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RESEARCH ARTICLE

Role of CT in diagnosis of complications of cholesteatoma

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Abstract

Middle ear cholesteatoma is a relatively common disease that can lead to serious consequences. High resolution computed tomography (HRCT) of temporal bone plays crucial role in diagnosis of cholesteatoma, assessing the disease extent and its various complications. In this article, we discuss some of the major complications of cholesteatoma diagnosed on computed tomography (CT) which requires early surgical management.

Introduction:-

Cholesteatomas consists of keratinized squamous epithelium which is trapped within the temporal bone (either in the middle ear or mastoid). It grows and destroys the important structures within the temporal bone. Mechanism of bone destruction by cholesteatoma is by pressure of matrix of cholesteatoma and by enzymatic bone resorption.[1]

Classification of cholesteatoma :-

Cholesteatomas can be either **congenital** or **acquired**.[2,3,4]

Congenital cholesteatomas usually occur in children with intact tympanic membrane who don't have history of otitis media. They arise from embryonic epithelial remains in 2% of cases.[4]

Acquired cholesteatomas are more commonly found and constitute approximately 98% of cases.[4]They are main complication of chronic otitis media with ingrowth of keratinized squamous epithelium from external auditory canal to middle ear through the tympanic membrane. They occur most commonly in the **pars flaccida** portion (82%) and less likely in **pars tensa** (18%).[2]

Hallmark of cholesteatoma is soft tissue mass like opacity in middle ear and mastoid antrum with associated smooth bony erosion of ossicles and expansion of adjacent structures.[5]

Cholesteatomas arising in **pars flaccida** portion extends towards the Prussak's space. Ossicles in epitympanum (head of malleus and body of incus)are displaced medially. From Prussak's space, mass extends into the antrum and mastoid air cells through aditus ad antrum.[6]

Pars tensa cholesteatoma usually occurs in setting of perforated tympanic membrane. The mass then extends towards sinus tympani and facial recess of mesotympanum.[6]

Diagnosis :-

ENT surgeon is able to suspect cholesteatoma clinically in most of the cases. Aim of imaging is to assess the extent of disease and its various complications. High resolution temporal bone (HRCT) is the most valuable for detection of cholesteatoma and its various complications including extra-temporal complications.[7]I/v contrast is required for demonstration of intra-cranial and extra-cranial abscesses. At our institution, HRCT helical scanning is performed onIngenuity CT (128 slice, Philips Medical Systems) with contiguous 1mm thick axial and reformatted coronal sections.I/v contrast is given in cases of extra-temporal complications of cholesteatoma.

MRI can be required to demonstrate various intra-cranial complications of cholesteatoma and especially in post-operative follow up of patients to evaluate residual or recurrent disease.

Imaging features of pars flaccida cholesteatoma:-

Soft tissue mass is seen in Prussak's space with displacement of ossiclesmedially [Figure 1]. There is erosion of scutum. Posterior extension into mastoid antrum is seen via aditus ad antrum with loss of figure of "8" appearance.[7]

Imaging features of pars tensacholesteatoma:-

Soft tissue mass is seen medial to ossicles with lateral displacement of ossicles. Extension of mass into the sinus tympani and facial recess of mesotympanum is seen.[7]

Advanced lesions :-

Extensive cholesteatomas are difficult to categorize but HRCT can demonstrate the extent of lesion and associated complications which are valuable for surgical planning.[7]

Complications::-

Major complications of cholesteatoma are either due to direct involvement of important adjacent structures or due to secondary infection.

We present some of the major complications of cholesteatoma that require early surgical management.

Ossicular chain erosion/destruction:-

It occurs in 75% of pars flaccida and in upto90% of pars tensa cholesteatoma [Figure 2a and 2b]. Incus is the most commonly affected bone.[1,8]

Facial nerve canal dehiscence:-

Facial nerve canal can be eroded, however function of nerve can be spared. Most common site of facial nerve compression is tympanic segment of facial nerve [Figure 3]. Facial palsy occurs in 1-4% of patients with cholesteatoma.[9] Facial palsy is more common in patients with associated labyrinthine fistula. Early surgical approach is necessary in these cases to improve the nerve function more adequately.[10]

Lateral sinus thrombosis with thrombophlebitis:-

Lateral sinus thrombosis is a rare but danger complication of cholesteatoma in today's modern era of antibiotics. It can still be seen in poor socio-economic groups. Proximity of middle ear and mastoid air cells to dural venous sinuses predisposes them to thrombosis and thrombophlebitis secondary to infection and inflammation in middle ear and mastoid.[11]

There is usually erosion of the dural sinus plate which forms the posterior wall of mastoid. Bony plate erosion initially causes perisinus abscess [Figure 4a and 4b]. Due to pressure effect of the perisinus abscess over the sinus wall, there is ultimately necrosis of the sinus wall with formation of mural thrombus.[12]Mural thrombus may get infected. It may propagate upwards upto the confluence of sinuses and even into superior sagittal sinus. Invasion of petrosal sinuses can cause spread of infection to cavernous sinus. Inferiorly thrombus may propagate into the internal jugular vein and extend along it into the neck[Figure 5a and 5b]. Abscess may form along the internal jugular vein and it may extend into the carotid space.[13]

CT examination with i/v contrast demonstrates the classic empty delta sign due to non-filling of thrombosed sinus and enhancement of sinus wall and perisinus collaterals.[11]Extension of thrombus into other sinuses can also be demonstrated.

Surgical treatment usually includes mastoid exploration with clearance of perisinus abscess and exposure of sinus. Sinus is incised and thrombus is removed as much as possible. Oral and i/v antibiotics are given.

Otogenic neck abscess(Bezold's abscess):-
Cholesteatoma may be complicated with superadded mastoiditis. Bezold abscess is rare complication of cholesteatoma with superimposed mastoiditis. There is erosion of mastoid tip and lateral wall of mastoid with extension of infection into the adjacent soft tissue of neck [Figure 6a and 6b]. It extends into the posterior cervical and perivertebral spaces. It usually extends into the infratemporal fossa. If left untreated, abscess may spread into the carotid, prevertebral and retropharyngeal spaces and as far as mediastinum with poor prognosis.[14,15]

Bezold's abscesses are more common in adults than in children. Pneumatisation of mastoid process leads to thinning of bone and is an important predisposing factor in genesis of bezold's abscess.[14]

CT scan with i/v contrast demonstrates the irregular peripherally enhancing abscesses in the neck with their extension into the various compartments of neck andalso associated erosions of mastoid wall.

Treatment usually includes radical mastoidectomy and drainage of neck abscesses with combination of oral and i/v antibiotics.

Labyrinthine fistula :-
It is the abnormal opening in the bony capsule of inner ear with leakage of perilymph from semicircular canals into the middle ear. It may occur as complication of middle ear cholesteatoma. Due to close proximity to medial wall of attic, lateral semicircular canal is most frequently eroded.[5] HRCT shows dehiscence of the wall of lateral semicircular canal [Figure 7]. Dehiscence of cochlear promontory or fistula of oval window are uncommon locations for labyrinthine fistula.

Labyrinthitisossificans:-
Labyrinthitis is inflammation of membranous labyrinth. Ossification of membranous labyrinth usually occurs as a sequelae to previous infection. Tympanic labyrinthitis usually occur via spread of infection from middle ear to labyrinth via oval or round window or via labyrinthine fistula.[16]Labyrinthitis inflammation leads to fibroblast proliferation within the labyrinth.[17]The most common site to undergo fibrosis and new bone formation is basal turn of cochlea near round window niche [Figure 8].Vestibule and semicircular canals can be involved.

HRCT can demonstrate dense sclerosis, irregularity or obliteration of cochlea, semicircular canal or vestibule due to new bone formation.[17]

Labyrinthitisossificans results in profound hearing loss and also due to ossification process can prevent cochlear implant.

Automastoidectomy:-
It occurs due to destruction of the mastoid bone forming the postero-superior wall of external auditory canal by the adjacent cholesteatoma in patients who have no history of previous infection [Figure 9a and 9b]. It is due to extensive destruction of middle ear cavity and mastoid by cholesteatoma. Cholesteatoma drains externally spontaneously causing appearance of post-mastoidectomy state.[18]

Superimposed fungal infection:-
Superadded fungal infection is a very rare complication of cholesteatoma. Probable route of entry to middle ear is either from nasopharynx through Eustachian tube or through perforated tympanic membrane. CT findings are non-specific and similar to cholesteatoma. Hyperdensity seen within the soft tissue mass favours superadded fungal infection [Figure 10a and 10b]. Most common fungus to invade the middle ear is mucormycosis. Treatment usually involves radical debridement in form of radical mastoidectmy with or without use of Amphotericin B.[19]

Intracranial complications:-
It usually occurs due to erosion/destruction of tegmen with dural involvement that primarily starts as meningitis [Figure 11]. Spread of infection into brain can also occur via dural venous sinuses most commonly lateral sinus

thrombophlebitis. Labyrinthitis can cause meningitis through internal auditory canal and through vestibular or cochlear aqueducts. Late intra-axial complications include intracranial infections with formation of brain abscess.

Post-contrast CT scan can reveal focal enhancement of meninges in case of meningitis. Brain abscess can be seen as an irregular hypodense collection with thick enhancing capsule and perifocal edema in the adjacent brain tissue. Otogenic brain abscess usually develops either in temporal lobe or cerebellum of the same side as infected ear [Figure 12]. There could be formation of epidural or subdural abscess seen as extra-axial collections with enhancing membrane. Otitic hydrocephalus and intracranial extension of cholesteatoma are some of the rare intracranial complications.[20,21]

Aggressive surgical therapy is mandatory.

Legends:-

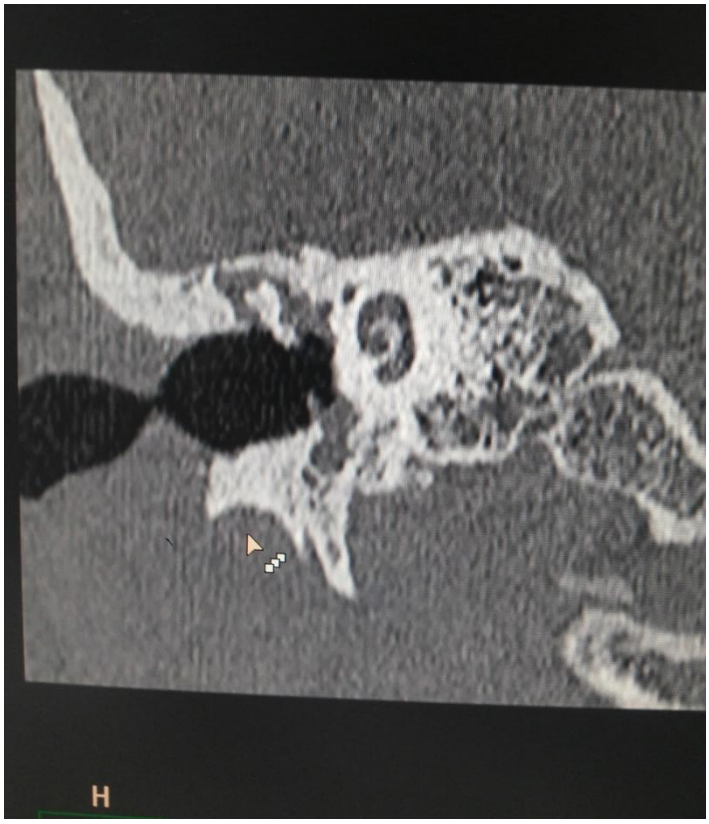

Figure 1. HRCT temporal bone (coronal section) shows soft tissue mass in epitympanum involving Prussak's space with associated subtle erosion of ossicles and blunting of scutum. Ossicles are displaced medially.

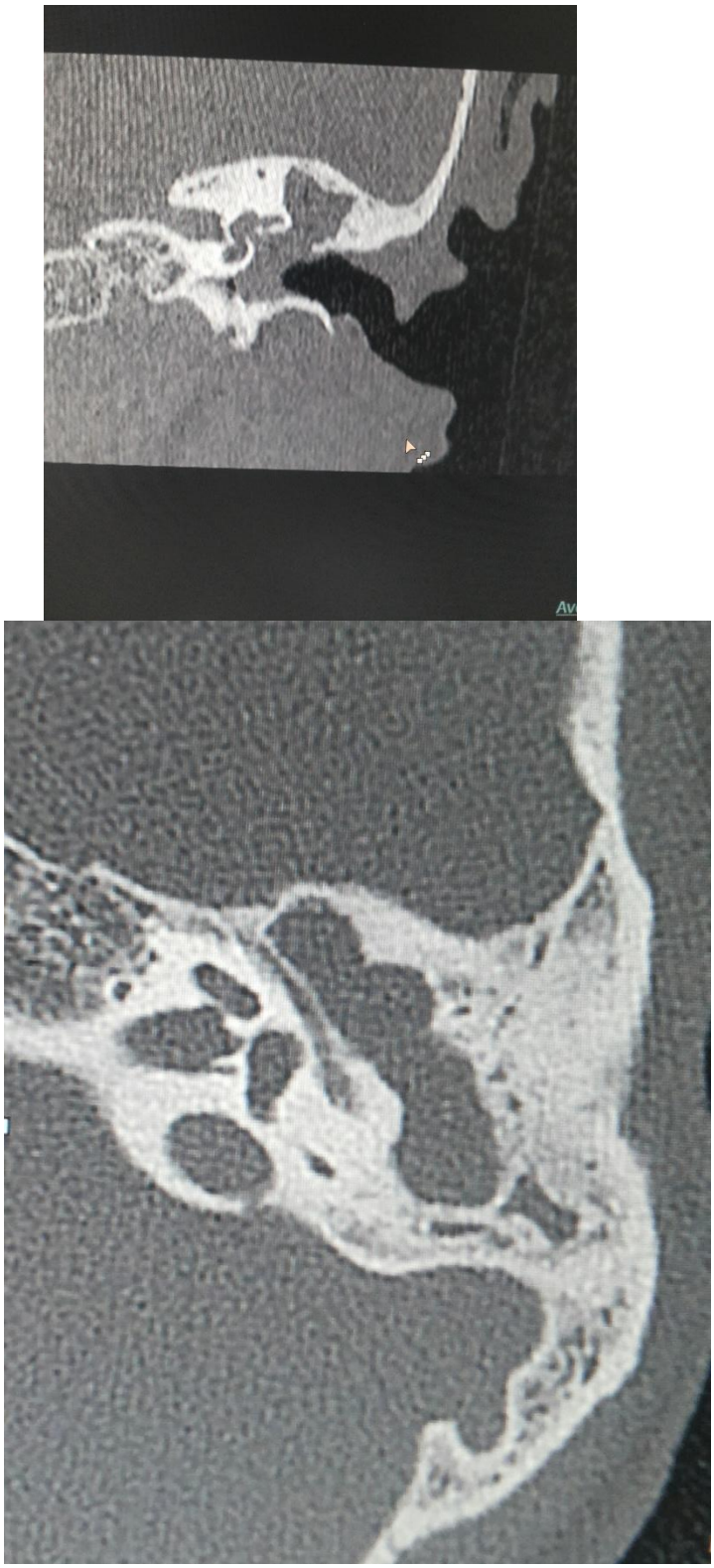

Figure 2a and 2b. Coronal and axial images show soft tissue mass in middle ear cavity with complete destruction of ossicles.

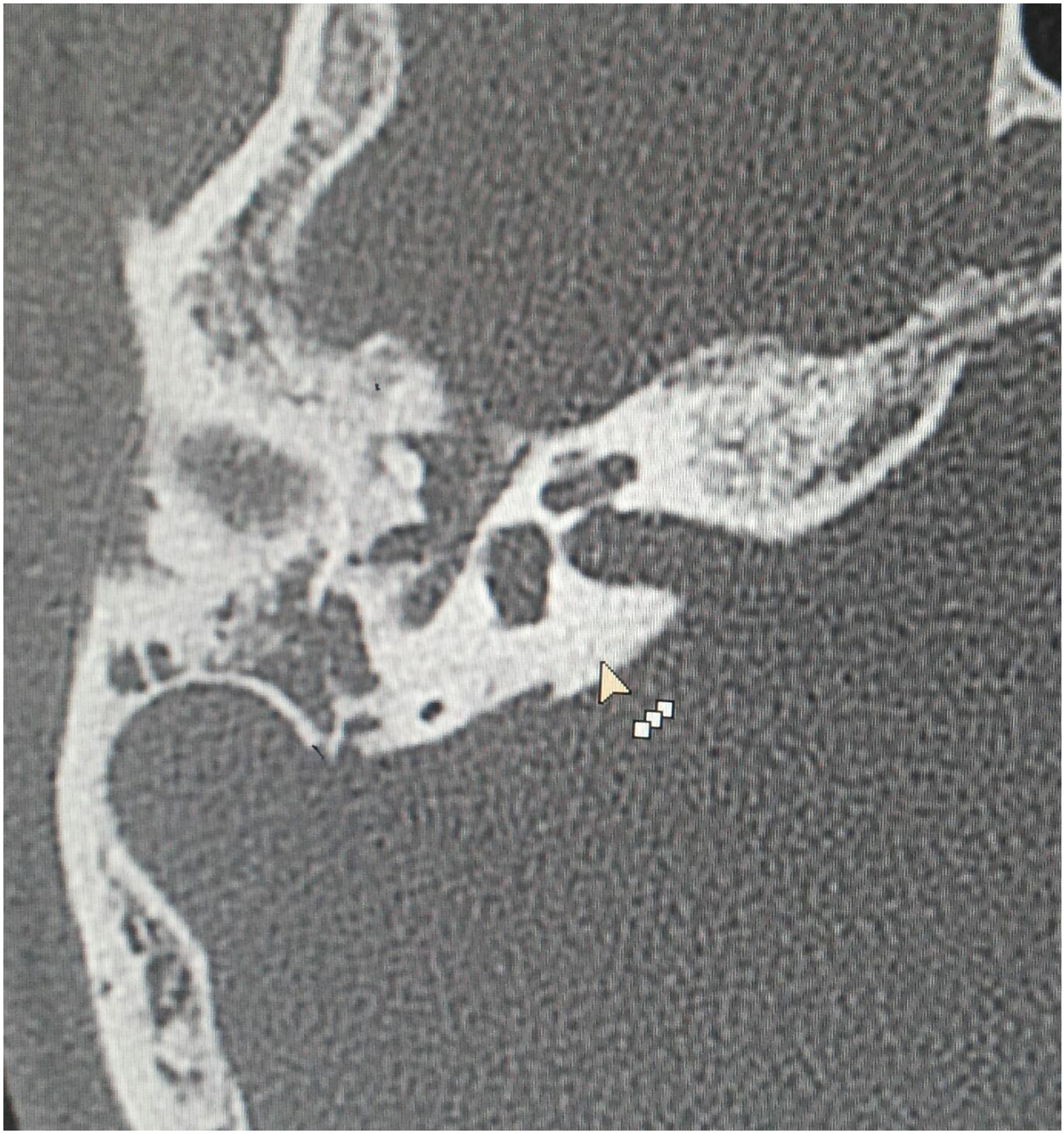

Figure 3. Axial sections shows dehiscence of the lateral wall of tympanic segment of facial nerve canal.

Figure 4a and 4b. HRCT and CECT shows destruction of the dural sinus plate of sigmoid sinus and perisinus abscess

Figure 5a and 5b. CECT in coronal and sagittal sections show lateral sinus thrombosis extending into the internal jugular vein. IJV is distended and non-enhancing with few air foci seen within s/o infected thrombosis.

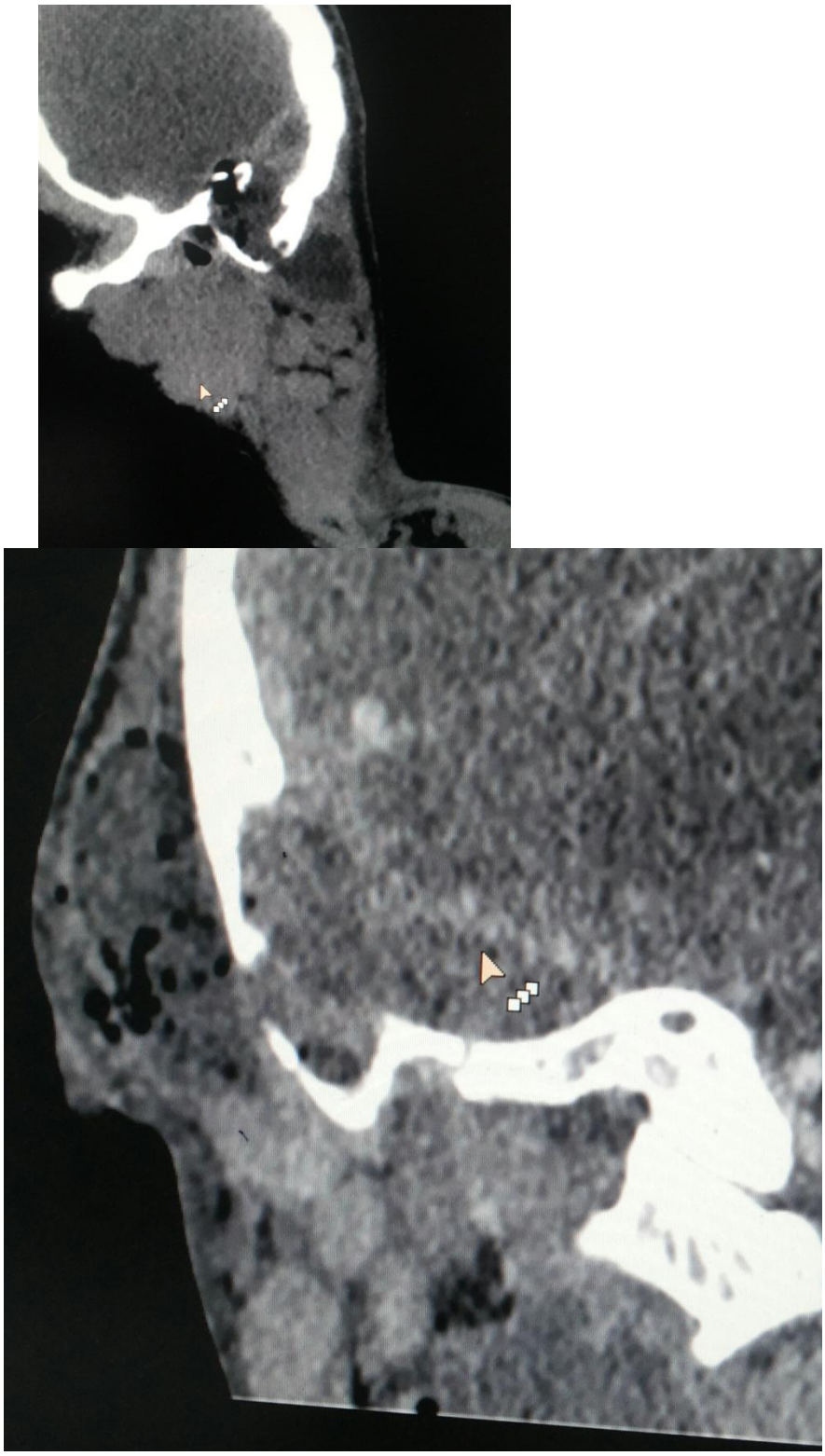

Figure 6a and 6b. CECT (sagittaland coronal images) show erosion of mastoid tip and lateral wall of mastoid antrum with abscesses in the adjacent soft tissue of neck.

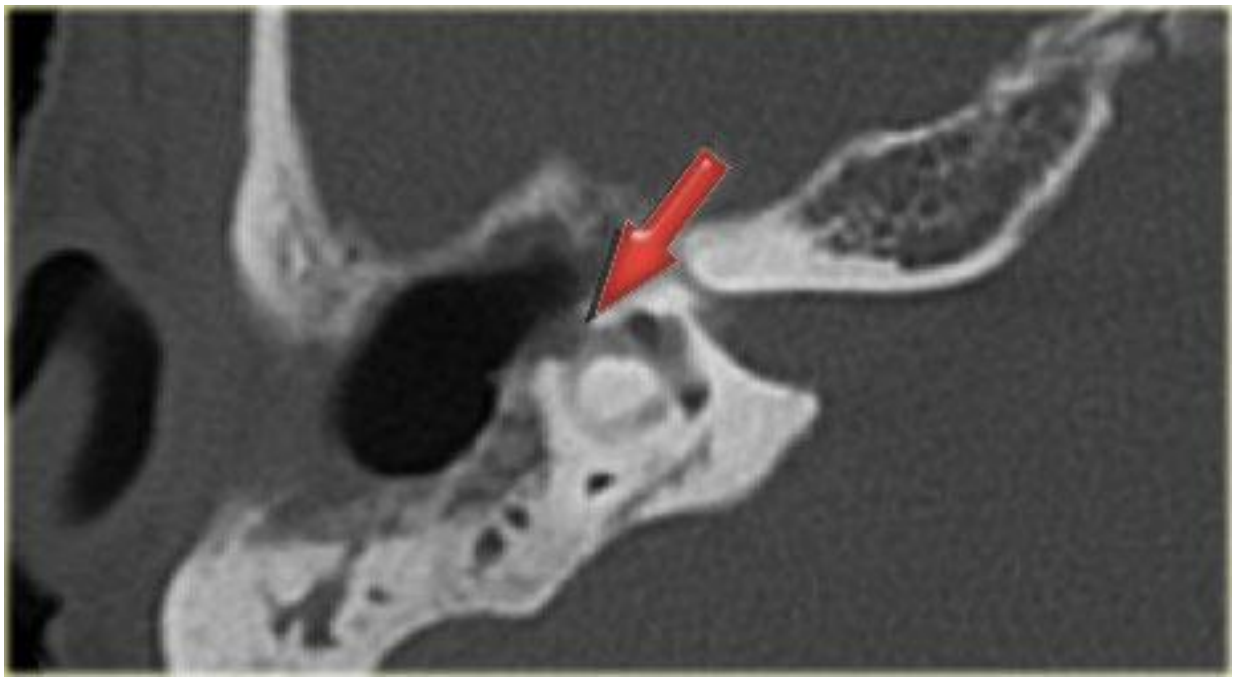

Figure 7. Axial HRCT shows erosion of the wall of lateral semicircular canal by middle ear cholesteatoma s/o fistula.

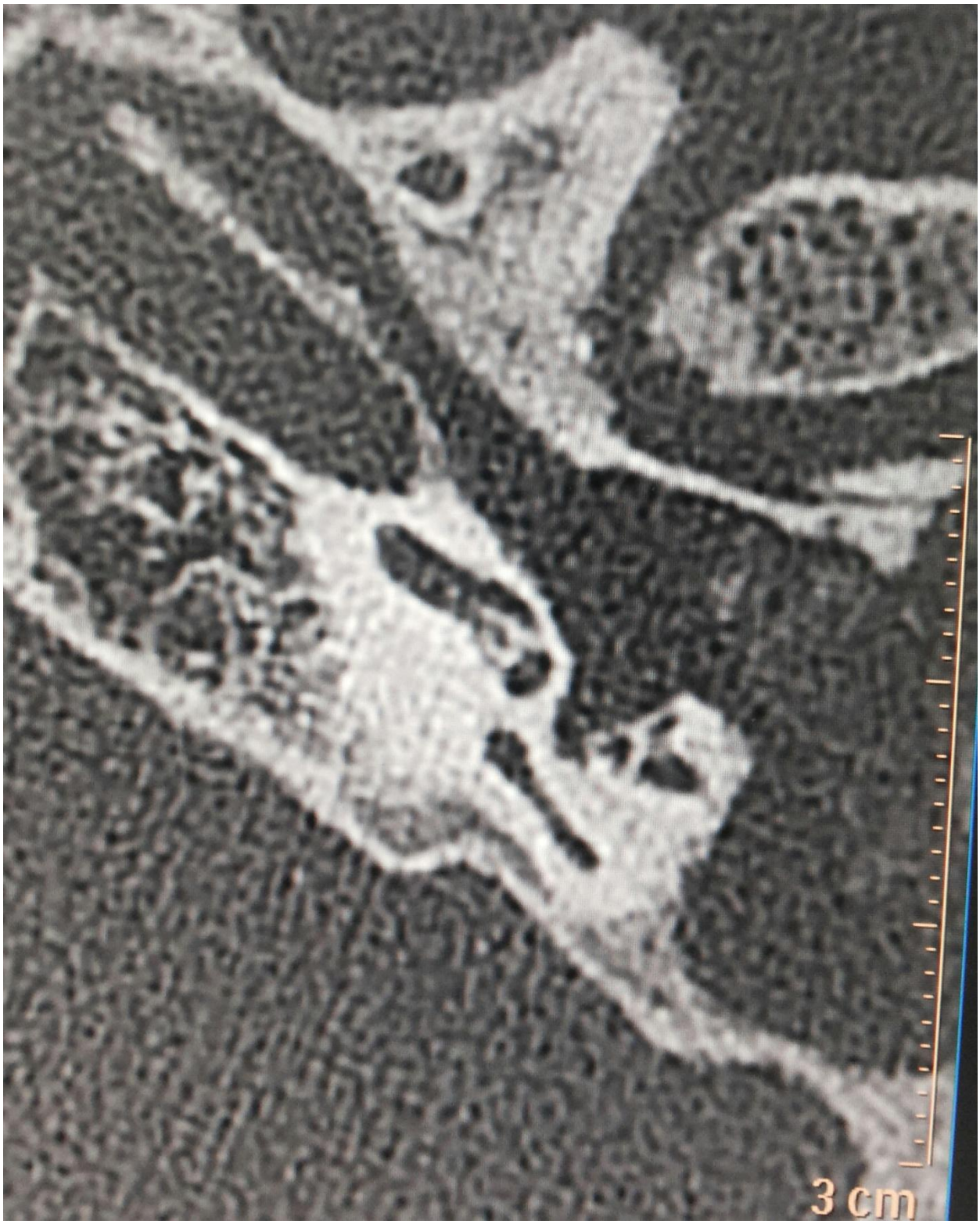

Figure 8. Axial HRCT shows ossification of the basal turn of cochlea.

Figure 9a and 9b. Axial and coronal HRCT shows destruction of the postero-superior wall of external auditory canal by adjacent cholesteatoma.

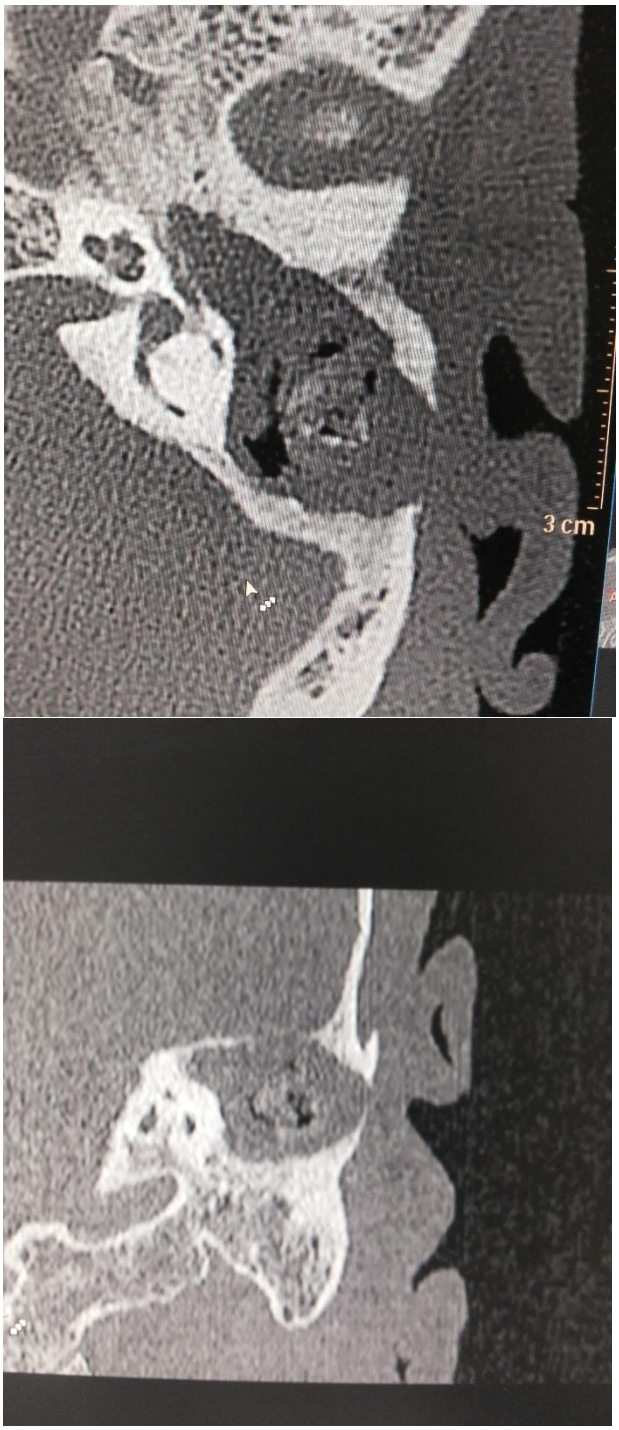

Figure 10a and 10b. Axial and coronal sections show hyperdensity within the cholesteatoma s/o superimposed fungal infection

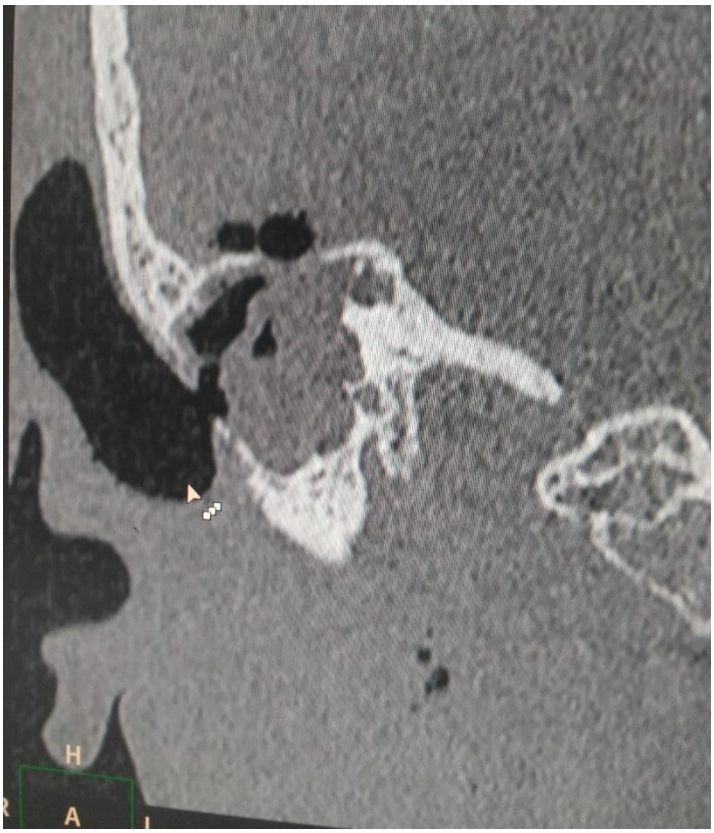

Figure 11. Coronal HRCT shows tegmental erosion with likely intracranial complications.

Figure 12. Axial CECT of brain shows peripherally enhancing thick walled abscess in left cerebellum with associated sigmoid sinus thrombosis and mastoid cholesteatoma.

Conclusion:-

Various extra-temporal complications of cholesteatoma including extra-cranial and intra-cranial complications are rare in today's antibiotic era. CT is the modality of choice in the diagnosis of cholesteatoma and its various complications. It enables physicians to institute prompt therapy and prevent life threating consequences. Therefore CT temporal bone should be performed as early as possible in patients suspected of cholesteatoma. This imaging approach can help in planning effective surgical treatment.

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