Table 8. Continued

Etiologic Agents	Diagnostic Procedures	Optimum Specimens	Transport Issues
Balamuthia mandrillaris	Histology (trichrome stain)	Brain tissue	Closed container, RT, 2 h Formalin, indefinite
	Balamuthia antibody, IFA[e]	Serum	Clot tube, RT, 2 h
	Balamuthia IIF staining[e]	Brain tissue	Closed container, RT, 2 h
	NAAT[e]	Brain tissue	Closed container, RT, 2 h

Abbreviations: BCYE, buffered charcoal yeast extract; CSF, cerebrospinal fluid; ELISA, enzyme-linked immunosorbent assay; GMS, Gomori methenamine silver; IFA, indirect fluorescent antibody; IgG, immunoglobulin G; IgM, immunoglobulin M; IIF, indirect immunofluorescent antibody; NAAT, nucleic acid amplification test; PCR, polymerase chain reaction; RT, room temperature.

[a]A negative result does not rule out *M. tuberculosis*.

[b]Refer positive IgM to Toxoplasma Serology Laboratory in Palo Alto, CA, for confirmatory testing (http://www.pamf.org/serology/). The absence of IgM or IgG does not exclude *Toxoplasma* infection [48].

[c]Only 50% sensitivity if patient has solitary parenchymal lesion [49]; potential for false positive ELISA results due to cross-reactivity with Echinococcus.

[d]Diagnosis usually on the basis of clinical presentation, neuroimaging, and serology. Only occasionally are invasive procedures (brain biopsy) required.

[e]Available at the Centers for Disease Control and Prevention; for pre-mortem diagnosis contact CDC Emergency Operations Center (770) 488–7100 [50]. https://www.cdc.gov/laboratory/specimen-submission/index.html

Table 9. Laboratory Diagnosis of Central Nervous System Shunt Infections

Etiologic Agents	Diagnostic Procedures	Optimum Specimens	Transport Issues
Bacterial (one organism or mixed)			
Aerobes: *Staphylococcus, Streptococcus,* Enterobacterales, *Pseudomonas, Acinetobacter, Corynebacterium* spp. Anaerobes: *Cutibacterium acnes*	Gram stain Aerobic and anaerobic bacterial culture (hold 14 d for *C. acnes*)	CSF	Sterile, anaerobic container, RT, immediately
Mycobacterium spp. (rare)	AFB smear AFB culture	CSF (≥5 mL)	Sterile container, RT, 2 h
Fungal			
Candida spp., other fungi	Calcofluor stain Fungal culture	CSF	Sterile container, RT, 2 h

Abbreviations: AFB, acid fast bacillus; CSF, cerebrospinal fluid; RT, room temperature.

Infections caused by oropharyngeal microbiota include epiglottitis, mastoiditis, inflammation of salivary tissue and suppurative parotitis [51, 62]. Because the epiglottis may swell dramatically during epiglottitis, there is a chance of sudden occlusion of the trachea if the epiglottis is disturbed, such as by an attempt to collect a swab specimen. Blood cultures, including aerobic and anaerobic media, are the preferred sample for the diagnosis of epiglottitis, being positive in 70% of 40 confirmed cases that included Hib vaccinated and unvaccinated children, and positive in 27% of 79 Hib unvaccinated adults with epiglottis [63, 64]. If swabbing of the epiglottis is attempted, it should be in a setting with available appropriate emergency response [65]. Oropharyngeal microbiota also can extend into tissues of the middle ear and mastoid [51, 66]. Aspirated material, saline lavage of a closed space, and tissue or tissue scrapings are preferred specimens and must be transported in a sterile container. Small pieces of tissue must be kept moist during transport. This can be accomplished by adding a few drops of sterile, nonbacteriostatic, normal saline. Suppurative parotitis is sampled by expressing pus from the parotid gland followed by collection by aspiration. Swabbing is susceptible to contamination by adjacent bacterial microbiota, although swabbing for mumps virus NAAT testing is the preferred sample. In the rare instance where anaerobic bacterial pathogens are suspected (especially chronic middle ear, mastoid, or parotid infection), anaerobic transport is required.

Infections caused by exogenous pathogens (not part of the oral microbiota) include malignant otitis externa, otitis externa, animal bites, trauma, irradiation burns and complications of surgical procedures [66, 67]. Squamous epithelial microbiota and environmental pathogens are important etiologies of these infections; most frequently gram-negative bacilli, such as *Pseudomonas aeruginosa,* and staphylococci. Aerobic and anaerobic bacterial culture, and occasionally fungal and mycobacterial culture, are needed to determine the specific etiology. Gram, fungal, and mycobacterial stains should be ordered with corresponding cultures.

Key points for the laboratory diagnosis of head and neck soft tissue infections:

- A swab is not the specimen of choice for these infections because of the small volumes collected and ease of contamination with heavily colonized surfaces. Submit tissue, fluid, or aspirate when possible. This may require surgery with or without imaging guidance.
- Resist swabbing in cases of epiglottitis.
- Use anaerobic transport containers if anaerobes are suspected. This includes most specimens.
- Keep tissue specimens moist during transport.

Tables 11 and 12 include the most common soft tissue and tissue space infections of the head and neck that originate from