Chapter 77 – Deep Neck Abscesses

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Deep neck infection is the term used to describe infection developing within or spreading into the deep cervical spaces. Deep neck infection should be distinguished from infection involving the skin and superficial structures of the neck. An understanding of deep neck infection requires familiarity with the fascial planes of the neck, the spaces created by these fascial planes, and the potential routes by which infection may move between one fascial space and another.

The structures of the neck are encased in connective tissue. Condensations of this connective tissue create fascial planes. The deep neck spaces are in fact only *potential* spaces that in normal circumstances contain adipose tissue, blood vessels, and lymphatics. Deep neck infection occurs when microorganisms proliferate in these potential spaces.

The most common mechanism by which such infection occurs is dissemination of bacteria, either hematogenously or, more commonly, via lymphatics to the cervical lymph nodes. When local immunity is inadequate to eradicate the bacteria, suppuration of the lymph node may progress to the development of an abscess within the space. Although the deep neck spaces are frequently discussed as discrete entities, it is important to recall that the spaces are described by condensations of fascia. When pressure exceeds the capability of the fascia to retard spread, the process will spread along planes of least resistance to involve other anatomic areas. Deep neck infections may be complicated by airway obstruction, vascular involvement, thrombosis, pseudoaneurysm or rupture, fulminating tissue necrosis, or sepsis.

PATIENT SELECTION

Patients with deep neck infection almost always have swelling and pain localized to the involved area. This is commonly associated with fever and leukocytosis. Airway compromise may be impending or present, and fulminating sepsis may be evident. Urgent evaluation and management are required to reduce morbidity and may be lifesaving.

Submental-Submandibular Space

Infection in the submandibular space may be due to obstruction of the submandibular duct. Submental infection is most commonly odontogenic and is typically ascribed to periapical infections of the first molar. Abscesses involving the submental space characteristically begin either superior or inferior to the mylohyoid muscle (Fig. 77-1). Infection superior to the mylohyoid muscle produces erythema and edema of the anterior floor of the mouth with elevation of the tongue, dysarthria, difficulty handling oral secretions, and drooling (Fig. 77-2). Progression of infection of the floor of mouth may lead to retrograde displacement of the tongue (Ludwig's angina) and, ultimately, airway compromise. Fulminant Ludwig's angina may require tracheotomy to establish an airway before surgical intervention because endotracheal intubation may be impossible.

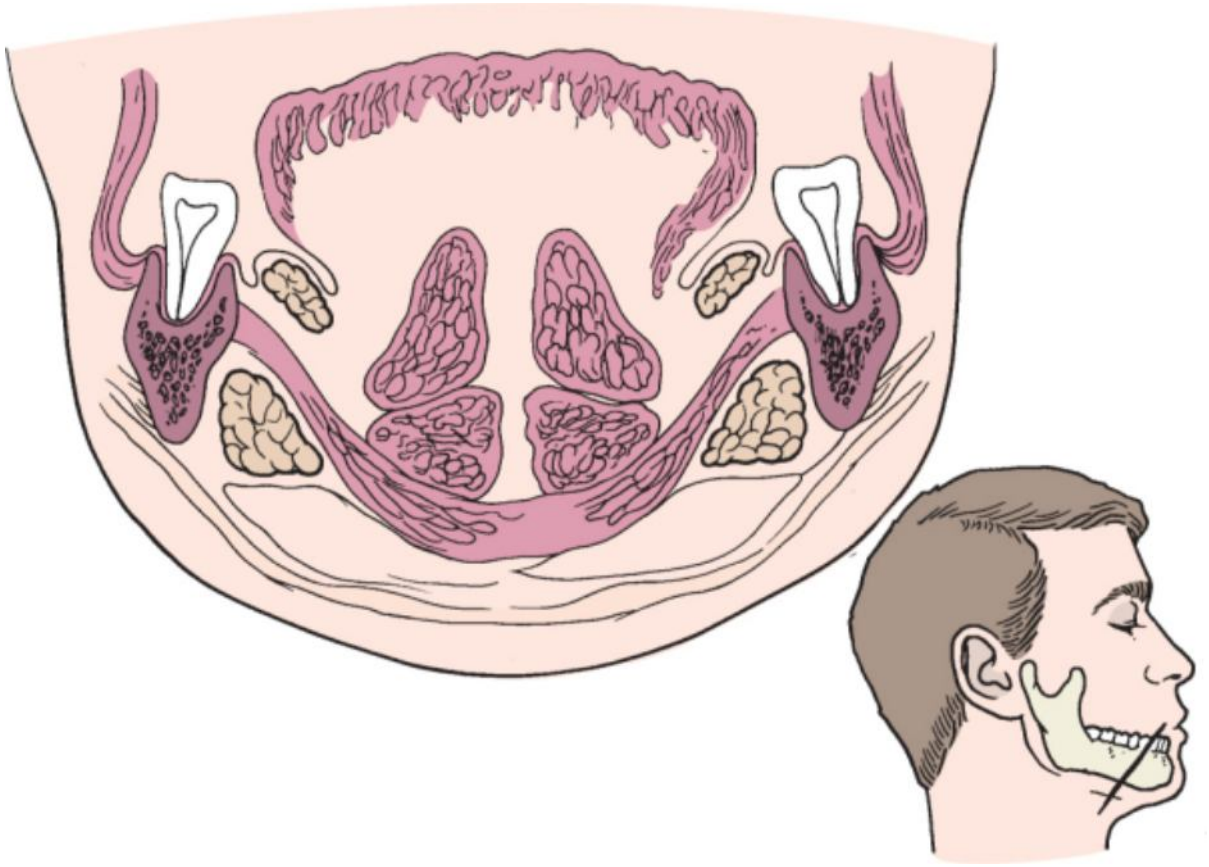

Figure 77-1 The mylohyoid sling divides the submental space into two relatively independent sites. The plane of this schematic is depicted in the *inset*.

Figure 77-2 This patient had an odontogenic sublingual infection with tongue protrusion.

Infection inferior to the mylohyoid muscular sling may come from or extend to involve the submandibular triangle and gland. Submandibular swelling and pain are the hallmarks of this condition. Palpable fluctuance may develop, although this is ordinarily a rather late sign of infection, and surgical intervention may be indicated before frank fluctuance is apparent.

Parapharyngeal Space

Infection of the parapharyngeal space is usually secondary to infection in the tonsils or dental apparatus, although a discrete primary focus of infection may not be identifiable. Initial symptoms include trismus, pain, dysphagia, and a stiff neck. A mass effect may produce a muffled “hot potato” voice.

The parapharyngeal space describes the potential deep cervical space anterior to the carotid sheath, medial to the pterygoid musculature, and lateral to the pharyngeal wall and tonsil. Its base is at the skull base; its apex is at the hyoid bone. A parapharyngeal space abscess produces trismus with medial displacement of the tonsil and lateral pharyngeal wall (Fig. 77-3). This condition may be difficult to distinguish from peritonsillar abscess, although infection of the parapharyngeal space is almost always accompanied by brawny induration of the neck with limitation of cervical motion (Fig. 77-4). These cervical features are not characteristic of peritonsillar abscess (Fig. 77-5). Fluctuance rarely develops in patients with a parapharyngeal space abscess because the space is covered by the bulky sternocleidomastoid muscle. Accordingly, the surgeon should not wait for the development of fluctuance before initiating surgical intervention.

Figure 77-3 An abscess in the parapharyngeal space is characterized by its location and by the presence of a fluid-filled cavity surrounded by a thick-walled cyst.

Figure 77-4 A child with the characteristic swelling and neck positioning associated with a parapharyngeal abscess.

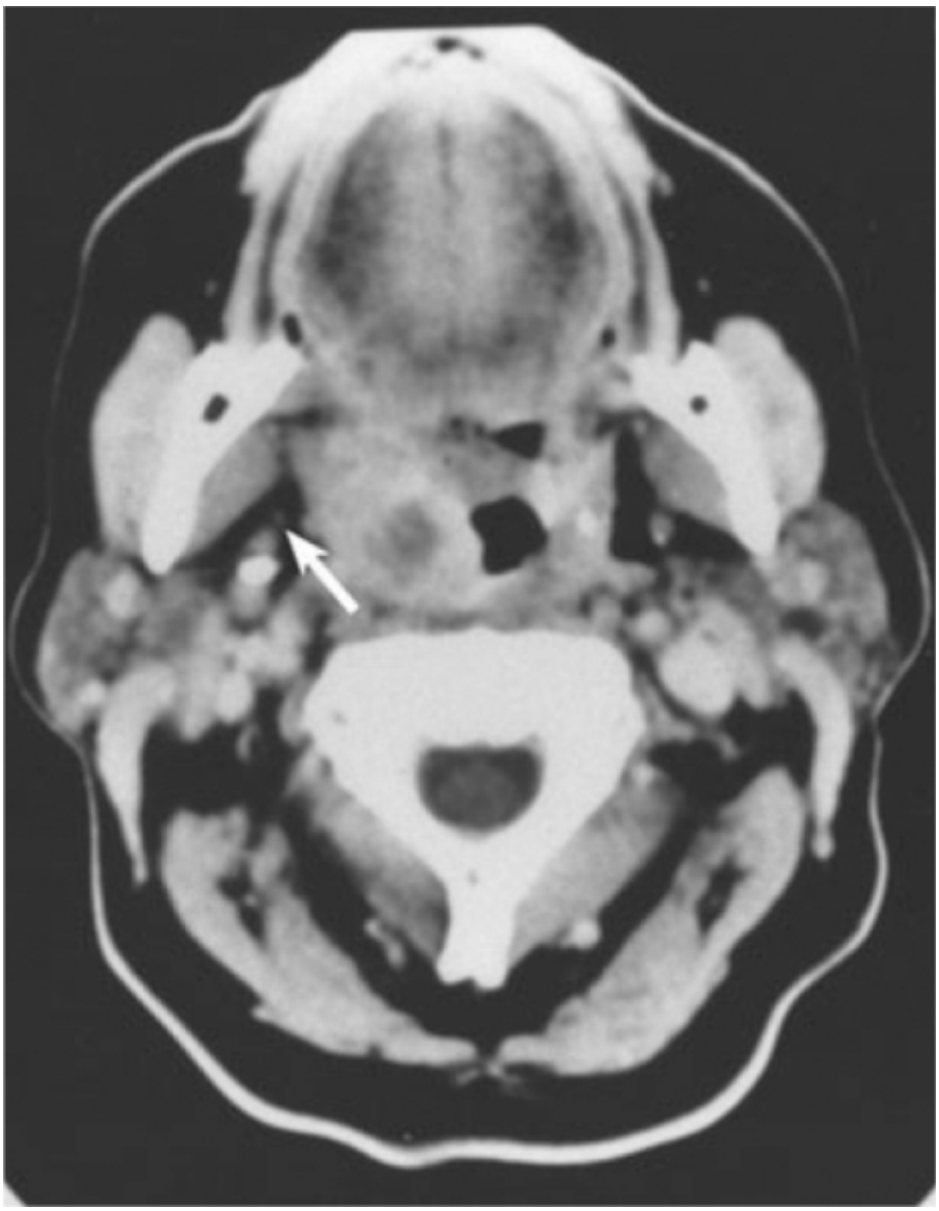

Figure 77-5 Peritonsillar abscess with medial displacement under the tonsillar soft tissue. The parapharyngeal fat *(arrow)* remains relatively unaffected.

Retropharyngeal Space

The retropharyngeal lymphatics drain the sinonasal tract and nasopharynx; hence, rhinosinusitis is often considered to be the initiating event. Symptoms include pain, dysphagia, dysarthria, and a stiff neck. In fact, irritation of the prevertebral fascia may cause meningismus that mimics meningitis.

The retropharyngeal space is a potential space posterior to the pharyngeal wall and anterior to the alar component of the prevertebral fascia. This space is classically described as having a midline raphe, although infection with sufficient tissue oncotic pressure may cross the midline. The retropharyngeal space is limited laterally by the carotid sheaths. Free communication with the parapharyngeal spaces may ensue if tissue pressure is sufficient. A retropharyngeal space abscess is characterized by anterior displacement of the posterior pharyngeal wall, dysphagia, and some voice alteration described as a muffled or “hot potato” voice that is reflective of a space-occupying lesion in the oropharynx or hypopharynx. The retropharyngeal space extends from the skull base superiorly to the midthorax at approximately the level of the tracheal bifurcation. Therefore, a retropharyngeal abscess may “point” into the mediastinum.

Retropharyngeal infection may be demonstrated on a lateral neck radiograph. The normal depth of the retropharyngeal soft tissue overlying C2 averages 4 mm. Soft tissue greater than 7 mm thick is pathologic in both children and adults. A rule of thumb is that the retropharyngeal soft tissues are normally no wider than a third the width of the body of C2 in adults. In small children, the width of the soft tissue may be equal to the width of the body of C2 (Fig. 77-6).

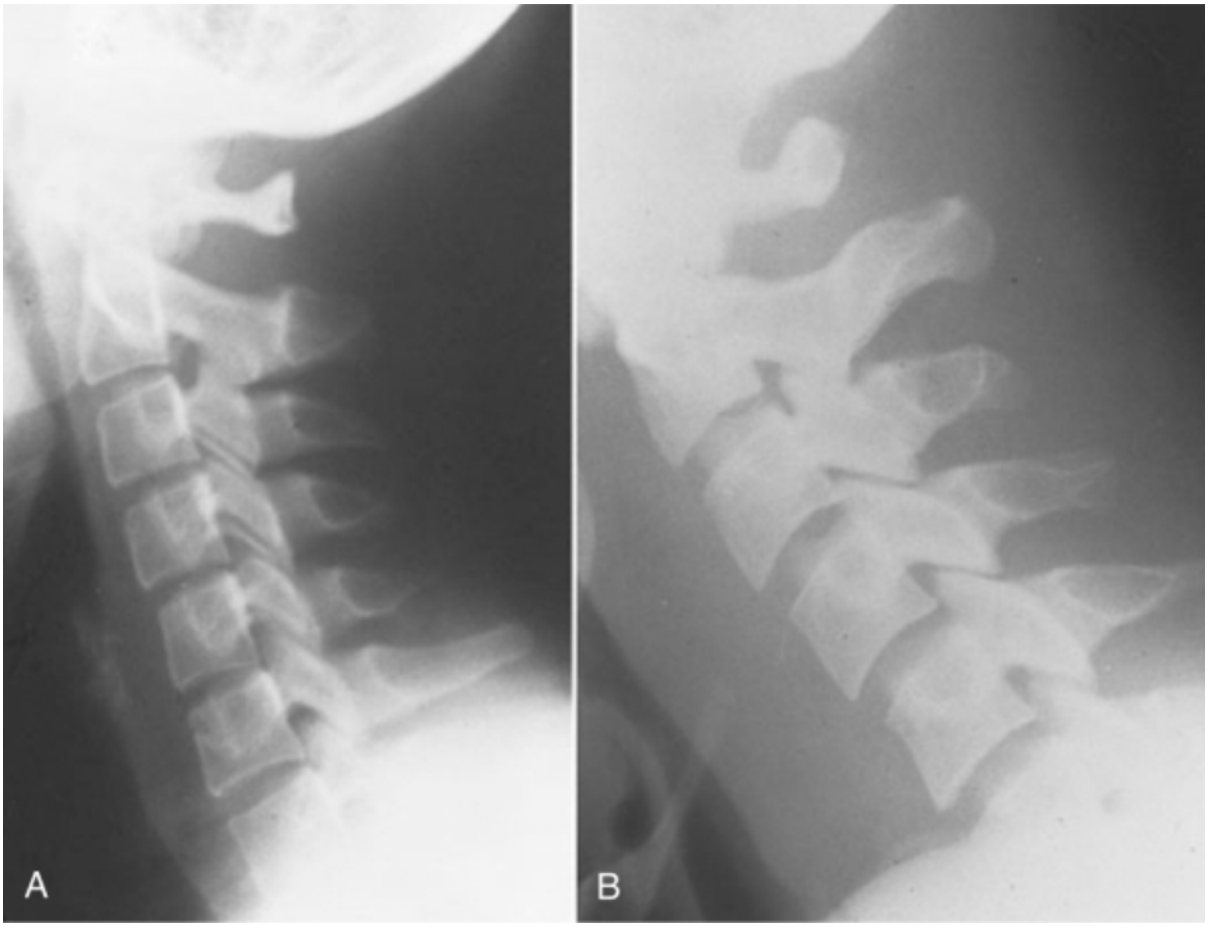

Figure 77-6 **A,** Lateral soft tissue radiograph of the neck demonstrating the normal thickness of soft tissue overlying the cervical vertebra. **B,** Retropharyngeal abscess demonstrating bulging of the retropharyngeal soft tissue.

Lower in the neck (C6), the retropharyngeal soft tissue should be considered abnormal if it is greater than 14 mm in children younger than 15 years or greater than 22 mm in adults. Interpretation of soft tissue thickness is unreliable in infants because of difficulty positioning the child and redundancy of this soft tissue.

A retropharyngeal space abscess frequently produces severe dysphagia with meningismus characterized by posturing of the cervical musculature as a result of inflammation of the anterior paraspinal muscles. The author's group has observed patients mistakenly considered to have meningitis when in fact the neck stiffness was due to a retropharyngeal abscess.

Prevertebral Space

Infection in the prevertebral space originates almost solely from osteomyelitis of the spine. Formerly, this meant tuberculosis, although the author's group has observed staphylococcal osteomyelitis, often attributable to ostensibly mild penetrating trauma or a postoperative sequela of surgery on the cervical spine.

The prevertebral space is a potential space that lies anterior to the spinal column in the midline and is formed by the alar fascia anteriorly and the prevertebral fascia posteriorly (Fig. 77-7).[1] Infection of the prevertebral space is usually due to infection that originates in the spine itself, the classic example being tuberculous osteomyelitis of the vertebral body. Iatrogenic infection may follow cervical fusion procedures, in which case the most common organism is *Staphylococcus aureus*. The prevertebral space extends from the skull base superiorly to the sacrum inferiorly and may be the conduit of infection from the neck to the abdomen.

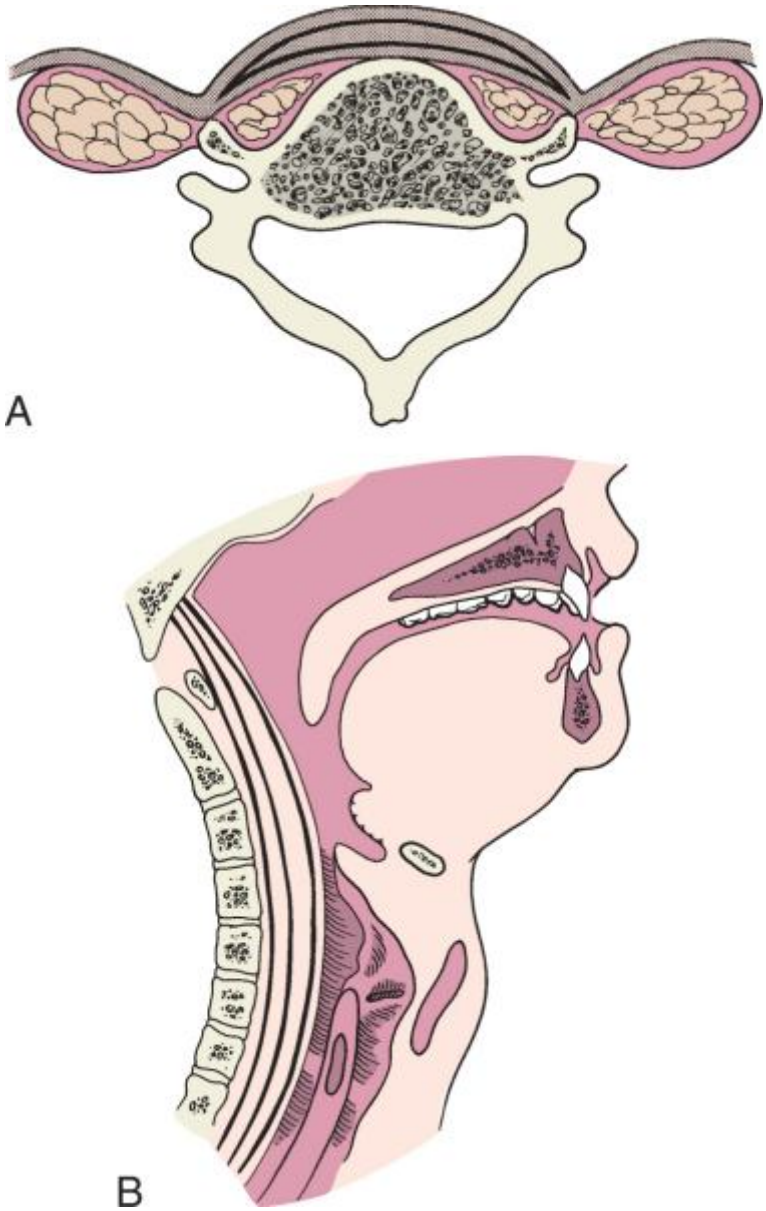

Figure 77-7 **A,** Axial schematic of the relationship of the potential space anterior to the vertebral bodies. The alar fascia separates the prevertebral space from the retropharyngeal space. **B,** Sagittal drawing depicting the relationship between the retropharyngeal and prevertebral spaces.

ETIOLOGY OF DEEP NECK INFECTION

Deep neck infection most commonly arises from a site of active bacterial infection in the upper aerodigestive tract. An odontogenic source is most common, although tonsillitis, pharyngitis, and even sinusitis are occasionally identified as the initiating site of infection. Nonetheless, it is estimated that the initiating site of infection is not identified in as many as 50% of deep neck infections.[2,3]

An understanding of the bacteriology of deep neck infection has evolved since the 1970s. Initial reports indicated that the most commonly involved organisms were *S. aureus* and *Streptococcus* species.[1,4] More recently, an appreciation of the importance of anaerobic bacteria in the development of deep neck infection has evolved (inasmuch as more than 90% of the flora of the oropharynx are anaerobic bacteria, one would expect this to be the case, especially in odontogenic deep neck infection).

One study reported that *S. aureus* was the predominant organism isolated in children younger than 1 year. Older children were most commonly infected with group A *Streptococcus*.[5] Recent reports indicate an increase in the incidence of methicillin-resistant *S. aureus* in community-acquired staphylococcal infections.

Infection in the deep neck spaces is occasionally due to trauma. For instance, blunt trauma to the anterior aspect of the neck may result in laceration of the pharyngeal mucosa and direct inoculation of the deep tissue spaces with bacteria. Alternatively, patients are occasionally encountered in whom the mucosa is lacerated by a sharp foreign

body such as a fish or chicken bone in the hypopharynx. Iatrogenic deep neck infection may develop after traumatic endotracheal intubation or endoscopic evaluation. More commonly, perforation of the cervical or thoracic esophagus leads to infection of the visceral space or the mediastinum. Use of the internal jugular vein for the intravenous administration of illicit narcotics is associated with both deep neck infection and thrombosis of the internal jugular vein (Fig. 77-8).[6,7]

Figure 77-8 Intravenous drug abuse may be associated with septic thrombophlebitis of the internal jugular vein and deep neck infection.

PREOPERATIVE EVALUATION

Every patient suspected of having infection in one of the deep neck spaces should undergo computed tomography (CT). This allows the surgeon to localize the site of the lesion to an appropriate space and determine whether the infection has progressed from local tissue sepsis (cellulitis) to suppuration (frank abscess). CT will clearly demonstrate the site of abscess (Fig. 77-9). A mass with a low-density center surrounded by a high-density rim suggests central necrosis and abscess formation. Conversely, development of an inflammatory mass that is homogeneous throughout may indicate that the infection is still in the cellulitis phase. This is important inasmuch as cellulitis may respond to intravenous antibiotics alone whereas surgical drainage is required for an abscess. This may be especially true in children.[8]

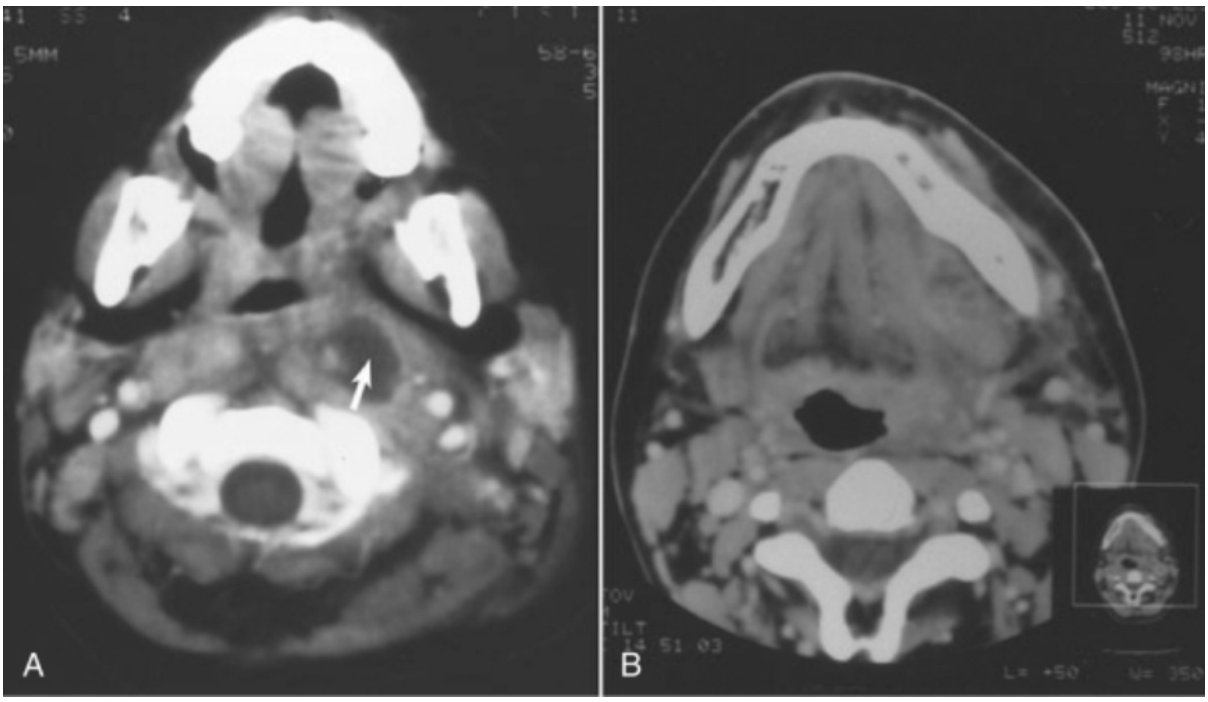

Figure 77-9 **A,** The large cystic cavity in the parapharyngeal space *(arrow)* suggests a parapharyngeal space abscess. **B,** Cellulitis in the parapharyngeal space with early abscess formation in the masseteric space is shown.

All patients should be hydrated, and antibiotics should be administered intravenously. The antibiotics chosen should reflect the most likely microbiology and should be administered empirically before the results of Gram stain and sensitivity testing are available. In this regard it is critical that suspicious sites of infection be cultured and submitted for Gram stain. Additionally, fine-needle aspiration of abscess cavities may be appropriate to obtain tissue for Gram stain, as well as culture and sensitivity testing before the administration of antibiotics. We recommend the administration of an antibiotic effective against β-lactamase, as well as an antibiotic effective against anaerobic oral flora.

The airway should be carefully monitored. If the patient is having difficulty handling secretions, is drooling, or is frankly short of breath, an elective tracheotomy should be performed immediately. When an odontogenic source of infection is identified, consultation with a dentist may be appropriate. On occasion, drainage of a periorbital abscess or tooth extraction may contribute greatly to subsequent control of infection.

SURGICAL APPROACHES

Patients admitted with deep neck infection should be carefully monitored for the adequacy of their airway. Patients with infection involving the parapharyngeal or retropharyngeal space should usually be in an intensive care setting, and monitoring should include percutaneous oximetry. Antibiotics should be administered intravenously. We use broad-spectrum coverage with efficacy against gram-positive cocci, as well as anaerobic bacteria. Patients who give a history of intravenous drug abuse, as well as patients with acquired immunodeficiency syndrome or insulin-dependent diabetics, should be covered for methicillin-resistant *Staphylococcus*, in addition to other gram-negative aerobic organisms such as *Klebsiella*.[6,7,9] When CT suggests cellulitis, the patient should be monitored regularly for response to therapy. Failure to improve is an indication to intervene surgically.

When a deep neck abscess is diagnosed, it should be drained. A number of authors have described management of patients with well-localized deep neck infection by needle aspiration of the abscess and high-dose intravenous antibiotics.[9–11] Some authors have suggested the introduction of a large-bore catheter or double-lumen catheter under CT guidance to ensure proper placement.[12] The catheter is then aspirated regularly or even irrigated. These techniques require close, careful patient follow-up. Progression of disease is an indication to institute more aggressive therapy consisting of open surgery and drainage. Most investigators acknowledge that patients with airway compromise are not good candidates for needle aspiration therapy, and the physician should probably proceed directly to establishing an airway and incision and drainage under these circumstances.

The standard of therapy for the management of deep neck abscess is incision and drainage. The submandibular space can be approached percutaneously or through the mouth. The choice of access usually reflects the specific location of the abscess. Abscesses that develop superior to the mylohyoid sling may be adequately drained through the floor of the mouth. Generally, however, an abscess that is posterior and inferior to the mylohyoid

muscle requires a transcervical incision placed in a submandibular skinfold. Care is taken to avoid the facial nerve. The abscess is opened bluntly. Finger dissection helps to fully evacuate all loculations, after which the wound is copiously irrigated and a drain inserted. Specimens are always obtained for Gram stain and sensitivity testing.

Access to the parapharyngeal space should be obtained percutaneously (Fig. 77-10). Usually, a horizontal incision made in an upper cervical skin crease offers adequate exposure and results in postoperative cosmesis. This incision should ordinarily be made at approximately the level of the carotid bifurcation. The sternocleidomastoid muscle is then reflected posteriorly. The great vessels are reflected posteriorly and the abscess cavity entered. The parapharyngeal space is most easily approached by passing just anterior to the posterior belly of the digastric muscle. Ligation of the facial artery with anterior displacement of the submandibular gland may be required. The abscess cavity is digitally explored, with care taken to break down all loculations. The wound is copiously irrigated and a drain inserted. The parapharyngeal space should not be drained transorally inasmuch as such drainage does not allow the surgeon to identify and protect important neurovascular structures.

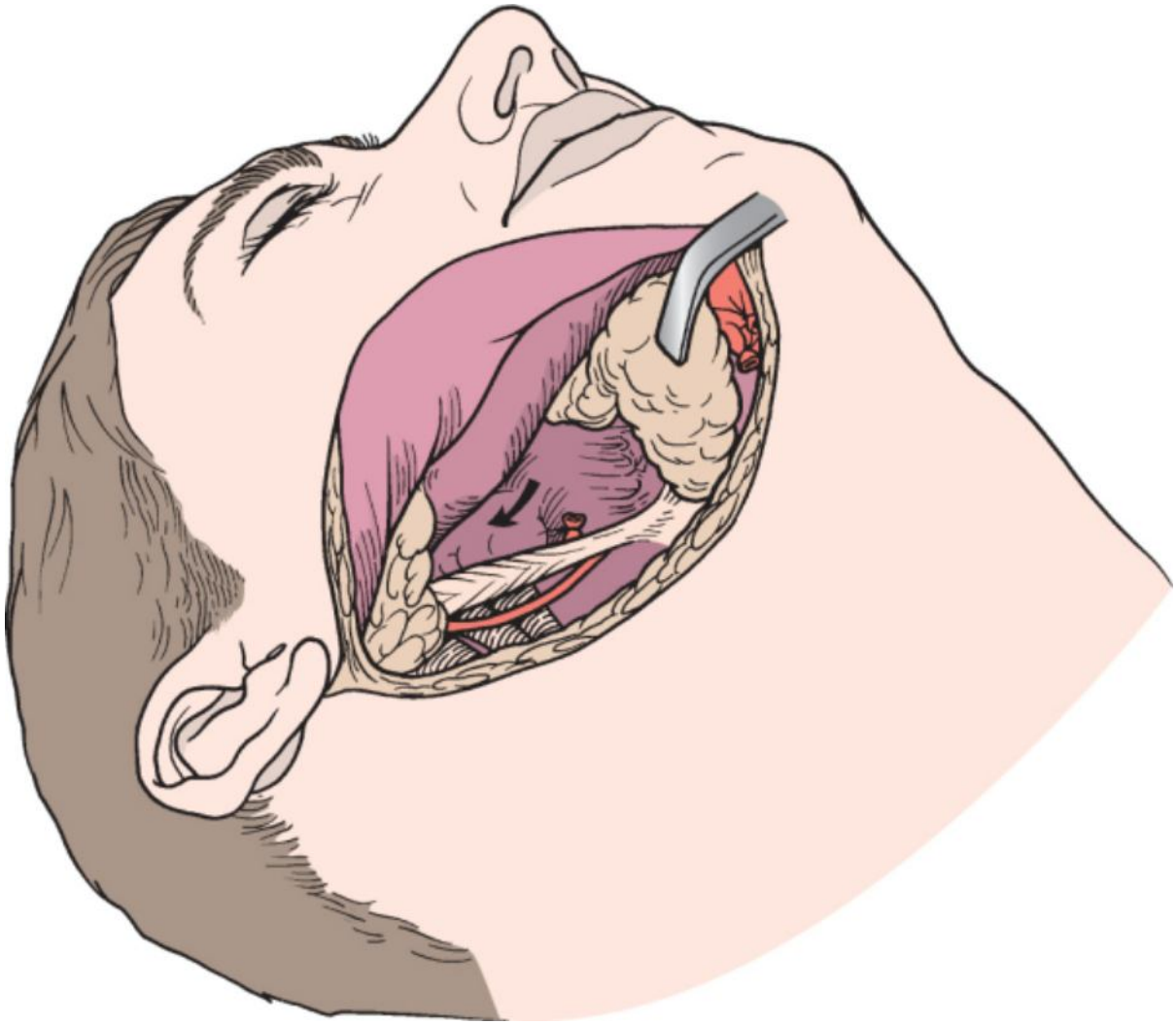

Figure 77-10 Surgical approach to the parapharyngeal space.

Limited, well-localized abscesses that involve the superior aspect of the retropharyngeal space may be drained transorally. The risk, of course, is that purulent debris will be aspirated. Accordingly, we recommend that patients be intubated and placed in the Trendelenburg position. The abscess is incised, explored, drained, and irrigated. Because it is exceedingly difficult to leave a drain in the wound after transoral procedures, this particular approach is suitable only for small, well-localized abscesses.

When a retropharyngeal abscess is large and life-threatening, it should be drained transcutaneously. A horizontal incision is placed in the cervical skin crease at approximately the midlevel of the abscess, which in most circumstances may be estimated to be the region of the hyoid bone. Skin flaps are minimally elevated superiorly and inferiorly. Posterior retraction of the sternocleidomastoid muscle and the great vessels exposes the retropharyngeal space, which is explored digitally with care taken to break down all loculations. The wound should be copiously irrigated. Drains can be left in multiple sites in the retropharyngeal space to ensure proper

postoperative drainage.

Most patients requiring incision and drainage of abscesses of the parapharyngeal or retropharyngeal space should be carefully considered for tracheotomy. If airway compromise exists preoperatively, tracheotomy should be undertaken. Routine endotracheal intubation may be difficult or impossible, and postoperative swelling may persist for several days and require prolonged airway support. The tracheotomy may be removed promptly when the infectious process has resolved.

Necrotizing cervical fasciitis is a rarely encountered, potentially lethal infection caused by polymicrobial organisms, including gram-positive cocci and anaerobic bacteria, that synergistically produce acute fulminant infection with tissue necrosis. Classically, patients with necrotizing fasciitis have evidence of soft tissue air because of air-forming organisms.[13–18] At the time of incision and drainage, frank purulent debris is not encountered. Instead, exploration may reveal foul-smelling gray-brown tissue fluid with no localization of infection. Muscle and fascia may be frankly necrotic. This is a potentially lethal situation. Incision plus drainage is inadequate. The entire area of infection must be exposed in patients with necrotizing fasciitis. Necrotic tissue should be débrided and the wound left *open*. Drains alone are insufficient to control this infection. Broad-spectrum antibiotics should be administered, and the patient should be monitored in an intensive care setting. Urgent initiation of hyperbaric oxygen therapy may be considered. The patient must be returned to the operating room for débridement of progressive necrotic tissue on multiple occasions. The requirement for repeated débridement is the rule rather than the exception. The wound cannot be closed until all necrotic tissue has been eliminated and the wound is actively granulating with healthy tissue. Cosmetic considerations should be postponed until all evidence of infection is controlled. Failure to adequately débride all necrotic tissue and assume vascularized tissue before wound closure may result in death.

Septic thrombophlebitis of the internal jugular vein may be heralded by a spiking febrile course. CT can also identify the thrombosed vein as a characteristic O caused by contrast material on the wall of the vein and absence of contrast material within the lumen. Jugular vein thrombosis is most commonly associated with patients in whom deep neck infection is caused by self-injection of illicit drugs directly into the jugular vein.[7,19] The surgeon should be especially aware of the possibility that the patient is infected with methicillin-resistant *S. aureus*. At the time of incision and drainage, it is appropriate to ligate and remove the thrombosed jugular vein. Any associated neuropathy, the most common type of which is injury to the vagus nerve or the cervical sympathetic chain, may resolve with resolution of the infection, although the neuropathy may be permanent.

Infection-induced erosion of the carotid arterial system may develop with deep neck infection.[20] This rare situation may be encountered at the time of incision and drainage if a clot is found in the neck, which should alert the surgical team immediately. Proper proximal and distal control of the carotid artery is necessary to prevent life-threatening exsanguination. A pseudoaneurysm of the carotid or other affected vessel may be evident on a contrast-enhanced CT scan. Sometimes it is possible to identify a branch of the external carotid artery that is affected and individually ligate that particular branch. In other circumstances, the entire common carotid artery may need to be ligated. When the situation allows, intraoperative arteriography may provide information that aids in making these decisions.

POSTOPERATIVE MANAGEMENT

Intravenous antibiotics are continued as the patient convalesces. Communication with the laboratory is important for identifying the infecting organism and its antibiotic sensitivities. This will allow the treatment team to modify antibiotic use according to culture and sensitivity information. A feeding tube is required for nutritional support when patients can take an adequate diet.

The wound and drains are inspected regularly. The drains may be advanced when drainage is scant and then removed. The incision is allowed to heal by secondary intention. The tracheotomy tube is removed when resolving pain and edema indicate a favorable clinical course.

Failure to adequately drain all loculations may result in persisting pain, fever, leukocytosis, and dysfunction. Failure to demonstrate clear-cut clinical improvement indicates a possible persistent undrained abscess. Repeat CT may be helpful in these circumstances. If a small loculation is demonstrated, it may be possible to drain it with the gloved hand by re-exploring the wound. Failing this, return to the operating room is appropriate and should be expeditiously carried out.

Progression of deep neck infection to mediastinitis is a potential fatal complication. This situation can be recognized clinically by the severity of the bedside situation as characterized by fever, diaphoresis, shortness of breath, and sepsis. Localization of the infectious process through CT scanning may facilitate appropriate drainage. Consultation with colleagues in thoracic surgery is always appropriate.

Infected third or fourth bronchial cleft cysts may be manifested as a paratracheal abscess or unilateral bacterial thyroiditis. In the acute setting, antibiotics should be administered. A barium esophagogram may help identify a

possible hypopharyngeal tract. Surgical exploration with excision of the tract and closure of the pharyngeal fistula is indicated when the thyroid gland is involved by the tract; unilateral thyroid lobectomy is required.

Failure to recognize and adequately treat necrotizing fasciitis or jugular vein thrombosis is a potentially lethal error of omission. These rare entities are de-scribed under “Surgical Approaches” earlier in this chapter.

PEARLS

- Gram-positive cocci (streptococci and staphylococci) are the most commonly identified organisms in deep neck infection.
- The retropharyngeal space extends into the thorax.
- The prevertebral space extends to the sacrum.
- Broad-spectrum antimicrobial therapy should be administered until the specific pathogen has been identified.
- Failure to improve with antibiotic therapy is an indication for incision and drainage of deep neck infection.

PITFALLS

- Subcutaneous emphysema may indicate necrotizing fasciitis.
- Transoral drainage is rarely indicated.
- Cutaneous ecchymosis may an indication of necrotizing fasciitis or vascular erosion.
- Failure to drain all loculations of an abscess may explain persistent sepsis; localization plus drainage is required.
- Jugular vein thrombosis is often accompanied by a spiking febrile course.