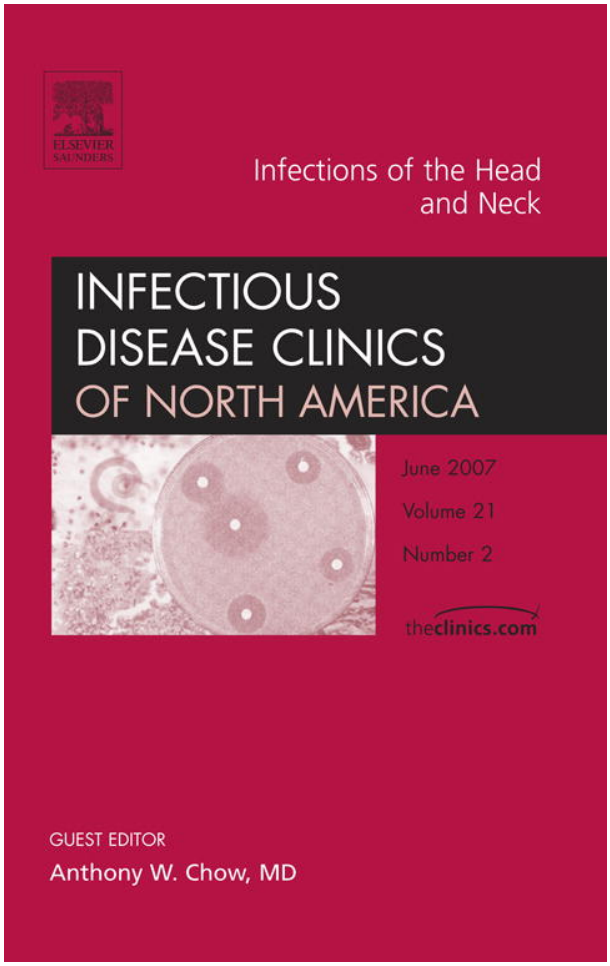

ELSEVIER
SAUNDERS

INFECTIOUS
DISEASE CLINICS
OF NORTH AMERICA

Infect Dis Clin N Am 21 (2007) 523–541

Cervical Lymphadenitis, Suppurative Parotitis, Thyroiditis, and Infected Cysts

Nawaf Al-Dajani, MD, Susan H. Wootton, MD*

Division of Infectious and Immunological Diseases, Department of Pediatrics, BC Children's Hospital, 4480 Oak Street, University of British Columbia, Vancouver, BC V6H 3N1, Canada

Neck masses are common and have a variety of infectious and noninfectious causes. A directed history and thorough physical examination are the cornerstones on which a diagnosis is made. In particular, the age of the patient is critical in formulating an appropriate differential diagnosis for neck masses. Unlike adults, neck masses in children seldom represent ominous disease. This article reviews the more common infectious causes of neck swelling—cervical lymphadenitis, suppurative parotitis, thyroiditis, and infected cysts. Noninfectious causes of neck masses include tumors, congenital anomalies, and skin and salivary gland disease.

Cervical lymphadenitis

The cervical lymphatic system involves a great array of superficial and deep lymph nodes that protect the head, neck, nasopharynx, and oropharynx against infection. Cervical lymphadenitis is characterized by inflammation of one or more of these lymph nodes. Most cases of cervical lymphadenitis, especially in children, are caused by an infectious agent; some immunologic processes and malignancies result in a similar presentation. The following section reviews the differential diagnosis and therapy of cervical lymphadenitis caused by infectious processes.

* Corresponding author. Vaccine Evaluation Center, Rm L-427, 4500 Oak Street, Vancouver, BC V6H 3N1.

E-mail address: swootton@cw.bc.ca (S.H. Wootton).

0891-5520/07/$ - see front matter
doi:10.1016/j.idc.2007.03.004 *id.theclinics.com*

Pathophysiology

The lymphatic system of the cervical region serves as the initial line of defense against infections for all structures within the head, neck, and upper respiratory tract. Micro-organisms of the skin, oropharynx, or respiratory tract can invade local cervical lymph nodes, resulting in localized infection [1,2]. If this initial defense fails, micro-organisms can disseminate, resulting in systemic disease. There are three groups of cervical lymph nodes: (1) Waldeyer's ring (including the adenoids and tonsils); (2) the nodes that surround Waldeyer's ring (occipital, postauricular, preauricular, parotid, and facial nodes); and (3) the submaxillary, submental, and deep and superficial jugular nodes [3]. Most cervical lymphatics drain to the submaxillary and deep cervical lymph nodes. Consequently, these nodes are often involved in cervical lymphadenitis.

Etiology

Infectious causes of cervical lymphadenitis are multiple (Table 1). The most common bacterial organisms causing acute unilateral infection are *Staphylococcus aureus* and *Streptococcus pyogenes*. In newborns adenitis may be caused by group B streptococci, whereas viruses are more common in children [4]. The presence of dental or periodontal disease suggests anaerobic bacteria [2]. In the past, anaerobic infections were uncommon; an observation that probably represented inadequate anaerobic-culturing techniques at the time.

The epidemiology of methicillin-resistant *S aureus* (MRSA) infections is changing. In the past, MRSA infections typically occurred in a hospital setting. More recently, the incidence of infections in adults and children who do not have traditional risk factors (prolonged hospitalization, surgical procedure, indwelling catheters) has increased [5]. The recent description of MRSA infection in healthy newborns is of particular concern [6]. MRSA, a common cause of skin and soft tissue infections, should be considered in patients presenting with cervical lymph node swelling.

The cause of cervical mycobacterial adenitis varies by age [7]. Adults more commonly present with *Mycobacterium tuberculosis*, whereas children, especially those age 2 to 5 years, tend to present with nontuberculous mycobacteria. In a report by Starke and colleagues [8], only 11 (10%) of 110 children who had active tuberculosis presented with cervical or supraclavicular lymphadenopathy. Species of nontuberculous mycobacteria that commonly cause infection in children include *Mycobacterium avium-intracellulare*, *Mycobacterium scrofulaceum*, and *Mycobacterium kansasii* [9].

Cat-scratch disease (CSD) is also a common cause of lymphadenitis in young children and adults and generally is self-limited. CSD was first described in 1931, but it was not until 1983 that Wear and colleagues [10] described *Bartonella henselae*, a small, gram-negative, silver-stained bacillus, as the causative agent of CSD.

Table 1
Infectious agents associated with cervical lymphadenitis

Type of organism	Common	Rare
Bacteria	*Staphylococcus* aureus	Non-group A streptococci
	Streptococcus pyogenes	Enterobacteriaceae
	Peptostreptococcus spp	*Escherichia coli*
	Peptococcus spp	*Klebsiella* spp
	Bacteroides spp	*Pseudomonas* spp
	Bartonella henselae	*Haemophilus influenzae*
		Actinomyces Israeli
		Fusobacterium spp
		Francisella tularensis
		Yersinia spp
		Corynebacterium spp
		Brucella spp
		Listeria monocytogenes
		Bacillus anthracis
Viruses	Epstein-Barr virus	
	Herpes simplex virus 1 and 2	
	Cytomegalovirus	
	Adenovirus	
	Enterovirus	
	Rubella virus	
	Roseola virus	
	Varicella-zoster virus	
	Influenza virus	
	Parainfluenza virus	
	Respiratory syncytial virus	
Mycobacteria	*Mycobacterium tuberculosis*	
	Mycobacterium avium-intracellulare	
	Mycobacterium scrofulaceum	
Fungi		*Sporothrix schenckii*
		Histoplasma capsulatum
		Aspergillus fumigatus
		Candida albicans
		Cryptococcus neoformans
		Coccidioidomycosis
Parasites		*Toxoplasma gondii*
		Leishmania spp
		Trypanosoma spp
		Filaria spp

Adapted from Brook I. The swollen neck. Cervical lymphadenitis, parotitis, thyroiditis, and infected cysts. Infect Dis Clin North Am 1988;2(1):223; with permission.

HIV is another cause of chronic cervical lymphadenitis, but patients typically develop more generalized lymphadenopathy. Early manifestations of maternally derived HIV infection can include lymphadenopathy associated with splenomegaly [11]. In adolescents (age $>$ 13 years) and adults, lymphadenopathy is recognized as a diagnostic criterion for HIV [12]. Human T-cell lymphotropic virus (HTLV), a retrovirus linked to adult T-cell

leukemia/lymphoma and HTLV-1–associated myelopathy/tropical spastic paraparesis, also can present with more generalized lymphadenopathy [13].

Clinical manifestations

The presentation of cervical lymphadenitis can be classified into three broad groups: (1) acute unilateral cervical lymphadenitis; (2) acute bilateral cervical lymphadenitis; and (3) subacute or chronic cervical lymphadenitis. *S aureus* and *S pyogenes* are the most common causes of acute unilateral cervical lymphadenitis [2,3,14,15]. Lymph nodes infected with *S aureus* tend to be fluctuant, quite tender, and vary in size (2–6 cm). Often the skin overlying the infected lymph node is warm and erythematous. Systemic symptoms tend to be mild. In neonates, acute unilateral cervical lymphadenitis is generally caused by *S aureus*; however, a "cellulitis-adenitis syndrome" caused by group B streptococci has been described [4]. These infants often are male and typically present with fever, facial or submandibular cellulitis, and ipsilateral otitis media.

Acute bilateral cervical lymphadenitis often is caused by viral pathogens; however, it also may represent pharyngitis caused by *S pyogenes* as well as *Mycoplasma pneumoniae* (see Table 1). In general, the lymph nodes are small and rubbery with little redness or warmth. Additional clinical features such as gingivostomatitis (herpes simplex), herpangina (coxsackie virus or enterocytopathogenic [ECHO] virus), or rash (cytomegalovirus) may help identify the causative virus. Posterior acute bilateral cervical lymphadenitis often is associated with rubella or infectious mononucleosis. Typically, viral infections resolve within 1 to 2 weeks without complication.

Chronic unilateral cervical lymphadenitis is often caused by *B henselae,* atypical mycobacteria, or *Toxoplasma gondii*. The highest incidence of *B henselae* infection (CSD) occurs in children younger than 10 years. Patients develop lymphadenopathy, usually preceded by an erythematous papule or pustule at the inoculation site. Some children (25%) progress to more severe disease [16,17]. Atypical mycobacterial infections generally are localized to a single tonsillar or submandibular node (<3 cm), but deeper nodes may be involved. The overlying skin becomes very thin and changes from red to distinctive lilac. Some nodes (10%) drain spontaneously, resulting in sinus tract formation. Chest radiographs are normal, and Mantoux skin tests usually result in less than 15 mm of induration (usually 5–9 mm) [2].

Differential diagnosis

Differentiating between infectious and noninfectious causes of cervical lymphadenitis is of paramount importance. A detailed medical history including the presence of skin lesions, exposure to animals or feeding insects, dentition, constitutional symptoms, history of recurrent infections or lymphadenopathy, immunization status, contact with tuberculosis, place of residence, and recent travel may provide essential clues. The duration

of swelling and its location also serve as diagnostic aids. For example, tumors and congenital anomalies generally are present for weeks and are often in the midline. A history of cat contact may suggest CSD, whereas coexisting dental or periodontal infection may suggest anaerobic bacteria [2,16].

Physical examination should include a thorough evaluation of the liver, spleen, and lymphatic system as well as the oropharynx, dentition, conjunctiva, and skin. Palpation of the mass to determine its location, consistency (solid or fluctuant, smooth or nodular), and motility (fixed or movable) is helpful in differentiating structures within the neck.

The extent of the diagnostic evaluation depends on the history and physical examination. For most uncomplicated cases of cervical lymphadenitis, determining the precise cause often is not necessary. For patients who do not respond to initial medical management or are acutely ill, a search for a cause should be pursued. Cultures of the blood, a complete blood cell count, liver function studies, and amylase as well as serologic tests for viruses may be indicated. Culture of material collected directly from the lymph node by fine needle aspiration (FNA) is especially valuable. The aspirate should be sent for routine Gram stain, aerobic and anaerobic bacterial culture, acid-fast stain, and mycobacterial culture. For chronic cervical lymphadenitis, methenamine-silver stain, fungal cultures, and polymerase chain reaction for *B henselae* should be done. An intradermal skin test for tuberculosis and atypical mycobacteria should be applied. In addition, high-resolution and color Doppler ultrasonography offers clues into the cause and the degree of suppuration [18]. If the diagnosis remains in doubt, an excision biopsy should be performed for both histology and cultures.

Therapy and prevention

Most cases of acute cervical lymphadenitis require no specific therapy because they are the sequelae of viral pharyngitis or stomatitis. Empiric therapy should provide adequate coverage for *S aureus* and *S pyogenes*. Oral therapy should include cephalexin, oxacillin, or clindamycin, or the combination of amoxicillin and a beta-lactamase inhibitor (clavulanic acid). Therapy given for 10 to 14 days generally is sufficient. Parenteral therapy (cefazolin, nafcillin, oxacillin, or clindamycin) may be required for toxic patients.

Lack of clinical improvement after 36 to 48 hours should indicate a need for reassessment of therapy. Culture results may guide the selection of appropriate therapeutic agents. When fluctuation or pointing is present, the abscess should be incised and drained because antibiotic therapy alone is insufficient. Surgical evacuation of the abscess is helpful in promoting resolution.

If CSD or mycobacterial infection is suspected, incision and drainage should be avoided because cutaneous fistulae often develop. Treatment for CSD depends on the severity of disease and may include gentamicin, rifampin, or trimethoprim-sulfamethoxazole; most cases do not require antibiotic therapy. Azithromycin also has been shown to be effective [19]. Total

surgical removal is the most effective therapy for nontuberculous mycobacterial cervical lymphadenitis [20]. After excision, antimycobacterial agents (isoniazid and rifampin) are given until organisms are identified. If *M tuberculosis* is identified, these agents are continued for 9 to 12 months. Streptomycin and pyrazinamide are added if isoniazid-resistant *M tuberculosis* is documented.

Conditions predisposing to cervical lymphadenitis should be managed and treated appropriately. Examples of such conditions include dental caries or abscesses, oropharyngeal or otitic infections, and skin infections involving the face or scalp. Avoiding exposure to highly contagious pathogens (*M tuberculosis*) and animals known to transmit infection (toxoplasmosis and CSD) may reduce the risk of cervical lymphadenitis further.

Suppurative parotitis

Inflammation of the parotid gland is caused by a variety of infectious agents and noninfectious systemic illnesses. Depending on the clinical presentation and cause, parotitis can be classified into several types: suppurative, viral, granulomatous, recurrent, or chronic. Determining the type of parotitis has important treatment implications.

Pathophysiology

Inflammation of the parotid gland is caused by local infection, systemic infection (eg, mumps), or hematogenous seeding. Factors that decrease or interrupt the flow of saliva increase the risk for parotitis. Risk factors include dehydration, poor oral hygiene, oral trauma, xerostomia, ductal obstruction, certain drugs (anticholinergics or antihistamines), certain chronic diseases (Sjögren's syndrome or diabetes mellitus), malnutrition, neoplasms of the oral cavity, tracheostomy, immunosuppression, and sialolithiasis [21,22].

Etiology

Infectious parotitis is caused by a wide variety of organisms (Table 2). *S aureus* is by far the most common pathogen; however, streptococci and gram-negative bacilli also have been reported [21–24]. Gram-negative organisms often are seen in neonates and in hospitalized, debilitated patients. Anaerobic infections of the parotid gland are rare; only a few cases have been reported [24]. In cases of recurrent parotitis in children, *Streptococcus* spp are the most commonly isolated organisms [25].

M tuberculosis and atypical mycobacteria, such as *M avium-intracellulare*, are rare causes of granulomatous parotitis [26]. Other causes of granulomatous parotitis include *Actinomyces* spp and gram-negative intracellular organisms such as *Francisella tularensis* and *Brucella* spp [27].

Table 2
Infectious pathogens associated with suppurative parotitis

Type of organism	Common	Rare
Bacteria	*Staphylococcus aureus*	*Streptococci pneumoniae*
	Streptococcus pyogenes	Viridans streptococci
	Alpha-hemolytic streptococci	*Haemophilus influenzae*
		Moraxella catarrhalis
		Pseudomonas aeruginosa
		Escherichia coli
		Proteus spp
		Salmonella spp
		Klebsiella spp
		Peptostreptococcus spp
		Prevotella spp
		Fusobacterium spp
		Actinobacillus spp
Mycobacteria	*Mycobacterium tuberculosis*	
	Mycobacterium avium-intracellulare	
	Other mycobacteria	
Fungi	*Candida albicans*	
Viruses	Mumps virus	
	Coxsackieviruses A and B	
	Echoviruses	
	Epstein-Barr virus	
	Influenza A virus	
	Parainfluenza viruses 1 and 3	
	Cytomegalovirus	
	Herpes simplex virus 1	
	Lymphocytic-choriomeningitis	
	Human immunodeficiency virus	

Adapted from Brook I. The swollen neck. Cervical lymphadenitis, parotitis, thyroiditis, and infected cysts. Infect Dis Clin North Am 1988;2(1):228; with permission.

Even in the postvaccine era, epidemic mumps caused by paramyxovirus is the most common viral cause of parotitis in childhood [28]. Other viral agents associated with parotid infection are coxsackie viruses, Epstein-Barr virus, influenza A virus, lymphocytic-choriomeningitis virus, parainfluenza viruses, herpes simplex virus, and cytomegalovirus [29].

Clinical manifestations

A detailed history and physical examination help to determine the cause of parotitis. Acute suppurative parotitis is characterized by the sudden onset of unilateral induration and erythema that extends from the cheek to the angle of the jaw. The parotid gland becomes swollen and extremely tender. Purulent discharge may be expressed from the orifice of the parotid duct with gentle pressure. The infection can extend locally into surrounding tissue, the face, ear, or through the fascial plane to the mediastinum resulting in severe

complications such as thrombophlebitis of the jugular vein (Lemierre syndrome) or septicemia.

Mumps, the most common form of viral parotitis, is characterized by a prodrome of fever, malaise, anorexia, and headache followed by unilateral or bilateral earache and parotid tenderness. Drainage from the parotid duct is clear even though the duct is erythematous and swollen. Other viral agents may cause similar symptoms. Rarely, mumps is complicated by meningoencephalitis, pancreatitis, orchitis, myocarditis, pericarditis, arthritis, and nephritis.

Granulomatous parotitis is rare and presents as a painless enlarging mass without surrounding inflammation. Often, evidence of systemic tuberculous disease is absent. Actinomycosis of the parotid gland also causes painless nodular swelling and often is associated with oral (dental caries) or cervicofacial infection. Fistulas draining yellow or white material with sulfur granules are common [27].

Recurrent parotitis of childhood, a unique disease characterized by acute and subacute parotid gland swelling, is quite rare with a peak incidence around 6 years of age [25,30]. Children have repeated episodes of fever, pain, and unilateral parotid swelling that last up to 2 weeks, resolving spontaneously. Culture of drainage from the parotid duct often yields streptococcal organisms. The disease tends to become less frequent with age, stopping by early adulthood.

Bilateral parotid enlargement is a common finding in children who have HIV infection (20%–50%) and often is the first manifestation of HIV infection in an otherwise healthy older child [31]. Pre-existing xerostomia and secondary infections caused by immunosuppression may increase the risk for parotitis in these patients.

Differential diagnosis

Acute suppurative parotitis should be differentiated from other types of parotitis. Typically, suppurative parotitis is characterized by the expression of purulent material from the parotid duct with gentle pressure over the gland. A Gram stain of the purulent material may support bacterial infection; however, cultures may simply represent oropharyngeal contamination. In contrast, FNA of the parotid gland may yield the causative organism. Aerobic, anaerobic, fungal, and mycobacterial cultures should be performed. Surgical exploration and drainage may be indicated for diagnosis as well as for therapy.

In contrast, viral parotitis does not produce purulent discharge from the parotid duct. Mumps and other viral infections can be diagnosed using a variety of methodologies including culture, serology, and nucleic acid tests (polymerase chain reaction).

Multiple imaging techniques are available that can assist with the diagnosis of parotitis including ultrasound, CT scan, and X-ray sialography (the criterion). Unlike X-ray sialography, MR sialography is not contraindicated during acute infection and does not require the injection of contrast material. This technology may offer a promising alternative for diagnosis [32].

If infection is not found, noninfectious causes should be pursued. Such disorders include collagen vascular diseases, cystic fibrosis, alcoholism, diabetes, gout, uremia, sarcoidosis, ectodermal dysplasia syndromes, familial dysautonomia, sialolithiasis, benign and malignant tumors, metal poisoning, and drug-related disorders. Nonparotid swelling that may simulate parotitis includes lymphoma, lymphangitis, cervical adenitis, external otitis, dental abscess, actinomycosis not involving the parotid, anaerobic infection of the buccal space, and infected cysts.

Therapy and prevention

Maintenance of adequate hydration, parotid massage, sialagogues (eg, lemon drops, hard candy), and administration of parenteral antimicrobial therapy are essential. The choice of antibiotics depends on the agent responsible. Most cases respond to antimicrobial therapy, but some inflamed glands may reach a stage of abscess formation that requires surgical drainage. Broad antimicrobial therapy is indicated to cover all possible aerobic and anaerobic pathogens, including adequate coverage for *S aureus*, hemolytic streptococci, and anaerobic bacteria.

A penicillinase-resistant penicillin or a first-generation cephalosporin plus clindamycin in combination with an aminoglycoside is generally adequate [33], but vancomycin for MRSA or ceftazidime for broader gram-negative coverage may be required. If the patient does not respond to medical therapy, or if fluctuance increases, surgical incision and drainage are indicated. Treatment of viral parotitis includes antipyretics, analgesia, and hydration. For mycobacterial infection, excision of the gland and specific antimicrobial therapy may be required [26]. Patients who have actinomycosis should be managed with penicillin G [27]. Children who have recurrent parotitis should be treated with appropriate antibiotics, but chronic suppressive therapy is not recommended.

Active immunization against the mumps virus has reduced the occurrence of mumps significantly. Unfortunately, outbreaks continue to occur within unvaccinated populations [34]. Maintenance of good oral hygiene, adequate hydration, and early and proper therapy of bacterial infection of the oropharynx may reduce the occurrence of suppurative parotitis.

Thyroiditis

The thyroid gland is remarkably resistant to infection, and infectious thyroiditis is quite rare. Infectious thyroiditis can be classified into three groups: (1) acute suppurative (AST); (2) subacute (ST); and (3) chronic thyroiditis. The incidence of infectious thyroiditis is unknown, but AST is estimated to account for 0.1% to 0.7% of all thyroid pathology [35,36]. AST, first described by Bauchet in 1857, carries substantial risk and should be treated as a medical

emergency. In the preantimicrobial era, the case-fatality rate of AST was 22% [37]. Early recognition of AST is crucial for preventing devastating complications.

Pathogenesis and risk factors

The rarity of thyroid infections has been attributed to several factors of the thyroid gland: its high content of iodine, hydrogen peroxide production, rich blood supply with anastomotic arterial network, abundant lymphatic drainage, and unique encapsulated location [2,38,39]. Most cases of AST involve the left thyroid lobe because of the persistence of piriform sinus fistula, but the right lobe or both lobes may be involved [40,41]. Other routes of infection include hematogenous spread, additional congenital defects, direct spread from adjacent infected tissue, or lymphatic spread [2,38]. In ST, both lobes often are involved. Predisposing factors for infection include previous thyroid disease (goiter or adenoma), preceding infection in a distant site, trauma, postpartum or postabortal status, advanced age, diabetes mellitus, smoking, immunocompromising conditions, and chemotherapy [2,39].

Pathogens and infecting agents

In the largest review of infectious thyroiditis to date, bacteria were isolated in the majority of patients [42]. Gram-positive cocci are the most common organisms and include *S aureus*, *S pyogenes*, *Streptococcus viridans*, *Streptococcus pneumoniae*, and *Staphylococcus epidermidi*s (Table 3). Gram-negative aerobic organisms such as *Klebsiella* spp, *Salmonella typhi*, and *Escherichia coli*, as well as anaerobic bacteria such as *Bacteroides* spp and *Peptostreptococcus* spp, have been reported. Anaerobic infections are commonly polymicrobial [43,44]. In ST, measles virus, influenza virus, adenovirus, echovirus, mumps virus, and Epstein-Barr virus are common [45–47]. Mycobacterial species have also been reported but usually are associated with miliary or disseminated disease. Other rare causes include parasites (*Echinococcus*, *Taenia solium*, and *Strongyloides stercoralis*) and *Treponema pallidum* [42]. Fungal etiologies include *Aspergillus* spp and *Coccidioides immitis* [48]. In patients who have HIV infection, *Pneumocystis jiroveci* is the most common organism in autopsy specimens [38].

Clinical manifestations

The most frequent symptoms of infectious thyroiditis are pain (which may refer to the ear or occiput), fever, dysphagia, dysphonia, hoarseness, chills, and preceding sore throat. In AST, clinical manifestations are similar in children and adults (Table 4) [40,49]. Stridor or dyspnea may develop because of tracheal narrowing (Fig. 1). Expectoration of purulent sputum should raise the suspicion of anatomic abnormalities. Death may occur because of tracheal obstruction, tracheal perforation, mediastinitis, or thyroid

Table 3
Pathogens associated with infectious thyroiditis

Type of organism		
Bacterial	Gram-positive aerobes	Gram-positive anaerobes
	Staphylococcus aureus	Peptostreptococci
	Group A streptococci	*Clostridium septicum*
	Streptococcus viridans	*Actinomyces* spp
	Streptococcus pneumoniae	Gram-negative anaerobes
	Staphylococcus epidermidis	*Bacteroides* spp
	Group B streptococci	*Prevotella* spp
	Enterococci	*Fusobacterium* spp
	Corynebacterium spp	Spirochete
	Nocardia asteroids	*Treponema pallidum*
	Rhodococcus equi	
	Gram-negative aerobes	
	Enterobacteriaceae	
	Escherichia coli	
	Salmonella spp	
	Klebsiella pneumoniae	
	Acinetobacter spp	
	Enterobacter cloacae	
	Others	
	Pseudomonas aeruginosa	
	Brucella spp	
	Haemophilus spp	
	Eikenella corrodens	
	Bartonella spp	
	Coxiella burnetii	
	Mycobacterium	
	Mycobacterium tuberculosis	
	Mycobacterium chelonia	
	Mycobacterium avium-intracellulare	
Fungal	*Pneumocystis jiroveci*	
	Aspergillus spp	
	Candida spp	
	Coccidioides immitis	
	Pseudoallescheria boydii	
	Cryptococcus spp	
	Histoplasma capsulatum	
Parasitic	*Echinococcus* spp	
	Trypanosome spp	
	Falciparum spp	
	Strongyloides stercoralis	
	Taenia solium	
Viral	Measles virus	Mumps virus
	Influenza virus	Epstein-Barr virus
	Adenovirus	Cytomegalovirus
	Echovirus	St. Louis encephalitis virus
	Human foamy virus	Herpes Simplex virus
	Rubella virus	Human T-cell Lymphotropic virus

Table 4
Manifestations of acute suppurative thyroiditis in children

Symptom	Children (%)	Adult (%)
Neck mass	100	100
Pain/tenderness	93	100
Left lobe involvement	87	85
Fever	80	100
Dysphagia/sore throat	40	90
Antecedent upper respiratory tract infection	33	88

Adapted from Chi H, Lee YJ, Chiu NC, et al. Acute suppurative thyroiditis in children. Pediatr Infect Dis J 2002;21(5):385; with permission; and Szabo SM, Allan DB. Thyroiditis. Differentiation of acute suppurative and subacute. Case report and review of the literature. Clin Pediatr (Phila) 1989; 28(4):173; with permission.

abscess rupture. Other complications include pneumonia, sepsis, vocal cord paralysis, regional sympathetic nerve disruption, and thyroid dysfunction [2,42]. Occasionally, patients may show symptoms of thyroid dysfunction, nervousness, gastrointestinal disturbance, or tremor. In patients who have mycobacterial, fungal, or parasitic infections resulting in chronic thyroiditis, specific symptoms usually are lacking. Diagnosis often is made intraoperatively or postmortem in autopsies [2]. The symptoms of ST generally are milder than those of AST and are more common in women (Table 5) [42,50].

Diagnosis

Thyroiditis should be suspected in patients presenting with anterior neck swelling associated with fever, dysphagia, and hoarseness. Leukocytosis and

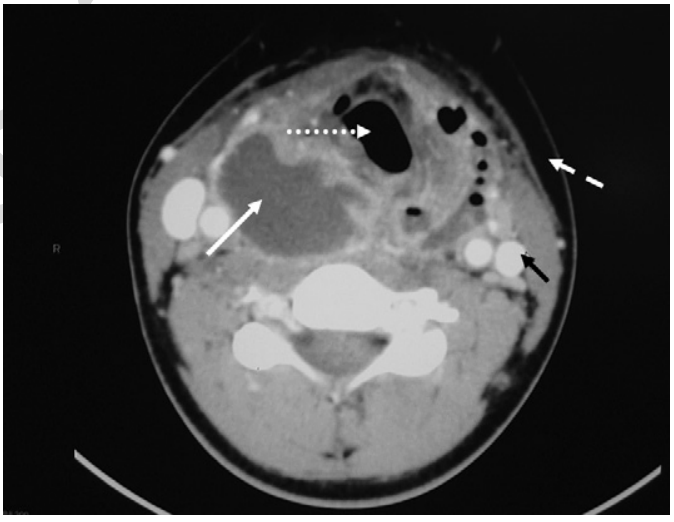

Fig. 1. CT scan of thyroid gland showing (*A*) thyroid abscess (*white solid arrow*), (*B*) mass effect on trachea (*white dotted arrow*), (*C*) air bubble (*white dashed arrow*) suggesting fistula/communication with posterior pharynx, and (*D*) vascular structure, left internal jugular vein (*black arrow*). "(*Courtesy of* Nawaf Al-Dajani, MD, Vancouver, British Columbia, Canada, 2006.)"

Table 5
Clinical features differentiating acute suppurative thyroiditis from subacute thyroiditis

Characteristic	Acute suppurative thyroiditis	Subacute thyroiditis
Preceding upper respiratory tract infection	88%	17%
Fever	100%	54%
Thyrotoxicosis	Uncommon	Common
Sore throat	90%	36%
Painful thyroid gland	100%	77%
Left side affected	85%	Not specific
Migrating tenderness	Possible	27%

Adapted from Szabo SM, Allan DB. Thyroiditis. Differentiation of acute suppurative and subacute. Case report and review of the literature. Clin Pediatr (Phila) 1989;28(4):173; with permission.

elevated sedimentation rate as well as C-reactive protein are observed frequently. Fewer than 6% of patients have coexisting bacteremia or fungemia. Thyroid function tests generally are normal (83%) [38,40]. In AST, the T4 level can be high during the acute stages because of the abundant release of T4 from the inflamed lobe. In prolonged ST or chronic thyroiditis, T4 can be low as hypothyroidism evolves. In mycobacterial thyroiditis, 50% of patients tend to be hyperthyroid; the opposite occurs in fungal thyroiditis [42].

Multiple imaging studies can assist with the diagnosis of infectious thyroiditis. Ultrasonography can identify lobe involvement and abscess formation [51]. In AST, thyroid radionuclide scans show focal reduced uptake or a cold nodule (90%–95%), whereas diffuse reduced uptake is seen in ST. Thyroid CT or MRI scans can delineate abscess extension and identify anatomic abnormalities [52,53]. Upper gastrointestinal contrast studies may show a fistula after successful treatment with antibiotics. Upper airway endoscopies can identify the piriform sinus and assess vocal cords and airways status. The criterion for diagnosis is FNA (ultrasound- or CT-guided) or biopsy for culture. Specimens should be sent for aerobic, anaerobic, fungal, and mycobacterial culture.

Management

Because AST can be fatal, initial therapy includes establishing an airway and intravenous access. Antibiotics tailored toward common pathogens, oral flora, and anaerobes (penicillin, cefazolin or cloxacillin in combination with clindamycin) are initiated. Broad-spectrum antibiotics such as cefotaxime and meropenem can be used in severe cases as well as vancomycin (if MRSA is suspected) and metronidazole. Fungal infection can be treated with amphotericin B, fluconazole, voriconazole, or caspofungin [48].

In the case of airway obstruction, failure of medical therapy, or clinical deterioration, prompt surgical intervention is indicated. Surgery also is

indicated for patients who have persistent piriform sinus fistula or thyroglossal cyst after successful medical management. Recently, endoscopic fibrin glue has also been used with success [54]. Thyroid function tests should be followed because hypothyroidism may develop. Most patients who have AST and who are appropriately treated recover completely, but disease will recur in 16%. Treatment for ST is symptomatic; initial therapy includes nonsteroidal anti-inflammatory drugs. Some patients may require steroids. Again, thyroid function tests must be followed in patients who have ST because hypothyroidism develops in approximately 10% of these patients. ST generally is self limited, with most patients recovering within several weeks [50].

Infected cysts

Thyroglossal duct cyst

Thyroglossal duct cysts (TDC) account for 70% of congenital neck anomalies. TDC arise from the embryonic remnant of the thyroglossal duct that connects the foramen cecum (at the base of the tongue) with the thyroid gland. Most patients remain asymptomatic for years. A midline neck mass developing during late childhood, adolescence, or even adulthood is the most common presentation. There is a slight male predominance [55].

Dermoid and epidermoid cysts

Dermoid cysts and epidermoid cysts are the second most common congenital neck cysts. They typically occur in the midline of the neck anywhere from the hyoid bone to the mouth floor. Depending on their location, such cysts can interfere with breathing and swallowing. In contrast to epidermoid cysts, dermoid cysts contain skin appendages (eg, sebaceous glands, hair follicles) [56]. Surgical removal is almost always necessary to prevent infection or recurrence.

Branchial cleft cyst

Branchial cleft cysts arise from the incomplete obliteration of the branchial clefts during embryogenesis. Almost all branchial cleft anomalies arise from the second cleft (95%). Branchial cleft cysts usually are located in the anterior triangle of the neck at the junction of the middle and upper third of the sternocleidomastoid muscle. Often presenting at birth, branchial cleft cysts may become evident later in infancy or childhood. Branchial cleft cysts often become infected with sinus tract or abscess formation. Occasionally, internal drainage into the pharynx or external auditory meatus can occur. Interference with swallowing and breathing also may occur [57,58].

Laryngocele

A laryngocele is a cystic dilation of the laryngeal saccule. The congenital form is a remnant of air sac, whereas the acquired form develops from

increased intraglottic pressure, excessive coughing, or glass blowing. Laryngoceles are rarely bilateral. The size can vary, increasing with Valsalva's maneuver. Most patients present with dysphonia, neck mass, or airway obstruction. Laryngoceles can become infected, especially if the saccule orifice becomes blocked [56,59].

Cystic hygroma

Cystic hygromas are lymphangiomas, a benign developmental condition of unknown origin. Cystic hygromas develop when communication between lymphatic sac and internal jugular vein or thoracic duct fails to develop, resulting in the accumulation of lymph and cystic formation [60]. Most present during the neonatal or childhood period (1 in 6000 births) and generally are located in the posterior triangle of the neck. Cystic hygromas can be single or multicystic. They are soft and fluctuant and transilluminate. Cystic hygromas can grow rapidly within the first few weeks, extending to internal structures of the neck, pharynx, larynx, and epiglottis. Airway compromise is common and can be challenging during delivery and neonatal resuscitation.

Pathogenesis and causative agents

In patients who have TDC, secretions of the thyroglossal duct epithelial cells accumulate, leading to dilation of the duct and gradual development of a cystic structure. This development, in combination with inadequate drainage and low oxygen tension, contributes to bacterial overgrowth and abscess formation. Connection to the mouth floor facilitates oral flora migration to the cyst cavity. TDC frequently become infected (40%–60%) [61]. *S aureus* and *S pyogenes* are the predominant pathogens. Alpha hemolytic *streptococci*, *Peptostreptococcus* spp, and gram-negative anaerobes (*Prevotella*, *Porphyromonas*, and *Bacteroides* spp) are common also [59]. Other types of congenital cysts become infected by the same mechanism (blocking of cyst orifice) with similar pathogens [59].

Clinical presentation

Most patients who have infected TDC present with a painful midline neck mass that is erythematous and warm. Hoarseness, dysphagia, or odynophagia are associated symptoms. Fever, chills, and other constitutional symptoms are uncommon [62]. In addition, the mass moves upward with swallowing. Fluctuation suggests abscess formation. In rare cases, airway compromise and suffocation may develop, especially if the TDC developed at the base if the tongue. This presentation can be fatal. Other forms of congenital neck cyst present in a similar fashion (Table 6). Purulent discharge may develop if a sinus tract has formed. Enlarged regional lymph node also may occur. Occasionally mass effect on surrounding organs, trachea, or pharynx may occur.

Table 6
Common congenital neck cysts by location, signs, and age range of onset

Type	Location	Signs	Age
Thyroglossal duct	Midline	Cyst moves with swallowing	Birth–elderly
Dermoid/epidermoid	Midline	Cyst may move with swallowing	Birth–adult
Branchial	Anterior neck triangle Lateral	Associated with draining sinus	Childhood–adult
Laryngocele	Lateral neck	Size fluctuates Transilluminates	Infancy–adult
Cystic hygroma	Posterior neck triangle	Soft, enlarges in first few weeks of life	Birth–infancy

Diagnosis

The diagnosis of infected neck cysts is based on clinical presentation (see Table 6). Most infected TDC present with a midline neck mass that moves with swallowing, whereas others, such as branchial cleft cyst or laryngocele, are lateral. Ultrasound scans can differentiate cystic from solid structures, detect abscesses, and guide FNA. CT and MRI scans detect suppuration and identify anatomic structure before surgical intervention. Fistulography can delineate the course of the fistula and identify the level of brachial cleft involvement. Pharyngoscopy and laryngoscopy identify internal orifices and mass effects. FNA or intraoperative cultures and histopathology are the criterion for identifying infectious agents and confirming developmental anomalies or malignant transformation [2,59]. Cultures should be processed for aerobes, anaerobes, fungi, and mycobacteria.

Management

Antibiotics (penicillin or cefazolin in addition to clindamycin) are targeted toward oral flora. Antibiotic regimens should be adjusted based on culture and sensitivity results. Oral antibiotics such as first-generation cephalosporins, amoxicillin/clavulanate, or clindamycin may be adequate for mild cases. Broad-spectrum antibiotics should be reserved for severe cases. Incision and drainage are indicated for abscesses and if medical therapy is unsuccessful. To prevent recurrences, surgical intervention (''Sistrunk procedure'' for TDC) is required ultimately [59]. Such surgery is delayed until an acutely inflamed cyst has resolved [54].

References

[1] Barton LL, Feigin RD. Childhood cervical lymphadenitis: a reappraisal. J Pediatr 1974; 84(6):846–52.
[2] Brook I. The swollen neck. Cervical lymphadenitis, parotitis, thyroiditis, and infected cysts. Infect Dis Clin North Am 1988;2(1):221–36.

[3] Scobie WG. Acute suppurative adenitis in children: a review of 964 cases. Scott Med J 1969; 14(10):352–4.
[4] Baker CJ. Group B streptococcal cellulitis-adenitis in infants. Am J Dis Child 1982;136(7): 631–3.
[5] Herold BC, Immergluck LC, Maranan MC, et al. Community-acquired methicillin-resistant *Staphylococcus aureus* in children with no identified predisposing risk. JAMA 1998;279(8): 593–8.
[6] CDC. Community-associated methicillin-resistant Staphylococcus aureus infection among healthy newborns— Chicago and Los Angeles county, 2004. MMWR Morb Mortal Wkly Rep 2006;55(12):329–32.
[7] Lai KK, Stottmeier KD, Sherman IH, et al. Mycobacterial cervical lymphadenopathy: relation of etiologic agents to age. JAMA 1984;251(10):1286–8.
[8] Starke JR, Taylor-Watts KT. Tuberculosis in the pediatric population of Houston, Texas. Pediatrics 1989;84(1):28–35.
[9] Wolinsky E. Mycobacterial lymphadenitis in children: a prospective study of 105 nontuberculous cases with long-term follow-up. Clin Infect Dis 1995;20(4):954–63.
[10] Wear DJ, Margileth AM, Hadfield TL, et al. Cat-Scratch disease: a bacterial infection. Science 1983;21(4618):1403–5.
[11] Scott GB, Hutto C, Makuch RW, et al. Survival in children with perinatally acquired human immunodeficiency virus type 1 infection. N Engl J Med 1989;321(26):1791–6.
[12] Centers for Disease Control and Prevention. 1993 Revised classification system for HIV infection and expanded surveillance case definition for AIDS among adolescents and adults. MMWR Morb Mortal Wkly Rep 1992;41(RR-17):1–19.
[13] Edlich RF, Arnette JA, Williams FM. Global epidemic of human T-cell lymphotropic virus type-1 (HTLV-1). J Emerg Med 2000;18(1):109–19.
[14] Dajani AS, Garcia RE, Wolinsky E. Etiology of cervical lymphadenitis in children. N Engl J Med 1963;268(24):1329–33.
[15] Yamauchi T, Ferrieri P, Anthony BF. The aetiology of acute cervical adenitis in children: serological and bacteriological studies. J Med Microbiol 1980;13(1):37–43.
[16] Bass JW, Vincent JM, Person DA. The expanding spectrum of Bartonella infection. II. Cat-scratch disease. Pediatr Infect Dis J 1997;16(2):163–79.
[17] Arisoy ES, Correa AG, Wagner ML, et al. Hepatosplenic cat-scratch disease in children: selected clinical features and treatment. Clin Infect Dis 1999;28(4):778–84.
[18] Papakonstantinou O, Bakantaki A, Paspalaki P, et al. High-resolution and color Doppler ultrasonography of cervical lymphadenopathy in children. Acta Radiol 2001;42(5): 470–6.
[19] Bass JW, Freitas BC, Freitas AD, et al. Prospective randomized double blind placebo-controlled evaluation of azithromycin for treatment of cat-scratch disease. Pediatr Infect Dis J 1998;17(6):447–52.
[20] American Thoracic Society. Diagnosis and treatment of disease caused by nontuberculosis mycobacteria. Am J Respir Crit Care Med 1997;156(2 Pt 2):S1–25.
[21] Petersdorf RG, Forsyth BR, Bernanke D. Staphylococcal parotitis. N Engl J Med 1958; 259(26):1250–4.
[22] Krippaehne WW, Hunt TK, Dunphy JE. Acute suppurative parotitis: a study of 161 cases. Ann Surg 1962;156(2):251–7.
[23] Leake DL, Krakowiak FJ, Leake RC. Suppurative parotitis in children. Oral Surg Oral Med Oral Pathol 1971;31(2):174–9.
[24] Brook I, Frazier EH, Thompson DH. Aerobic and anaerobic microbiology of acute suppurative parotitis. Laryngoscope 1991;101:170–2.
[25] Giglio MS, Landaeta M, Pinto ME. Microbiology of recurrent parotitis. Pediatr Infect Dis J 1997;16(4):386–90.
[26] O'Connell JE, George MK, Speculand B, et al. Mycobacterial infection of the parotid gland: an unusual case of parotid swelling. J Laryngol Otol 1993;107(6):561–4.

[27] Hensher R, Bowerman J. Actinomycosis of the parotid gland. Br J Oral Maxillofac Surg 1995;23(2):128–34.
[28] Cherry JD, Jahn CL. Exanthem and enanthem associated with mumps virus infection. Arch Environ Health 1966;12(4):518–21.
[29] Clark JR, Campbell JR. Parotitis. In: Feigin RD, Cherry JD, Demmler GJ, Kaplan SL, editors. Textbook of pediatric infectious diseases, 5th edition. Philadelphia: Saunders; 2004. p. 197–201.
[30] Ericson S, Zetterlund B, Ohman J. Recurrent parotitis and sialectasis in childhood: clinical, radiologic, immunologic, bacteriologic, and histologic study. Ann Otol Rhinol Laryngol 1991;100(7):527–35.
[31] Sperling NM, Lin P. Parotid disease associated with human immunodeficiency virus infection. Ear Nose Throat J 1990;69(7):475–7.
[32] Varghese JC, Thornton F, Lucey BC, et al. A prospective comparative study of MR sialography and conventional sialography of salivary disease. AJR Am J Roentgenol 1999;173(6): 1497–503.
[33] Brook I. Diagnosis and management of parotitis. Arch Otolaryngol Head Neck Surg 1992; 118(5):469–71.
[34] Centers for Disease Control and Prevention. Update: multistate outbreak of mumps—United States, Jan 1–May 2, 2006. MMWR Morb Mortal Wkly Rep 2006;55(20): 559–63.
[35] Henderson J. Abscess of the thyroid. A discussion and report of four cases. Am J Surg 1935; 29:36–41.
[36] Hendrick JW. Diagnosis and management of thyroiditis. JAMA 1957;164:127–33.
[37] Robertson WS. Acute inflammation of the thyroid gland. Lancet 1911;1:930–1.
[38] Farwell AP. Infectious thyroiditis. In: Braverman LE, Utiger RD, editors. Werner & Ingbar's the thyroids: a fundamental and clinical text. 8th edition. Philadelphia: Lippincott Williams and Wilkins; 2000. p. 1044–50.
[39] Pearce EN, Farwell AP, Braverman LE. Thyroiditis. N Engl J Med 2003;348(26):2646–55.
[40] Chi H, Lee YJ, Chiu NC, et al. Acute suppurative thyroiditis in children. Pediatr Infect Dis J 2002;21(5):384–7.
[41] Pereira KD, Davies JN. Piriform sinus tracts in children. Arch Otolaryngol Head Neck Surg 2006;132(10):1119–21.
[42] Berger SA, Zonszein J, Villamena P, et al. Infectious diseases of thyroid gland. Rev Infect Dis 1983;5(1):108–22.
[43] Yu EH, Ko WC, Chuang YC, et al. Suppurative Acinetobacter baumanii thyroiditis with bacteremic pneumonia: case report and review. Clin Infect Dis 1998;27(5):1286–90.
[44] Jacobs A, Gros DA, Gradon JD. Thyroid abscess due to Acinetobacter calcoaceticus: case report and review of the causes of and current management strategies for thyroid abscesses. South Med J 2003;96(3):300–7.
[45] Volpe R. The management of subacute (de Quervain's) thyroiditis. Thyroid 1993;5:253–5.
[46] Parmar RC, Bavdekar SB, Sahu DR, et al. Thyroiditis as a presenting feature of mumps. Pediatr Infect Dis J 2001;20(6):637–8.
[47] Volta C, Carano N, Street ME, et al. Atypical subacute thyroiditis caused by Epstein-Barr virus infection a three year old girl. Thyroid 2005;15(10):1189–91.
[48] Goldani LZ, Zavascki AP, Maia AL. Fungal thyroiditis: an overview. Mycopathologia 2006;161(3):129–39.
[49] Szabo SM, Allan DB. Thyroiditis. Differentiation of acute suppurative and subacute. Case report and review of the literature. Clin Pediatr (Phila) 1989;28(4):171–4.
[50] Sniezek JC, Francis TB. Inflammatory thyroid disorders. Otolaryngol Clin North Am 2003; 36(1):55–71.
[51] Ahuja AT, Griffithes JF, Roebuck DJ, et al. The role of ultrasound and oesophagography in the management of acute suppurative thyroiditis in children associated with congenital pyriform fossa sinus. Clin Radiol 1998;53(3):209–11.

[52] Weber Al. CT and MR imaging evaluation of neck infections with clinical correlations. Radiol Clin North Am 2000;38(5):941–68.
[53] Stone ME. A new role for computed tomography in the diagnosis and treatment of pyriform sinus fistula. Am J Otolaryngol 2000;21(5):323–5.
[54] Cigliano B, Cipolletta L, Baltogliannis N, et al. Endoscopic fibrin sealing of congenital pyriform sinus fistula. Surg Endosc 2004;18(3):554–6.
[55] Ostlie DJ, Burjonrappa SC, Snyder CL, et al. Thyroglossal duct infections and surgical outcomes. J Pediatr Surg 2004;39(3):396–9.
[56] Koeller KK, Alamo L, Adair C, et al. Congenital cystic masses of the neck: radiologic-pathologic correlation. Radiographics 1999;19(1):121–46.
[57] Waldhausen JH. Branchial cleft and arch anomalies in children. Semin Pediatr Surg 2006; 15(2):64–9.
[58] Mandell DL. Head and neck anomalies related to the branchial apparatus. Otolaryngol Clin North Am 2000;33(60):1309–32.
[59] Brook I. Microbiology and management of infected neck cysts. J Oral Maxillofac Surg 2005; 63(3):392–5.
[60] Velez I, Mintz S. Cystic hygroma. N Y State Dent J 2006;72(5):51–2.
[61] Brousseau V, Solares C, Xu M, et al. Thyroglossal duct cyst: presentation and management in children versus adult. Int J Pediatr Otorhinolaryngol 2003;67(12):1285–90.
[62] Mohan P, Chokshi R, Moser R, et al. Thyroglossal duct cysts: a consideration in adults. Am Surg 2005;71(6):508–11.