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Review

Management of deep space infections of the neck

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Abstract

Infections of the deep neck spaces often present a clinical challenge for the ENT surgeon. Management of these complex suppurations of the neck requires in fact a multidisciplinary approach due to possible complications like mediastinitis, septic shock and MSOF, life threatening bleeding and ICU management. The spread of infection from the primary site to other regions is possible through the lymphatic, arterial and venous vessels, or directly along the fasciae. There are several classifications for the etiology, pathogenic mechanism and site of evolution, the most frequently encountered clinical forms being peritonsillar abscess, retropharyngeal abscess, lateropharyngeal abscess, and the deep cervical abscess. All of these abscesses are suppurative complications of primary neck infections. Extensive inflammation and suppuration of the neck requires in most cases multiple incisions for drainage such that patients experience significant scarring of the neck. Along with the presence of the tracheostomy and nazo-gastric feeding tube, the aesthetic aspect of the neck surgery involves a high degree of psychological stress for the patients. As a conclusion and in line with literature data, patients must be fully informed about the technique and the outcome of the surgery so that they can provide informed consent since the pathology can be both life-threatening and mutilating.

Keywords : deep neck space, abscess, surgery, quality of life, stress

Highlights

- ✓ Deep neck infections imply a certain degree of psychological stress for the patients
- ✓ They must be fully informed about the technique and surgical outcomes, because
- ✓ Such pathology is not only mutilating but also life-threatening

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Introduction

Infections of deep neck spaces often present as a clinical challenge for the ENT specialist. The primary contributing factors to deep neck infections are represented by acute infections of the pharynx, necrotizing lymphadenitis, specific and non-specific sialadenitis, impacted foreign bodies, penetrating injuries of the neck, cervical cellulitis, infected brachial cyst, Betzold abscess, and dental abscess. Odontogenic causes are considered to be the most common etiology in adults (1, 2). Although deep space neck infections are usually caused by association of common pathogens, in some cases, particular bacteria are involved (3, 4).

Deep neck infections occur more frequently in adults than children, who are only rarely affected. Also, the immunosuppressed and elderly populations are vulnerable. The microbiology of these infections is a mixture of aerobe and anaerobe organisms, which usually are present in pharyngeal and dental flora, most of them being streptococcus beta hemolytic, staphylococcus aureus, staphylococcus epidermidis, bacteroides, fusobacteria, occasionally escherichia coli, pseudomonas, haemophilus, Moraxella, and corynebacterium (5).

The potential evolution of deep space abscesses of the neck is towards severe complications in the mediastinum and further to multiple system failure, even death. For this reason, immediate evaluation of the patient needs to be done, both biologically and locally. The primary site of infection needs to be identified and the general status assessed. High fever is usually present at admission. This type of pathology must be managed by a multidisciplinary team coordinated by the ENT surgeon. Internal medicine, cardiology, infectious, thorax surgery, and ICU specialists need to be part of the multidisciplinary team. General examination of the patient needs to complete the local ENT exam. There are several classifications for the etiology, pathogenic mechanism, and site of evolution, the most frequently encountered clinical forms being peritonsillar abscess, retropharyngeal abscess, lateropharyngeal abscess, and the deep cervical abscess. All of these abscesses are suppurative complications of primary neck infections, oral sites being the most important (6).

Discussion

Extensive knowledge of cervical anatomy, imaging examinations, and surgical techniques necessary to resolve these complex cases play a decisive role not only in the diagnosis and optimal therapy but also in prevention of the underlying morbidities. The ENT

examination usually reveals general edema of the pharynx, important swelling of the anterior or posterior palatinal arch, trismus, salivary stasis, tenderness in the neck region, and signs of inflammation in the soft tissues surrounding the pharynx. However, skin involvement is not unusual. The cutaneous fistula with purulent secretions expressed outwardly is a possibility.

Blood testing demonstrates leukocytosis with neutrophilia, elevated ESR, with or without any organ failure. Liver, kidney, and pancreatic functions must be assessed at admission. Acute inflammatory syndrome is present in all cases, the immunocompromised patients associating or not a high fever. Biological assessment has to include cultures from blood during fever spike and the prelevation of purulent secretions for bacterial staining and antibiogram.

CT scans with intravenous contrast is the gold standard of the visualization of the involved structures and also allows physicians to monitor the evolution of the infection (7). The abscess appears to be a low-density collection with peripheral enhancement and might have multiple dispersed gas accumulation. MRI has limited indications for abscesses in the neck region but is useful in case of neurological complications. Paratracheal space needs to be thoroughly examined as purulent secretions evolving in this region might lead to extrinsic compression of the trachea followed by impaired breathing. Pathological lymph nodes in the neck and mediastinum can be observed and pleural liquid might be present. Thorax and mediastinum complications provide reason to including a thorax surgeon in the multidisciplinary team.

Extensive inflammation and suppuration of the neck requires in most cases multiple incisions for drainage such that patients experience significant scarring of the neck. Depending on the site of the infection and the extent of the suppuration, some surgical techniques have been developed with the aim of ensuring the optimal exposure of each individual deep neck space, with the best approach for complete drainage of the abscesses. Along with the presence of the tracheostomy and nazo-gastric feeding tube, the aesthetical aspect of the neck surgery involves a high degree of psychological stress for the patients. Tracheostomy is performed in most cases of deep space neck infections involving the oral cavity, oropharynx and hypopharynx as well as anterior region of the neck with larynx involvement. Patients need to be fully informed about the technique and the outcome of the surgery so they must sign the informed consent since the pathology can be both life-threatening and mutilating.

- *Quality of life*

Considering the fact that deep space neck suppurations are a surgical and medical emergency, pre-therapy assessment needs to be performed as soon as possible. When surgery is mandatory, patients need to be informed about the risks and benefits of general anesthesia, surgical technique, outcome, complications, and general and localized scarring. The multiple incisions required on the cervical region will cause significant distress to the patient, with an alteration of the psychological profile in terms of social interaction. Impaired appearance and mutilation may be severe in extreme cases, but the surgeon must take into account the life-threatening pathology involved. However, the patient might need psychotherapy until plastic surgery is performed as a second stage surgery.

The presence of the tracheostomy tube is life-changing for patients. The quality of life of these patients is impaired in more ways than one. The quality of air reaching the lower respiratory tract is altered by the fact that it is not humidified and purified, which in terms of possible complications is linked to cough, hemoptysis, broncho-pneumonia and even respiratory dysfunction. Temporary tracheostomy is the surgery performed to ensure the safety of the lower respiratory tract. Some patients refuse the primary surgical therapy when they are informed about the need of a tracheostomy. However, we have had no patients that did not accept the surgery at some point in the evolution of the case. The support of family is key in the decision-making process for each patient and, according to the mental capacity of patients, family members can only be informed with the patient's consent or in the cases in which the patient is unable to communicate. In some cases, there are no family members available for discussions, due to migration to distant areas (8).

Psychotherapy is mandatory for female patients since scars in the neck region are harder to conceal. Still, male patients have similar or greater levels of psychological distress.

- *Anatomic considerations*

Deep neck spaces extend from the base of the skull to the upper part of the thorax in the proximity of the mediastinum. The postero-lateral deep spaces of the neck comprise the retropharyngeal space, the danger space, the prevertebral space, and the visceral vascular space. The hyoid bone represents the limit for upper neck spaces such as the submandibular space, the parapharyngeal space, the peritonsillar space, the masticator space, the temporal space, and the parotid space. In addition to this anatomic organization, there is the need to comment on the anterior visceral space. This

space extends from the hyoid bone to the upper thorax aperture, and contains the cervical viscera thyroid gland, trachea and esophagus communicating to the anterior mediastinum (9, 10).

The clinical aspects of the suppurations of the deep neck spaces are usually forthcoming and easy to diagnose. However, different deep spaces like the prevertebral and danger space are relatively difficult to assess clinically. A complete clinical and flexible endoscopic examination need to be performed in such cases. The anatomic system of the neck spaces is dependent on the muscle cervical fascia, nerves and blood vessels. The deep neck spaces communicate to one another, which means that a spread of infection may be possible. This spread is even more likely to occur in the cases of penetrating trauma of the neck.

The cervical fasciae divide the cervical region in spaces which communicate with each other, offering easy way for infections to spread. The spread of the infection is linked to the connection of other regions with the primary site of infection via lymphatic, arterial or venous vessels or directly along the fasciae. The deep spaces of the neck are mostly represented by the parapharynx spaces.

The parapharynx space resembles an inverted pyramid, with its base at the skull base and its apex at the great prominence of the hyoid bone. The styloid process divides the space into pre and retrostyloid compartments, the latter containing the carotid artery, internal jugular vein, sympathetic chain and IX, X, XI, XII pairs of cranial nerves, while the former contains fatty tissue, styloglossus and stylopharyngeal muscles, lymphatic nodes, and deep lobe of the parotid gland. The parapharynx space is in direct contact with the posteromedial region with the retropharyngeal space, inferiorly with the submandibular space, and laterally with the masticator space.

The retropharyngeal space stretches from the skull base to the tracheal bifurcation between the medial and deep cervical fasciae, laterally being limited by the large vessels of the neck. Peritonsillar abscess, the most common deep neck infection, can directly spread in the parapharynx space which leads the infection to the mediastinum (11).

- *Therapy planning*

Initial assessment is crucial for the staging of the patient regarding evolution and vital risks as well as prognosis. The history of the illness episode is mandatory, especially questions regarding trauma, hard food ingestion, and time frame of the symptoms debut. The extensive history of the patient can reveal a series of morbidities that may influence the evolution of the case

such as diabetes mellitus, immunodeficiency, cortisol therapy, transplant, malignant neoplasia, cardio-vascular pathology, endocrine pathology, immunosuppressant drugs administration, and autoimmune disease. If such pathology is present, the patient needs to be thoroughly assessed in order to stabilize morbidities. In most cases of patients with deep neck space infections and diabetes mellitus, the normalization of blood glucose levels leads to a better prognosis and lower risk of local and general complications (12, 13). CBC count and chest X-ray are performed at admission along with blood and in-site purulent secretions cultures. Antibiotics need to be administered to the patient as soon as possible, broad spectrum antibiotics with the need to control anaerobic pathogens at first and, after the antibiogram results, targeted antibiotics use (14). Since there is a multi-pathogenic involvement in the appearance of a deep neck space suppuration, the antibiotic regimen is to administer more than one type of antibiotic (15). Antibiotics need to be administered intravenously for as long as the fever lasts and 48 hours thereafter. After the fever is lowered, oral antibiotics need to be used for as long as 4 to 6 weeks (16).

- *Surgical management*

Surgical treatment should follow general principles regarding the stabilization of the patient. Securing the airways by a tracheostomy is favorable to tracheal intubation. Transoral incision and drainage at multiple levels in the oropharynx and hypopharynx need to be used with precaution, due to the fact that blood vessels might be intercepted by the incisions, thus the need for bleed management. Transcervical incision anterior to the sternocleidomastoid muscle at the level of the hyoid bone is a successful approach of the retropharyngeal space abscesses and a cervical tube connected to active aspiration system needs to be placed for drainage and daily washing of the space (17).

Thorax and pleural drainage and extended debridement of mediastinum through antero-lateral thoracotomy with large bore chest tubes are mandatory to evacuate collections located at this site. Different types of approaches have been developed so that the function can be preserved and vital anatomic structures to be secured. However, an extensive debridement of the necrotic tissue and the purulent site has to be performed in such a manner that relapse is minimal. The opened abscess is to be left opened until the total absence of secretions and the limit for the debridement has to be healthy tissue. Leaving the incision area unsutured makes it easy for the surgeon to inspect the evolution of the abscess, to wash and drain the cavity with saline solution and aseptic solutions, and in some cases to wash

the cavity with antibiotic based solutions. We do not use antibiotics for washing the abscess since we haven't seen improvement in the outcome and prognosis of the patients, and it is a hard to bear maneuver for the patient and rather costly. The tendency of the surgical wound is to close due to fibrin and collagen formation. To avoid closing of the wound in a precipitated time frame, we use iodine solution soaked meshes. The meshes needs to be removed when the abscess cavity is dry and without secretions. The time interval for abscess cavity washing is in accordance with the local evolution and the general status of the patient, but should not be done more than twice a day. Pain medication needs to be administered and local anesthesia has to be performed in most cases. In severe cases with large and multiple incisions, washing and wound caring has to be performed under general anesthesia.

Management of the upper airway tract is mandatory for patients having respiratory distress. According to Eftekharian et al. (18), tracheotomy was done in 8.8% of the cases. In our experience as many as 35% of the patients required a tracheotomy to ensure ventilation and airway management, since tracheal intubation without a flexible bronchoscope may be extremely difficult due to the trismus, soft tissue rigidity, and the possibility of tracheal displacement. As Osborn et al. have pointed out (19), tracheal intubation can lead to complications since the airway might already be injured. The difference in performing tracheotomy for these patients is explained by the selection of cases and the profile of the ENT departments, emergency departments having a higher incidence of deep neck space suppurations.

- *Deep space abscesses of the neck*

The management of deep space abscesses of the neck needs to address local collections and feared complications. Complications occur in patients that are immunocompromised, of old age, or with uncontrolled diabetes mellitus (20). The migration of the infection is done via the cervical fasciae and by communication of the retropharynx space with the mediastinum through the "danger space" (21). The involvement of the carotid sheath might lead to the erosion of the carotid artery with terrible outcome or with internal vein thrombophlebitis (22). Parapharyngeal abscess located in the posterior compartment of the neck is one of the worst complications due to the potential downwards evolution towards the posterior and superior regions of the mediastinum. This evolution of a deep neck space abscess can lead to the development of mediastinitis, empyema and to aspiration pneumonia if the abscess ruptures in the upper airway (23).

Surgery is the most important means of therapy along with the use of broad spectrum antibiotics at admission followed by specific antibiotherapy when the pathogen is isolated. An oral approach is rarely used in advanced cases, the best choice being cervicotomy with extensive debridement and drainage. Multiple incisions in the neck area centered on the sternocleidomastoid muscle and midline should be performed. The incisions need to be vertical. Extensive washing of the cavity formed by the abscess with peroxide and iodine solution are mandatory and need to be repeated until the cavity is left without secretions. Drain tubes with negative pressure aspiration need to be positioned in the abscess formed cavity, allowing easy access for further washing. The wound is to be left unsutured until the resolution of the infectious process. Assessment is done by direct visualization and by seriated cultures from the abscess site. CT examination has to be repeated if there is a suspicion of complications or before suturing the patient. A thoracic surgeon must be available at all times for emergency evaluation of the patient. The multidisciplinary team have to be consulted periodically.

Conclusions

Deep space neck infections are found more frequently in adults and rarely affects children, and they are usually the result of a multipathogen association. Also, the immunosuppressed elderly population is exposed as well as patients with unbalanced diabetes mellitus. The extent of the lesions is hard to assess due to anatomical organization and multiple extension pathways. Early stage peritonsillar abscesses can be resolved with antibiotics without surgery in a minority of cases. Most cases require surgery by transoral incision and drainage; however this depends on the selection of the patients in emergency departments. In some cases, the abscess located in the palatine tonsil fossa can spread to the deep neck spaces and mediastinum, worsening the prognosis and frequently leading to the death of the patient. Nerve dysfunction, artery, vein or lymphatic vessel rupture is always a possibility; therefore the surgeon must pay extreme attention to dissection. In most cases the surgeon can preserve the organs of the cervical compartment if a proper imaging assessment is done.

Morbidities need to be addressed as soon as possible with a special attention to regulate blood glucose levels. Deep neck space suppurations benefit for early empiric antibiotics administration until the result of the antibiogram is ready. The moment of the surgery is to be decided for each particular case. Most patients benefit from surgery if there is no improvement in the evolution

of the patient after 48 hours antibiotic use. Surgery needs to respect the general principles of large incisions and total debridement, preserving vital organs, leaving the wound open, and applying regular lavage and drainage of the abscess cavity.

To augment clinical and therapeutic particularities associated with deep neck infections, we emphasize the importance of a multidisciplinary team that must be involved in the therapy management of these patients.

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