Mastoiditis

What is mastoiditis?

The mastoid process is an inferior extension of the petrous temporal bone of the skull and provides a structural function as an anchor point for the large muscles of the neck. It contains multiple air cells that develop from a single main cavity (the antrum), after the age of about 2 years. In cross-section, it has a vacuolated or honeycomb appearance.

The tympanic cavity of the middle ear is in communication with the mastoid antrum via a small canal that runs through the petrous temporal bone. The mastoid air cells are related superiorly to the middle cranial fossa and posteriorly to the posterior cranial fossa. This means that suppuration in the mastoid may, rarely, spread to cause meningitis or a cerebral abscess. Other surrounding structures include the facial nerve canal, the sigmoid sinus and the lateral sinus.

Mastoiditis occurs when suppurative infection extends from a middle ear affected by otitis media to the mastoid air cells. The infective process causes inflammation of the mastoid and surrounding tissues and may lead to bony destruction.

Classification of mastoiditis

- Classic, or acute, mastoiditis is a rare complication of acute otitis media (AOM).
- Acute mastoiditis is defined as an acute inflammation of the mastoid with colliquation of the air-filled mastoidal bone[1] .
- Chronic, latent, or masked, mastoiditis presents in a chronic, or subclinical, fashion. It is usually associated with chronic suppurative otitis media or cholesteatoma.

Spectrum of otitis media[2]

Otitis media (OM) is an umbrella term for a group of complex infective and inflammatory conditions affecting the middle ear. All OM involves pathology of the middle ear and middle ear mucosa. OM is a leading cause of healthcare visits worldwide and its complications are important causes of preventable hearing loss, particularly in the developing world[3] .

There are various subtypes of OM. These include AOM, otitis media with effusion (OME), chronic suppurative otitis media (CSOM), mastoiditis and cholesteatoma. They are generally described as discrete diseases but in reality there is a great degree of overlap between the different types. OM can be seen as a continuum/spectrum of diseases.

- AOM is acute inflammation of the middle ear and may be caused by bacteria or viruses. A subtype of AOM is acute suppurative OM, characterised by the presence of pus in the middle ear. In around 5% the eardrum perforates.
- OME is a chronic inflammatory condition without acute inflammation, which often follows a slowly resolving AOM. There is an effusion of glue-like fluid behind an intact tympanic membrane in the absence of signs and symptoms of acute inflammation.
- CSOM is long-standing suppurative middle ear inflammation, usually with a persistently perforated tympanic membrane.
- Mastoiditis is acute inflammation of the mastoid periosteum and air cells occurring when AOM infection spreads out from the middle ear.
- Cholesteatoma occurs when keratinising squamous epithelium (skin) is present in the middle ear as a result of tympanic membrane retraction.

Who gets mastoiditis? (Epidemiology)

- Mastoiditis in acute or chronic form is now quite rare.
- The incidence in developed countries is 1.2-6.1 per 100,000[4] .
- There is a rising incidence, however, which is connected to restrained antibiotic therapy of AOM, inadequate dosing, choice of antibiotics and increasing resistance of bacteria[1] .

- As serious complications are rare, guidance is that the routine use of antibiotics in AOM is not thought to be justified by the potential reduction in risk of these complications. See the separate article Acute Otitis Media in Children.

Risk factors for mastoiditis

- Mastoiditis is more common in young children, with peak incidence at age 6-13 months.
- Patients with immunocompromise may be more prone to mastoiditis.
- Children or adults with intellectual impairment or communication difficulties are thought to be susceptible to the condition, possibly as a result of not being able to communicate their symptoms.
- Pre-existence of cholesteatoma is a risk factor for subsequent mastoiditis.

Infecting organisms[1]

- *Streptococcus pneumoniae* (most frequently isolated).
- *Streptococcus pyogenes*.
- *Staphylococcus* spp.
- *Haemophilus influenzae* (this is quite rare).
- *Pseudomonas aeruginosa* (becoming increasingly common).
- *Moraxella catarrhalis*.
- Other Gram-negative organisms (occur more frequently in chronic form).
- Mycobacteria (rare).
- Aspergillus and other fungi (rare).

Mastoiditis symptoms

Early diagnosis and prompt treatment are important to reduce the risk of complications[5] .

Acute (classic) mastoiditis

- History of acute or recurrent episodes of otitis media.
- Intense otalgia and pain behind the ear.
- Fever.
- Infants may present with irritability, intractable crying and feeding problems.
- Swelling, redness or a boggy, tender mass behind the ear.
- The external ear may protrude forwards; fluctuance can sometimes be demonstrated behind the ear (examine from behind).
- Ear discharge may be present and the eardrum may be perforated.
- Tympanic membrane bulges and is erythematous.
- The patient is unwell.

Chronic mastoiditis

- Presents in a subtle or subclinical fashion after an episode of AOM or with history of chronic suppurative otitis media.
- Recurrent bouts of otalgia and retro-aural pain.
- Recurrent headache.
- Episodes of fever.
- Infants may present with irritability, intractable crying and feeding problems.
- Tympanic membrane may appear infected or may be normal.
- May be no external evidence of peri-mastoid inflammation.

Other points on examination

- Examine for evidence of local neurological involvement. There may be an ipsilateral VIth or VIIth cranial nerve palsy, or pain over the distribution of the ophthalmic division of the Vth cranial nerve.

- The patient may complain of deafness and there may be signs of conductive deafness (Rinne's test negative; Weber's test - sound localised/loudest in the affected ear).

Differential diagnosis

- Otitis media or externa.
- Trauma to the ear/mastoid.
- Cervical lymph node enlargement.
- Meningitis.
- Cellulitis.
- Parotid swelling.
- Bone cysts or tumours.
- Basal skull fracture.
- Other source of intracranial or localised sepsis.
- Pyrexia of unknown origin.

Investigations[6]

- FBC may show leukocytosis.
- ESR and CRP may be elevated.
- Blood cultures should be taken.
- Fluid can be extracted from the middle ear through perforated drums or by intervention (tympanocentesis) and should be sent for Gram staining, culture and acid-fast stain.
- Skull X-ray of the mastoid area is not usually helpful but may show clouding of mastoid air cells.
- CT and/or MRI scanning can be used to aid diagnosis and look for intracranial complications[7] .
- Lumbar puncture should be carried out if intracranial spread is suspected.

- Audiograms during and after mastoiditis help to quantify and monitor any associated hearing loss.

Mastoiditis treatment and management

- Patients with suspected mastoiditis should usually be managed in a hospital setting [8] .
- Appropriate clinical suspicion and prompt diagnosis are important to reduce the likelihood of complications.
- The usual initial therapy is high-dose, broad-spectrum intravenous (IV) antibiotics, given for at least 1-2 days (eg, with a third-generation cephalosporin).
- Oral antibiotics are usually used after this, starting on IV treatment after 48 hours without fever and continuing for at least 1-2 weeks.
- Paracetamol, ibuprofen and other agents may be given as antipyretics and/or painkillers.
- Myringotomy ± tympanostomy tube insertion may be performed in some cases as a therapeutic procedure, or to collect middle ear fluid for culture.
- Immediate mastoidectomy is usually the method of choice to treat actue mastoiditis with subperiosteal abscess formation [1] .
- Surgical intervention, usually in the form of mastoidectomy ± tympanoplasty, is also usually suggested if there is:
    - Mastoid osteitis.
    - Intracranial extension.
    - Co-existing cholesteatoma.
    - Limited improvement after IV antibiotics.

- Mastoidectomy can be:
    - Simple: infected mastoid air cells are removed.
    - Radical: the tympanic membrane and most middle ear structures are removed and the Eustachian tube is closed.
    - Modified: the ossicles and part of the tympanic membrane are preserved.
- Incision and drainage of a subperiosteal abscess is another procedure that may be required.
- Patients with intracranial spread may also need neurosurgical intervention.
- In cases with unusual infecting organisms, specialist infectious disease input may be helpful.

Mastoiditis complications

Complications of mastoiditis have been signficantly reduced with the introduction of antibiotics. Many of the following complications are now very rare:

- Conductive and/or sensorineural hearing loss.
- Labyrinthitis.
- Osteomyelitis or bone erosion.
- Extension to the zygoma (zygomatic mastoiditis).
- Subperiosteal abscess (abscess between the periosteum and mastoid bone; gives appearance of a protruding ear).
- Cranial nerve palsies (especially V, VI and VII).
- Intracranial spread leading to extradural abscess, cerebral abscess, subdural empyema and meningitis.
- Intracranial venous sinus thrombosis (eg, lateral sinus thrombosis).
- Petrositis causing Gradenigo's syndrome (VIth cranial nerve palsy + deep trigeminal facial pain + suppurative otitis media) [9] .

- Carotid artery spasm, arteritis, occlusion, rupture or metastatic septic emboli leading to intracerebral infection (all very rare and associated with the most severe cases).

Prognosis

- The prognosis for the vast majority of cases that are diagnosed early is excellent with a low chance of complications or severe hearing loss.
- Most cases who have had an episode of acute mastoiditis have no long-term otological sequelae[10] .
- Complicated cases may, however, still lead to significant morbidity or even to death.

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