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Case report

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# The surgical challenge of high-riding jugular bulb in otologic surgery: a case-based experience for otologic surgeons

**Abstract**

A high-riding jugular bulb (HRJB) is a vascular anatomical variant wherein the dome of the jugular bulb extends superiorly into the middle ear cavity or toward the internal auditory canal. This is mostly asymptomatic, but it can pose significant surgical challenges when encountered unexpectedly during middle ear surgeries. Here, we report 2 cases: one with COM who underwent tympanoplasty, wherein bilateral high-riding jugular bulbs were noted (diagnosed intraoperatively in the to-be-operated ear), and the second where there was huge intraoperative bleeding due to a dehiscent jugular bulb. This article highlights the importance of thorough preoperative radiological assessment and intraoperative vigilance, especially in resource-limited settings where high-resolution imaging may not always be feasible.

**Keywords:** high-riding jugular bulb (HRJB), tympanoplasty, computed tomography, Hemorrhage, chronic otitis media (COM), modified radical mastoidectomy (MRM)

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## Introduction

The jugular bulb is a venous dilation of the internal jugular vein located in the jugular fossa of the temporal bone. Anatomical variations of the jugular bulb are not uncommon and can manifest as high-riding jugular bulbs (HRJB), dehiscent jugular bulbs (DJB), or jugular bulb diverticula. While HRJB may be asymptomatic and discovered incidentally on imaging, DJB may present with auditory symptoms including pulsatile tinnitus, conductive hearing loss, or vertigo depending on its relation to the middle and inner ear structures.[1,2] Even HRJB in some cases may pose a considerable risk during middle ear surgeries such as tympanoplasty, mastoidectomy, etc., as it may cause a potential life-threatening hemorrhage.[3]

This article presentstwo case reports: one with a unique finding of bilateral HRJB in a patient undergoing tympanoplasty and the other of a dehiscent high-riding jugular bulb (?? jugular diverticulum); thus emphasizing the need for accurate radiologic evaluation even in patients without symptoms.

## Case Report

### Case 1:

A 16-year-old female presented to the ENT department with complaints of bilateral on-and-off ear discharge and decreased hearing for the past 10 months. On clinical examination, she had large central perforationsbilaterally and was diagnosed with bilateral COM-mucosal type. On the right side, the otoendoscopic examination revealed a bluish hue in the hypotympanum reaching up to the round windowsuggesting a probable high-riding jugular bulb (Figure 1c & 1d). Otoendoscopy of the left ear revealed a large perforation. Nasal examination revealed pale mucosa and hypertrophy of the inferior turbinates.

Throat examination was unremarkable.Audiological evaluation showed bilateral moderate conductive hearing loss, with air conduction thresholds of 51.6 dB (right) and 56.6 dB (left), and bone conduction thresholds of 13.3 dB and 15 dB, respectively. The X-ray Schuller view showed a sclerosed mastoid, but the dural plate and sigmoid plate appeared normal (Figure 1e & 1f). HRCT Temporal Bone could not be done due to the financial constraints of the patient.

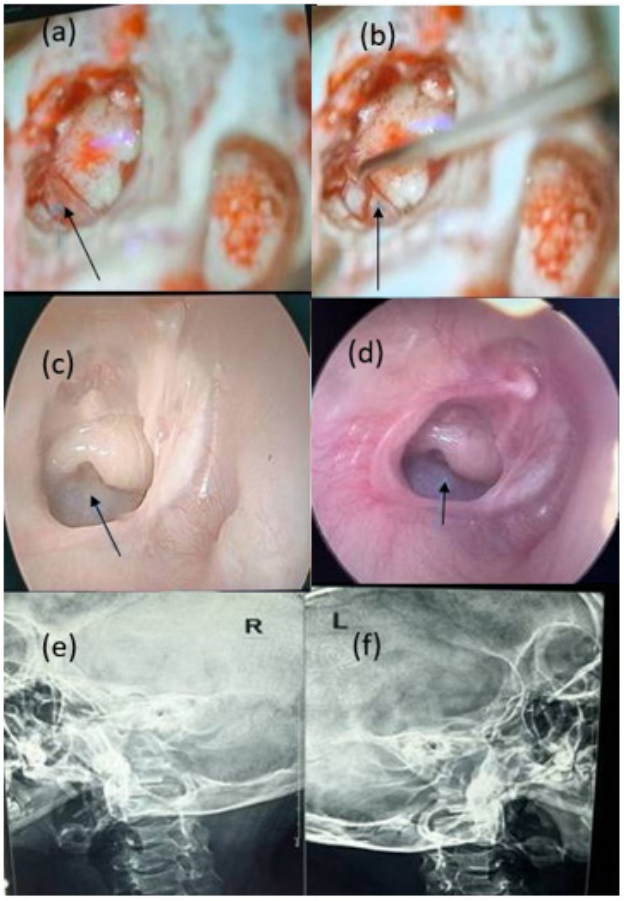


**Figure 1**

a) & b) Intraoperative photograph of the left ear showing non-dehiscent high–riding jugular bulb marked with black arrows

c) & d) Otoendoscopic photograph of the right ear showing a bluish dome of high jugular bulb visible through the tympanic membrane(black arrow)

e) & f) X-ray Schuller view showing sclerosed mastoid on both sides. Note that X-ray reveals normal dural and sigmoid plates

The patient was taken up for surgeryfor the left ear first (as the patient so requested and also due to more hearing loss).First, a cortical mastoidectomy was done and then the middle ear work was started after tympanomeatal flap elevation. The operative findings revealed ahigh-riding jugular bulb (Figure1a &1b). The long process and lenticular process of the incus were found necrosed. The jugular bulb was high-riding but not dehiscent. A small piece of cartilage was put over the stapes head and a second thin cartilage plate was kept over it.The temporalis fascia was also used as a fascial graft.The patient tolerated the procedure well and there were no immediate or delayed postoperative complications.

## Case 2

A 32-year-old patient presented to the ENT OPD with a history of persistent right ear discharge and hearing loss for the last 3 years. She gave a history of right ear surgery elsewhere 13 months back, but did not have any documentation. Examination of the ear revealed a discharging mastoid cavity withdebris and cholesteatoma in the mastoid cavity and a narrow meatotomy. There was a large perforation in the pars tensa. Examination of the opposite ear, nose and throat was unremarkable. Audiometry revealed moderately right severe sensorineural hearing loss (66.6dB AC, 60dB BC).

HRCT Temporal bone revealed a mastoidectomy defect in the lateral wall of the right mastoid bone with cavity formation. There was no visualization of the right middle ear ossicles (? postoperative). Soft tissue attenuation was seen in residual mastoid air cells, hypotympanum with erosion of the tegmen tympani and suspicious thinning of the tegmenmastoideum (Figure 2e & 2f). There was also thinning with possible erosion of the jugular bulb (Figure 2a & 2b). Findings were suggestive of chronic otomastoiditis with cholesteatoma formation.

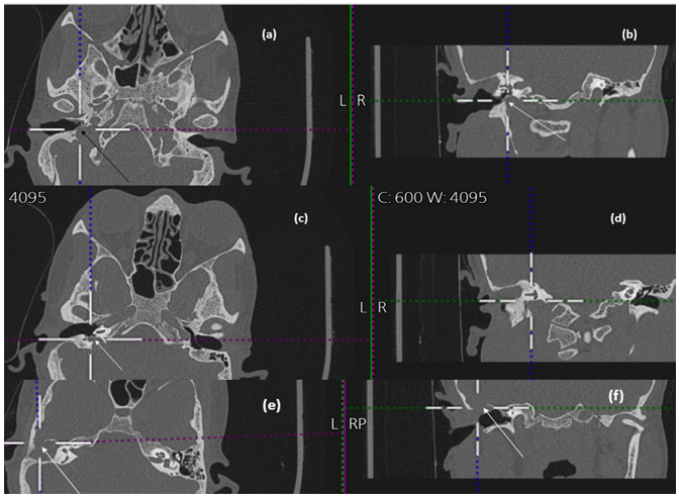


**Figure 2** HRCT temporal bone showing

a) Dehiscent jugular bulb right ear (black arrow) axial view and b) coronal view (white arrow)

c) & d) Axial and Coronal view of jugular bulb diverticulum (white arrow)

e) & f) Axial and Coronal view of the same patient showing dural plate erosion with soft tissue in the mastoid cavity (white arrow)

The patient was then taken up for surgery and underwent revision MRM. Intraoperatively, the cavity was filled with cholesteatoma and granulation tissue. There was a 1*1.5cm defect in the dural plate and anteposed sigmoid sinus. While raising the tympanomeatal flap, there was intense bleeding from the hypotympanum. A dehiscent jugular bulb was present, reaching just up to the lower edge of the round window niche. Bleeding was controlled with a 10-minute compression ( with a large adrenaline-soaked cotton)and after achieving hemostasis, a large piece of surgical and tightly packed Gelfoam pieces were kept in the hypotympanum. Incus and malleus were absent but stapes was present. A periosteal graft was used to reconstruct the eardrum. On evaluating the CT scan again, there appeared to be a diverticulum from the jugular bulb protruding into the hypotympanum, which was dehiscent and missed on initial reading of the scan (Figure 2c & 2d). Also, after detailed questioning, the patient revealed that the first surgical procedure (done outside) had to stop midway due to brisk hemorrhage intra-operatively. Postoperatively, the patient had anuneventful stay and she was advised to keep a regular follow-up for continuous re-evaluation.

# Discussion

The jugular bulb's position and structural integrity can vary significantly, with HRJB seen in up to 6% of temporal bone CT scans and DJB in 0.5% to 4% of cases.[4,5] A HRJB may be considered when it extends to or above the level of the inferior tympanic annulus.[6] Radiologically, a JB is also considered high-riding if it extends above the tympanic annulus,[7] or encroaches within 2 mm of the internal auditory canal.[8] The bony covering of the jugular bulb is extremely thin, only 0.1-0.3mm.[6] Often the high venous structure is not the jugular bulb itself but rather a diverticulum arising from the jugular bulb-as was probably seen in our second case.[6] The hypotympanum forms during the 22nd to 32nd weeks of gestation through the fusion of three distinct bony components: the tympanic bone (derived from membranous ossification), the canalicularotic capsule (of enchondral origin), and the petrosal ledge (formed via periosteal ossification). This heterogeneous composition contributes to developmental anomalies in this region, including the variation in the position and bony covering of the jugular bulb.[9]

HRJB may be overlooked unless specific imaging signs are sought. In the first case, the second HRJB in the left ear was incidentally discovered intraoperatively during tympanoplasty, while the imaging was not conclusive in the second. HRJB may be seen projecting into the middle ear cavity and may even about the round window or stapes. These positions make HRJB particularly vulnerable to trauma during middle ear procedures;[10] and in the hands of an inexperienced surgeon, may be catastrophic. It is also because, in contrast to the thick wall of the sigmoid sinus, which quite readily contracts with bipolar cautery, the thin wall of the bulb does not and is prone to rupture with manipulation.[6]

Managing the intraoperative hemorrhage in such cases of dehiscences of jugular bulb might prove challenging. Compression and head down positioning to prevent air embolism has been described in the literature as one of the primary measures to control mild hemorrhage in such cases.[11] However, in case of brisk hemorrhage, the middle ear should be tightly packed along with closing the sigmoid sinus and the jugular vein, only if an adequate contralateral circulation exists.[12] Ferri et al.[13] has described the endoscopic management of such vascular injuries due to jugular bulb dehiscences during middle ear surgeries. Transcatheter endovascular embolization (with a detachable coil) has also been mentioned in the literature as one of the measures, although it is associated with the potential risks of venous thrombosis and infarcts.[14]

These cases demonstrate that conventional radiography, in the absence of preoperative high-resolution computed tomography (HRCT) of the temporal bone - often due to economic or infrastructural limitations in a developing country - may be insufficient for accurate preoperative assessment. Consequently, surgeons must exercise heightened vigilance when elevating the tympanomeatal flap inferiorly. Furthermore, if radiological findings raise suspicion of anatomical variations or pathology, the surgical team should be prepared to manage such intraoperative challenges effectively.

## Conclusion

With COM being endemic in India and surgical intervention commonly needed, identifying vascular anomalies preoperatively is crucial. These casesunderscore the importance of improved radiologic assessment, intraoperative vigilance, and inclusion of HRJB evaluation in routine preoperative planning to avoid catastrophic outcomes in middle ear surgeries.

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None.

## Conflicts of interest

The authors declare that there are no conflicts of interest.

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