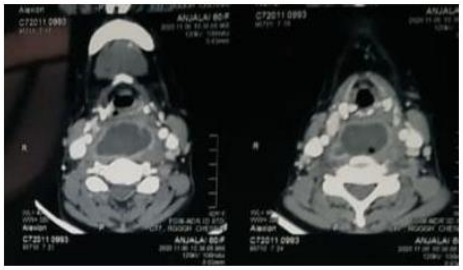


At presentation Lateral pharyngeal wall bulge

Left Peritonsillar abscess. ***Submandibular abscess***



Retropharyngeal abscess



DISCUSSION

In the present study conducted on 40 patients of deep neck space infection in Rajiv Gandhi Government General Hospital during the study period of June 2020 to September 2021 there is almost equal presentation in both male and females with a slightly higher incidence among males with a ratio of 1.1/1. This correlates with Pablos Santos et al [6] study where the male female ratio is 1.2/1 and Joon- Kyoo Lee et al [4] study where it is 1.29/1. Most of the studies in literature shows male preponderance in deep neck space infection.

In our study the disease was most commonly seen in the age group of 41 to 50 years(32.5%) followed by 31 to 40 (17.5%) and 51 to 60 (17.5%) years as like in the study by Pradip khokle et al [10] and Ashokan S et al [9] where the majority was in the age group of 41 to 50 years. Patients in the third, fourth and the fifth decade are most commonly affected by the disease.

It was found that diabetes mellitus (62.5%) is the most common associated systemic disease seen in deep neck infection patients similar to that of many articles in literature including studies by Huang Tsun et al [5], Raju Naik et al [13] and Nirmal Kumar J et al [12]. The other risk factors that were noted in our study are hypertension, heart diseases and chronic kidney disease. The diabetic status of the patient

has got significant impact over the duration of hospital stay, the number of spaces involved and on the occurrence of complications. In our study, among the diabetic patients, 80% of them were having uncontrolled glycemic status. Uncontrolled diabetic patients are more prone to develop deep neck space infections and have got poor prognosis if not intervened early.

Odontogenic infection (40%) followed by recurrent tonsillitis (12.5%) are the main causes of infection in our study with no aetiology identified in 32.5% of patients. Dental infections were the most common cause of infection in the studies by Nirmal Kumar J et al [12] (64.7%), Huang Tsun et al [5], Atishkumar B.Gujrathi et al [11] (24%) and Gaurav Kataria et al [8] (34%). Among the odontogenic source, 3 cases were following dental extraction and the rest 13 cases were due to dental caries. The diseased tooth and its infected root decides the spaces that gets involved. Infection following dental extraction is mostly due to the usage of unsterile instruments or due to the left behind infected tooth bits. The most common cause with odontogenic source is the presence of dental caries. Most of the cases of dental caries have associated chronic periodontal disease also. In our study, the lower molars were the most commonly affected tooth causing more occurrence of ludwigs angina, parapharyngeal and

submandibular space abscess. Good dental hygiene and regular dental visits can hence reduce the occurrence of deep neck infections.

Unknown etiology was seen in 32.5% of cases in our study which is slightly higher than in Pradip khokle et al [10] and Kanika Rana et al [7] studies where it is 10% and 20% respectively. The details of these 13 cases of unknown etiology were studied. 6 cases had multiple space involvement and 7 cases had single space involvement. The most common space involved is parapharyngeal space (7cases) followed by anterior cervical space infection (4 cases), and submandibular space(3 cases), parotid space (2 cases) and 1 case each of retropharyngeal and anterior visceral space.

Submandibular (25%) and parapharyngeal (25%) spaces are the most common spaces that are involved in our study. This is because the main etiology is odontological. In studies by Joon- Kyoo Lee et al[4] and Kanika Rana et al [7] both submandibular and parapharyngeal were the most commonly involved ones. Following these spaces, bilateral primary submandibular spaces(Ludwigs)(17.5%), peritonsillar space(15%), parotid space (12.5%), anterior cervical space(10%), retropharyngeal space(7.5%), masticator space(5%) , submental space(2.5%) and anterior visceral space(2.5%) are affected. But in many literature articles including the one by Pablo Santos Gorjon et

al[6], reveals more cases of peritonsillar space which in our study is only involved in 15 %. This finding could be mostly due to that majority of cases come into our tertiary centre as referrals and milder cases of peritonsillar abscesses are often treated at primary and secondary levels.

In our study, 62.5% of cases had only single space involvement while 37.5% of patients had multiple space infections. As diabetes is the most common risk factor in our study, the association between diabetic status and the number of spaces involved were studied and it was found that multiple space infections were seen significantly with a p value of 0.027 in uncontrolled diabetic patients. This finding is similar to that of Huang Tsun et al [5] study. This reflects the inability of the diabetic patients with uncontrolled glycemic status to confine the infection.This can further lead to higher frequency of complications and prolonged hospital stay.

Pus culture and sensitivity study of samples in our study showed the most common pathogen as klebsiella pneumonia(37.8%) followed by pseudomonas(10.8%), staphylococcus aureus (5.4%), peptostreptococcus (5.4%). Enterococcus, Proteus mirabilis and acinetobacter were seen only in one samples each. Klebisiella was the main organism grown in the study by Nirmal Kumar J et al[12] (46%).

There was negative culture seen in 32.4% of samples which could be due to the use of antibiotics before admission and before surgical procedure.

Diabetic patients with positive culture showed majority of Klebsiella pneumonia organism, this was similar to the study by Ashokan S et al [9] (31.57%) and Huang et al [5](54.5%). This is because the diabetic patients have defective host responses especially phagocytic function. Peptostreptococcus was the only anaerobic organism grown in our culture study and it was seen in 2 patients with Ludwigs angina having odontogenic source of infection.

The antibiotic sensitivity was checked for commonly used antibiotics for the particular cultured pathogen. Cultures showing growth of Klebsiella pneumoniae underwent sensitivity testing for amikacin, cefotaxime, ciprofloxacin, piperacillin-tazobactam, and meropenam. Of all the Klebsiella isolates, 92.8% were sensitive to amikacin, 85.7% were sensitive to piperacillin tazobactam, 71.4% were sensitive to ciprofloxacin. Maximum resistance 35.7% was seen to cefotaxime. This correlates with the study by Tiwana et al [14], where klebsiella showed maximum sensitivity to amikacin and piperacillin tazobactam. For pseudomonas culture, 100% sensitivity was seen to amikacin and piperacillin tazobactam. Proteus Mirabilis shows 100%

sensitivity to amikacin, ciprofloxacin, piperacillin tazobactam and Meropenam. Staphylococcus aureus culture is 100% sensitive to piperacillin tazobactam and 50% sensitive to amikacin and cefotaxime. Overall in our study, piperacillin taxobactam, amikacin and ciprofloxacin are the most sensitive antibiotics and it is better to start the initial empirical therapy using them.

All the cases in our study were diagnosed with the help of radiological investigations except 5(12.5%) cases of peritonsillar abscess where clinical evaluation was enough for the accurate diagnosis. CT was the main modality of radiological investigation in our study done for 87.5% cases. CT scans are essential for the diagnosis, to study the extent , for differentiation between cellulitis and abscess and also for the evaluation of complications. Radiological investigations are useful for detecting early complications and hence helps prevent further progress. X-ray neck and chest were also taken for 87.5% cases. X-ray of neck gives a quick evaluation of airway status and X-ray chest can help identify complications like mediastinitis, pleural effusion. Ultrasonogram was used for 47.5% cases mainly for the purpose of reassessing and serial monitoring of the infection. Ultrasound guided targeted drainage was done for one case of parapharyngeal abscess in our study. In the study by Raju Naik

et al[13] radiological investigations was done for 80% of cases similar to our study.

Conservative management was done for 3 cases(7.5%) in our study which included 2 cases of peritonsillar abscess and one case of Potts spine associated retropharyngeal abscess. Ceftriaxone along with metronidazole (45%) was the intial drug regimen that the patients were started on in our institution. Later on if needed additional antibiotic were added based on culture reports. The second most commonly used regimen was with 3 drugs, ceftriaxone, metronidazole and piperacillin tazobactam. In nearly 15% cases culture appropriate fourth antibiotic was also added. All patients were given adequate supportive management such as intravenous fluids, antipyretics, analgesics, mouth washes etc. Two patients (5%) diagnosed with tuberculosis were started on anti tubercular regimen.

92.5% cases underwent surgical intervention including needle aspiration, surgical incision and drainage and wound debridement. 84% of cases underwent surgical incision and drainage which is the main treatment modality in our study. Putting a large incision permits better drainage of collection, reduces compartment pressure and allows for better oxygenation and destruction of anaerobic organisms. Drainage of the pus was the definite management in the study by

Pradip Khokle et al[10]. 89% of cases underwent surgical drainage in the study by Gaurav Kataria et al [8]. Wound debridement was done for cases with skin involvement. In our study, wound debridement was done for 7 cases with regular sterile dressing. For uncomplicated stable single space infected patients with small abscess below 2.5cm in diameter we can attempt a trial of medical management with intravenous antibiotics and supportive measures. If there is no significant clinical improvement seen after 48 to 72 hours of medical therapy then it is better to intervene surgically. Those patients with unstable initial presentation with multiple space infection and with dreaded complications, it is always better to intervene surgically on the day of presentation itself. Airway patency is to be checked for all cases initially and measures to secure the airway is of prime importance. Those patients with dental caries as foci of infection should be consulted with dentist and dental extraction to be done to remove the nidus and to further prevent the associated morbidity. Impacted foreign bodies causing the infection should also be identified and removed. Failure to remove the infective foci can lead on to extended space disease and dreadful complications.

Majority of patients (52.5%) out of the 40 patients stayed for a period of 1-2weeks in the hospital. 20% of patients stayed for more

than 2 weeks in our study. Those are the patients with uncontrolled diabetic status and those with complications requiring additional treatment especially with skin necrosis. Pablos Santos et al [6] and Ashokan et al [9] has quoted in their studies that the diabetic patients have delayed discharge and more mean hospital stay than the non diabetic patients. In our study, the association between the diabetic status and the duration of the hospital stay were studied which showed that among the diabetic patients, those with uncontrolled diabetic status had prolonged stay at hospital than the controlled diabetic patients. This association is found to be significant with p value of 0.004.

32.5% cases presented with complications in our study, with skin ulceration being the most common (17.5%). 5 patients (12.5%) had airway compromise requiring the need for tracheostomy. Internal jugular vein thrombosis was seen in 4 (10%) cases. One patient went into septic shock and expired in our study. 85% of complications happened in the patients with high sugar value at presentation. Correlation between complications with diabetic status was studied and it significantly proves that complications are more encountered in diabetic patients with uncontrolled glycemic status. This association was found to be significant with a p value of 0.027. This finding is

similar to the comparative study done by Ashokan et al [9] and Huang Tsun et al[5].

97% of cases in our study resolved from the infection at the end of the treatment. Only one case (3%) out of the 40 cases expired due to septic shock. This was a case of Ludwigs angina with skin ulceration, airway compromise and uncontrolled diabetic status with diabetic ketoacidosis. The patient is also a known case of psychiatric illness, with poor care. The morbidity rate in our study is only 3% which is very less when compared with the literature articles.

CONCLUSION

Deep neck space infections are potentially harmful, life endangering condition of the head and neck. Early diagnosis and management with appropriate intravenous antibiotics along with the treatment of the underlying aetiology is essential for the complete recovery of the patient. In our study of 40 patients of deep neck space infections, the following conclusions are made.

- Patients in the third to fifth decade are the most commonly affected by deep neck space infection. There is no gender predilection in the incidence of deep neck space infection.

- Diabetic mellitus is the commonest and most important risk factor for the occurrence of the disease. Uncontrolled diabetic patients are significantly seen to have multiple space involvement, prolonged hospital stay and complications of the disease. Attaining stable glycemic control boosts healing and favours good outcome.

- Odontogenic infection is the most common etiology responsible for the disease. Making the population aware about the importance of periodic dental checkup with maintenance of

good oral hygiene is highly crucial for the prevention of the infection.

- Reduced polymorphonuclear leukocyte function plays a key role in the deterioration of gingival and periodontal health. This happens in diabetic patients and hence the control of blood glucose level plays a crucial role in the prevention as well as management of the infection.

- Klebsiella pneumonia is the most common organism isolated from the culture study of the infection. The antibiotic sensitivity study showed maximum response to piperacillin tazobactam, amikacin and ciprofloxacin. Hence, empirical regime must be started with these drugs to yield good results.

- In patients with diabetes, piperacillin tazobactam, amikacin or ciprofloxacin should be added to the regime, as there is a higher incidence of infection by Klebsiella pneumonia.

- Computed tomography of the neck with contrast is the single best investigation for deep neck space infection to see the extent, airway patency and complications.

- The first and foremost step of treating deep neck space infection is the assessment of airway. Securing a patent and stable airway is of prime importance.

- For patients with risk factors it is advisable to do an early surgical intervention to avoid complications and to improve prognosis and reducing the overall hospital stay.

- Treating deep neck space infection requires a multidisciplinary team of doctors including ENT surgeon, radiologist, diabetologist, anaesthetist, dentist, vascular and plastic surgeon.

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PROFORMA

Name:

Age/sex: Ip no:

Occupation: Address:

Date of admission:

Date of intervention:

Date of discharge:

Presenting complaints :

Complaint	***Yes***	***No***	***Duration***
Neck swelling			
Neck pain			
Fever			
Difficulty in swallowing			
Pain on swallowing			
Difficulty in breathing			
Throat pain			
Tooth pain			
Difficulty opening mouth			
Cough			
Voice change			
Others			

Past History: Diabetes Mellitus / Tuberculosis / Hypertension / Epilepsy / Jaundice / Asthma/ thyroid disorder/ heart diseases

H/o similar swelling:

H/o antibiotic usage:

Personal history: Diet ,Appetite, sleep-

Smoking, Alcohol, Tobacco Chewer-

H/o drug abuse:

General Examination:

- Build:
- Temperature:
- Pallor:
- Icterus:
- Cyanosis:
- Clubbing:
- Pedal edema:
- Lymphadenopathy :
- Stridor :

Systemic examination

- Cardiovascular-
- Respiratory-
- Abdomen examination-

- Central nervous system-

Pulse rate- Blood pressure-

Respiratory rate- Oxygen saturation-

***Local Examination*:**

ORAL CAVITY

- Lips:
- Gums:
- Teeth:
- gingivobuccal sulcus:
- gingivolabial sulcus:
- Oral Mucosa :
- Anterior 2/3rd of tongue :
- Floor of mouth :
- Hard and soft palate :
- Retromolar Trigone :

OROPHARYNX

- B/L Anterior pillars :
- B/L posterior pillars:

- B/L tonsillar fossa :
- Soft palate:
- Uvula:
- Posterior pharyngeal wall:

Dental formula:

Dental caries-

Loose tooth-

Indirect Laryngoscopy:

- Posterior 1/3rd of tongue:
- B/l vallecula:
- B/l lateral glossoepiglottic folds:
- Median glossoepiglottic fold:
- Epiglottis:
- B/l aryepiglottic folds
- B/l Arytenoids:
- B/l Ventricular bands:
- B/l vocal cords:
- B/l Pyriform fossa:

Examination of Neck:

Inspection

- Skin :
- Laryngeal contour :
- Tracheal Position :
- Any Swelling:

- Abnormal Veins, Sinus, Scar :

Palpation

- Tracheal position:
- Laryngeal crepitus:
- Carotid Pulsations :
- Swelling (if any)-

- Nodes

Examination of nose and ear:

Cranial nerve examination:

Provisional Diagnosis:

Management:

1. Radiological investigations-

i. X-ray neck:

ii. X-ray chest:

iii. CT / CECT neck:

iv. USG:

v. Vascular involvement:

2) Pus culture and sensitivity

3)Treatment-

- IV antibiotics:
- Needle aspiration:
- Incision and drainage:
- Tracheostomy:

Final diagnosis:

Outcome:

Complications :

PATIENT CONSENT FORM

Title of the Project : "A Comprehensive study on the clinical spectrum, bacteriological profile, diagnosis and management of deep neck space infections- our experience"

Institution : Upgraded Institute of Otorhinolaryngology, Madras Medical College, Chennai – 600003.

Name :
Age :
Sex :

Date :
IP No. :
Project Patient No. :

The details of the study have been provided to me in writing and explained to me in my own language.

I confirm that I have understood the above study and had the opportunity to ask questions.

I understood that my participation in the study is voluntary and that I am free to withdraw at any time, without giving any reason, without the medical care that will normally be provided by the hospital being affected.

I agree not to restrict the use of any data or results that arise from this study provided such a use is only for scientific purpose(s).

I have been given an information sheet giving details of the study. I fully consent to participate in the above study.

_____	_____	_____
Name of the subject	Signature	Date
_____	_____	_____
Name of the Investigator	Signature	Date

சுய ஒப்புதல் படிவம்

“A Comprehensive study on the clinical spectrum, bacteriological profile, diagnosis and management of deep neck space infections- our experience”

நான் இந்த ஆராய்ச்சியில் விவரங்களை முற்றிலும் புரிந்துகொண்டேன். ஆய்வில் பங்குஎடுத்தபோது சாத்தியமான அபாயங்கள் மற்றும் பயன்களை பற்றி நான் அறிந்துள்ளேன். நான் எந்த ஒரு வேளையிலும் ஆய்வில் இருந்து திரும்பமுடியும், அதன்பின்னர், நான்வழக்கம் போல் மருத்துவ சிகிச்சை பெறமுடியும் என்று புரிந்து கொள்கிறேன். நான் ஆய்வில் பங்குஎடுத்து பணம் எதையும் பெறமுடியாது என்று அறிந்துள்ளேன். இந்த ஆய்வின் முடிவுகள் எந்த மெடிக்கல் ஜர்னலில் வெளியிடப்பட இருந்தால் நான் எதிர்க்கவில்லை, என் தனிப்பட்ட அடையாளத்தை வெளிப்படுத்தப்பட்டு இருக்கக்கூடாது.

நான் இந்த ஆய்வில் பங்கெடுப்பதன் மூலம் நான் என்ன செய்யப்போகிறேன் என்று தெரியும்.

நான் இந்த ஆய்வில் என் முழு ஒத்துழைப்பையும் கொடுப்பேன் என்று உறுதியளிக்கிறேன்.

தன்னார்வளர்:

பெயர்:

முகவரி:

கையொப்பம்:

ஆராய்ச்சியாளர் கையொப்பம் மற்றும் தேதி:

INFORMATION SHEET

- We are conducting **"A Comprehensive study on the clinical spectrum, bacteriological profile, diagnosis and management of deep neck space infections- our experience"**at the Upgraded Institute of Otorhinolaryngology, Madras Medical College & Rajiv Gandhi Government General Hospital, Chennai – 600003.
- In this study the clinical presentation, etiology, associated systemic diseases, bacteriological profile, diagnosis, management and outcomes of deep neck space infections is studied by doing clinical, radiological and microbiological studies for all patients in the inclusion criteria
- At the time of announcing the results and suggestions, name and identity of the patients will be confidential.
- Taking part in this study is voluntary. You are free to decide whether to participate in this study or to withdraw at any time; your decision will not result in any loss of benefits to which you are otherwise entitled.
- The results of the special study may be intimated to you at the end of the study period or during the study if anything is found abnormal which may aid in the management or treatment.

Signature of Investigator **Signature of Participant**

Date :

ABBREVIATIONS

F- Fever	TON- tonsillitis	Pen- Penicillin
NS- Neck swelling	PPA- parapharyngeal abscess	X- X-ray
NP- Neck pain	ACSI- anterior cervical space infection	A-Antibiotics
D- Dysphagia	RPA- retropharyngeal abscess	ID- incision and drainage
O- Odynophagia	LA- Ludwigs angina	NA- needle aspiration
T- Trismus	AVSI- anterior visceral space infection	ATT- antitubercular treatment
BD- Breathing difficulty	SMA- submandibular abscess	X- ceftriaxone
TP- Throat pain	SMTA- submental abscess	M- metronidazole
VC- Voice change	PA- parotid abscess	AWC- airway compromise
EA- Earache	PTA- peritonsillar abscess	IJVT- Internal jugular vein thrombosis
DP- Dental pain	MA- masticator abscess	SU- skin ulceration
C-Cough	S- single space	R- resolved
ASI- associated systemic illness	M- multiple space	D- death
CDM- controlled diabetes mellitus	NG- no growth	
UDCM- uncontrolled diabetes mellitus	AK- amikacin	
UK- unknown etiology	Cip- ciprofloxacin	
FB- foreign body	Pip- Piperacillin tazobactam	
OD- Odontogenic	Mp- Meropenam	
DC- dental caries	Gm- gentamicin	
DE- dental extraction	Tax- cefotaxime	

Curiginal

Document Information

Analyzed document	A COMPREHENSIVE STUDY ON THE CLINICAL SPECTRUM, BACTERIOLOGICAL PROFILE, DIAGNOSIS AND MANAGEMENT OF DEEP NECK SPACE INFECTIONS- OUR EXPERIENCE.docx (D124673346)
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INSTITUTIONAL ETHICS COMMITTEE
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CERTIFICATE OF APPROVAL

To
Dr.BEEMA SALIM S F,
MS (ENT) Post Graduate,
Upgraded Institute of Otorhinolaryngology,
Madras Medical College &
Rajiv Gandhi Government General Hospital,
Chennai – 03.

Dear Dr. BEEMA SALIM S F,

The Institutional Ethics Committee has considered your request and approved your study titled **"A COMPREHENSIVE STUDY ON THE CLINICAL SPECTRUM, BACTERIOLOGICAL PROFILE, DIAGNOSIS AND MANAGEMENT OF DEEP NECK SPACE INFECTIONS – OUR EXPERIENCE"- NO.10102020.** The following members of Ethics Committee were present in the meeting held on **21.10.2020** conducted at Madras Medical College, Chennai 3.

1. Prof.P.V.Jayashankar :Chairperson
2. Prof.N.Gopalakrishnan,MD.,DM., FRCP, Director, Inst.of Nephrology,MMC,Ch : Member Secretary
3. Prof. K.M.Sudha, Prof. Inst. of Pharmacology,MMC,Ch-3 : Member
4. Prof. Alagarsamy Jamila ,MD, Inst. of Patholoy, MMC, Ch-3 : Member
5. Prof.Rema Chandramohan,Prof.of Paediatrics,ICH,Chennai : Member
6. Prof.S.Lakshmi, Prof. of Paediatrics ICH Chennai :Member
7. Tmt.Arnold Saulina, MA.,MSW., :Social Scientist
8. Thiru S.Govindasamy, BA.,BL,High Court,Chennai : Lawyer
9. Thiru K.Ranjith, Ch- 91 : Lay Person

We approve the proposal to be conducted in its presented form.

The Institutional Ethics Committee expects to be informed about the progress of the study and SAE occurring in the course of the study, any changes in the protocol and patients information/informed consent and asks to be provided a copy of the final report.

Member Secretary – Ethics Committee

SL n	Name	Age	Sex	IP no	Clinical features													Duration	ASI	CDM/ UCDM	Etiology	Diagnosis	Bacteriology	Antibiot							Investigations	Management		AB	Dur of Hosp stay	Complications	Outcome
					F	NS	NP	D	O	T	BD	TP	VC	EA	DP	C							AK	Cip	Pip	Mp	Gm	Tax	Pen		Medical	Surgical				
1	Vijayakumari	63	F	57837	+	+	+	+	+	+	-	-	-	+	-	-	1-2weeks	DM, HTN	UCDM	UK	R PPA, ACSI	Kleb. Pneu	S	-	S	S	S	S	-	X, CT, USG	A	ID	X,M,P,AK	>2weeks	SU	R
2	Rose	51	M	57077	-	+	-	+	-	-	-	-	-	-	+	-	1-2weeks	-	-	FB, OD(DE)	L PPA	MRSA	S	-	S	-	-	-	R	X, CT, USG	A	ID	X,M,P	1-2weeks	-	R
3	Anjalai	60	F	67845	-	-	-	+	+	-	-	-	-	-	-	-	1-2weeks	-	-	FB	RPA	Kleb. Pneu	S	R	S	S	-	R	-	X, CT	A	NA	X,M,P	1-2 weeks	-	R
4	Latha	28	F	68419	+	+	+	+	+	+	+	-	-	-	+	-	1-2weeks	DM	UCDM	OD(DC)	LA	Kleb. Pneu	R	S	S	R	R	-		X, CT	A	ID	X,M,P,Cip	>2weeks	AWC	R
5	Divya	26	F	64870	-	+	+	+	-	-	-	-	-	-	-	-	1-2weeks	-	-	UK	AVSI	-	-	-	-	-	-	-	-	X, CT, USG	A	-	X, M	<1week	-	R
6	Dharmalingam	36	M	61599	+	-	-	+	+	-	-	+	+	+	-	+	1-2weeks	DM	CDM	TON	R PTA	-	-	-	-	-	-	-	-	-	A	-	X, M	<1week	-	R
7	Sowkath Ali	49	M	71765	+	+	+	+	+	-	-	-	-	+	+	-	2-3weeks	DM	UCDM	OD(DC)	L PPA	Kleb. Pneu	S	S	S	S	S	-	-	X, CT	A	ID	X,M,P	1-2 weeks	IJV T	R
8	Ramalingam	54	M	2050	-	+	+	-	-	-	-	-	-	+	-	-	2-3weeks	DM	UCDM	UK	R SMA,R ACSI	P. Mirabilis	S	S	S	S	-	-	-	X, CT,USG	A	ID	X,M,P	1-2weeks	SU	R
9	Arunachalam	26	M	38976	+	+	+	-	-	-	-	-	-	-	+	-	1-2weeks	DM	UCDM	OD(DC)	L SMA	Pseudomona	S	S	S	S	R	-	-	X, CT,USG	A	ID	X, M	1-2 weeks	-	R
10	Natarajan	56	M	5765	-	+	+	+	-	-	-	-	-	-	-	-	3-4weeks	DM, HTN,	UCDM	UK	R PPA	Kleb. Pneu	S	S	S	-		S		X, CT	A	ID	X,M,P	1-2 weeks	-	R
11	Yasodha	49	F	50365	+	+	+	-	-	-	-	+	-	-	-	-	1-2weeks	DM	UCDM	OD(DC)	L SMA	Acinetobacte	S	S	S	-	-	-	-	X, CT,USG	A	ID	X, M	<1 week	-	R
12	Kirubakaran	38	M	4927	-	+	+	+	+	-	-	+	-	-	-	+	1-2weeks	DM	UCDM	UK	R PPA, ACSI	Kleb. Pneu	S	S	S	IS	-	S	-	X, CT	A	ID	X,M,P,AK	>2weeks	SU, IJV T	R
13	Vincent	48	M	136610	-	+	+	-	-	+	-	-	-	-	-	-	2-3weeks	-	-	UK	SMTA, L SMA	MSSA	-	-	S	-	-	S	R	X,CT	A	ID	X,M,P, Tax	>2weeks	SU	R
14	Jaidev	48	M	15140	-	+	+	-	-	+	-	-	-	+	-	-	1-2weeks	DM	UCDM	Infected parotid cyst	R PA	Kleb. Pneu	S	IS	S	S	S	R	-	X,CT,USG	A	ID	X,M,P	1-2weeks	-	R
15	Jayalakshmi	47	F	22666	-	+	+	-	-	+	-	-	-	+	+	-	1-2weeks	-	-	OD(DC)	L PA	NG	-	-	-	-	-	-	-	X,CT,USG	A	ID	X,M,P	1-2weeks	-	R
16	Harish	20	M	47889	+	+	+	-	-	-	-	-	-	-	-	-	1-2weeks	DM	UCDM	UK	L PPA	Pseudomona	S	S	S	S	S	-		X,CT	A	ID	X,M	1-2weeks	-	R
17	Vadivu	40	F	76926	-	+	-	+	-	-	-	-	-	-	-	-	>4weeks	-	-	UK	R PPA	NG	-	-	-	-	-	-	-	X, CT	A	NA	X,M	1-2 weeks	-	R
18	Vincy	14	F	60206	-	+	-	-	-	-	-	-	-	-	-	-	>4weeks	-	-	UK	R SMA,PA	NG	-	-	-	-	-	-	-	X,CT, USG	A	ID	X,M	1-2weeks	-	R

19	Anitha	28	F	2748	+	-	-	+	+	-	-	+	+	+	-	-	<1week	-	-	TON	L PTA	NG	-	-	-	-	-	-	-	-	A	NA	X,M	<1week	-	R
20	Sathish	37	M	6754	+	+	+	+	+	+	+	-	+	+	+	-	<1week	DM	UCDM	OD(DC)	L PPA, L PTA	Kleb. Pneu	S	S	S	-	-	-	-	X,CT	A	ID	X,M,P,AK	>2weeks	AWC, IJV T	R
21	Pachiyammal	60	F	142242	+	+	+	+	+	-	+	-	-	-	+		<1week	DM	UCDM	OD(DC)	LA	Pseudomona	S	R	S	R	S	-	-	X,CT	A	ID	X,M,P,AK	>2weeks	AWC	R
22	Saran raj	32	M	5327	+	-	-	+	+	-	-	+	-	+	-	-	<1week	-	-	TON	L PTA	NG	-	-	-	-	-	-	-	-	A	NA	X,M	<1week	-	R
23	Rajendran	65	M	137389	-	+	+	-	-	-	-	-	-	-	-	-	3-4weeks	DM, HTN, TB	CDM	TB	L SMA	NG	-	-	-	-	-	-	-	X, CT, USG	A, ATT	ID	X,M	<1week	-	R
24	Regina	62	F	22817	-	+	+	-	-	-	-	-	-	+	+	-	3-4weeks	DM,HTN, IHD	UCDM	OD(DE)	L SMA	Kleb. Pneu	S	S	S	-	S	-	-	X,CT,USG	A	ID	X,M	1-2weeks	-	R
25	Shanmugam	48	M	213991	+	+	+	+	+	-	-	-	-	-	-	-	2-3weeks	DM	UCDM	UK	L PPA	Kleb. Pneu	S	S	S	S	S	-	-	X,CT,USG	A	ID	X,M	1-2weeks	-	R
26	Anthony Prince	43	M	18109	-	+	+	+	+	+	-	-	-	-	+	-	1-2weeks	DM	UCDM	OD(DC)	L SMA	Kleb. Pneu	S	R	R	-	-	R	-	X, CT	A	ID	X,M,AK	>2weeks	SU	R
27	Sanjayya	65	M	20606	-	+	+	+	+	+	-	-	-	-	+	-	<1week	Anemia, CKD	-	OD(DE)	R SMA,MA	NG	-	-	-	-	-	-	-	X,CT, USG	A	ID	X,M,P	1-2weeks	-	R
28	Mahalakshmi	42	F	39622	-	+	-	+	+	-	-	-	-	-	-	-	1-2weeks	DM, CAD	UCDM	UK	R PPA, RPA	NG	-	-	-	-	-	-	-	X,CT,USG	A	NA	X,M	1-2weeks	IJV T	R
29	Kumaresan	40	M	14582	+	-	-	+	+	-	-	-	-	-	-	+	1-2weeks	TB	-	TB- Potts spine	RPA	-	-	-	-	-	-	-	-	X, CT	A, ATT	-	X,M,P	1-2 weeks	-	R
30	Lakshmi	60	F	22007	-	+	+	+	+	+	-	-	-	-	+	+	1-2weeks	DM, HTN,	UCDM	OD(DC)	LA, MA	Peptostepto coccus	-	-	S	S	-	-	S	X, CT, USG	A	ID	X,M,P	1-2weeks	-	R
31	Pushpa	76	F	161303	+	+	-	-	-	-	-	-	-	+	-	-	1-2weeks	DM, HTN	CDM	Sialadenitis	R PA	Pseudomona	S	-	S	S	S	-	-	X, CT, USG	A	ID	X,M	<1week	-	R
32	Rinku Devi	44	F	130112	-	+	+	+	-	+	-	-	-	+	+	-	>4weeks	DM	CDM	Sialadenitis	R SMA	Enterococcus	-	-	-	-	S	-	R	X,CT, USG	A	ID	X,M,P	1-2 weeks	-	R
33	Vijaya	57	F	72437	-	+	+	+	+	+	+	-	+	-	+	-	<1week	DM	UCDM	OD(DC)	LA	Kleb. Pneu	S	S	S	S	-	R	-	X, CT	A	ID	X,M,P	>2weeks	AWC	R
34	Manikandan	35	M	58843	+	+	+	-	-	-	-	-	-	-	-	-	1-2weeks	DM	CDM	UK	R ACSI	NG	-	-	-	-	-	-	-	X,CT, USG	A	ID	X,M	<1week	-	R
35	Sarala	33	F	209042	+	+	+	-	-	+	-	-	-	-	-	-	>4weeks	Anemia, RA	-	UK	R PA	NG	-	-	-	-	-	-	-	X,CT,USG	A	ID	X,M	1-2weeks	SU	R
36	Thirumalai	26	M	14326	+	-	-	+	+	-	-	+	+	+	-	-	<1week	-	-	TON	R PTA	NG	-	-	-	-	-	-	-	-	A	NA	X,M	<1week	-	R
37	Venkatesan	50	M	127620	+	+	+	+	+	-	+	-	-	-	+	-	1-2weeks	DM, CKD	UCDM	OD(DC)	LA	Kleb. Pneu	S	R	R	-	-	R	-	X,CT	A	ID	X,M,AK	Expired in 2days of	SU, AWC,	D
38	Malliga	45	F	58789	+	+	+	+	+	-	-	-	-	-	+	-	1-2weeks	DM	UCDM	OD(DC)	LA	Kleb. Pneu	S	S	S	S	-	-	-	X,CT	A	ID	X,M,P	1-2 weeks	-	R
39	Chithra	45	F	18564	-	-	-	+	+	-	-	+	+	+	-	-	<1week	-	-	TON	L PTA	NG	-	-	-	-	-	-	-	-	A	ID	X,M	<1week	-	R
40	Lenin	26	M	266653	-	+	+	+	-	+	-	-	-	-	+	+	<1week	MR, seizure	-	OD(DC)	LA	Peptostepto coccus	-	-	S	-	S	-	R	X,CT	A	ID	X,M,P	1-2weeks	-	R