



## Microsurgical Treatment of Vestibular Schwannoma with High Jugular Bulb: A Case Report

Gang Song, Liyong Sun, Jiantao Liang and Yuhai Bao\*

Department of Neurosurgery, Xuanwu Hospital, China

### Abstract

The retrosigmoid approach has been considered by neurosurgeons as the standard approach for the surgical management of vestibular schwannoma. However, few literatures have been focused on surgical treatment for the cases of vestibular schwannoma coexisted with high jugular bulb (HJB). Here we report our experience in dealing with such a case. A 37-year-old man presented with a 6-month-history of progressive tinnitus and hearing impairing on his right side. Magnetic resonance imaging (MRI) studies revealed a homogeneous enhanced tumor in the right cerebellopontine angle (CPA), with extension into the internal acoustic meatus (IAM). Thin layer computerized tomography (CT) with bone window demonstrated a HJB. By adopting special techniques to drill off the posterior wall of IAM and remove the tumor through "membrane dissection", the tumor was completely resected with the preservation of HJB and facial nerve. The post-operative recovery was uneventfully. The details of the case are described in the following, with the attached surgical video.

### Introduction

Vestibular schwannoma is a benign tumor arising from the myelin-forming cell of the vestibular nerve. The estimated incidence of vestibular schwannoma is about 1 in 100,000. Microsurgical resection of vestibular schwannoma through the classic retrosigmoid approach has been the standard treatment for this benign tumor. Due to the common extension of this tumor into the internal acoustic meatus, it is critical to drill off the posterior wall of internal acoustic meatus, in order to achieve complete removal of this part of tumor. In doing so, there is possibility that the jugular bulb will be encountered, if it is high riding.

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#### \*Correspondence:

Yuhai Bao, Department of Neurosurgery, Xuanwu Hospital, Capital Medical University, Changchun Street 45, Beijing 100053, China,  
E-mail: [baoyuhai@163.com](mailto:baoyuhai@163.com)

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The jugular bulb is situated between the horizontal course of the sigmoid sinus and the upper end of the internal jugular vein (IJV) at the skull base. The sigmoid sinus and the inferior petrosal sinus join the jugular bulb and it opens directly into the IJV [1]. Couloigner et al. [2] summarized various definitions and criteria for high jugular bulb (HJB). HJB has been defined when the dome of jugular bulb reaches above the inferior part of the round window (RW) [3], the inferior edge of the internal acoustic meatus (IAM) [4], the inferior part of the cochlear [5] and the inferior bony annulus of the tympanic membrane [6]. For each type of HJB different occurrence rates were reported [2]. From a neurosurgical point of view, a jugular fossa above the inferior edge of the IAM is classified as a high one. HJB were classified into three grades by Samii et al. [7] as follows: Grade I, jugular bulb situated less than 1.5 mm above the low border of the IAM; Grade II, jugular bulb between 1.5 and 3.0 mm above the low border of the IAM; Grade III, jugular bulb > 3 mm above the low border of IAM [8].

Even though the co-existence of HGB and vestibular schwannoma is a rare condition, when encountered, there will be additional technical obstacle for exposing the internal acoustic meatus. Here, by presenting a vestibular schwannoma case accompanied with HJB, we report our experience in overcoming this difficult circumstance.

### Case Presentation

A 37-year-old man presented with a 6-month-history of progressive high tone tinnitus and hearing impairing on his right side. The physical examination showed the patient's facial function was normal. Audiometric and audiological examination was normal. Preoperative magnetic resonance imaging (MRI) studies showed a homogeneously enhancing tumor in the right cerebellopontine angle (CPA), with extension into the IAM. The pre-operative diagnosis was vestibular schwannoma graded as T3a, according to the classification system proposed by Samii [7]. High-resolution thin layer (2mm) computerized tomography (CT) scan with bone window revealed that there was a HJB

(Grade III).

Microsurgical resection of this tumor was performed via the retrosigmoid approach, with the patient in the lateral position. After dura incision, the cerebrospinal fluid was released from the cisterna, and thus relaxing the brain immediately for further expose. The cerebellum was gently retracted back and the tumor was seen. Electrophysiological stimulation of the dorsal part of the tumor was undertaken, which excluded the existence of facial nerve on this part of tumor, after this insurance, intra-capsular central debulking was performed, creating working space for the subsequent procedure. An arc-shaped excision of the dura behind the posterior lip of the IAM over an area of about 1 cm, the posterior wall of the IAM was progressively removed with a diamond drill. A large drill (4 mm in diameter) was used at the beginning, but as the fundus was approached, smaller drill (1–2 mm in diameter) was used. During the drilling, irrigation was used to cool the bone. We identified the jugular bulb under a thin shell of bone. After compressing the jugular bulb, the fundus was extensively exposed. Smaller drill was used to remove fundus again. In the area of the fundus, tumor removal should proceed in a medial to lateral direction until the right-angle dissector could touch the end of IAM. At last, we used gelatin sponge to seal off jugular bulb by glue. We used right-angle dissector to remove the tumor in the IAM slightly and electrophysiological response could prompt us the position of the facial nerve in IAM. As soon as the pressure of the tumor on the adjacent structures is reduced, dissection of the tumor from the surrounding neural and vascular structures is performed by strictly gripping the tumor capsule and dissecting in the level of the arachnoid plane [7]. The tumor was removed totally and the facial nerve was intact. At last, the posterior wall of IAM was sealed off by muscle debris with glue. Postoperative pure tone test showed hearing level of bone conduction decreased about 10dB.

## Discussion

The retrosigmoid approach has been considered by neurosurgeons as the standard method for the surgical management of vestibular schwannoma [7]. In the retrosigmoid approach, drilling the posterior wall of IAM to remove the tumor is one of the essential steps. In this step, the posterior semicircular canal, the vestibular aqueduct, and the jugular bulb may be injured when drilling the posterior wall of IAM. Injury of the semicircular canal or vestibular aqueduct may cause a deterioration of hearing with vestibular disturbance. Inadvertent injury of the jugular bulb causes massive bleeding. Preoperative high-

resolution CT with thin slices (1–2 mm) and bone window is essential for assessing the HJB position and its adjacent structures including the posterior semicircular canal and the vestibular aqueduct.

In this case, we found the position of HJB in high-resolution CT. After drilling a thin layer of the posterior wall bone of IAM, and identifying the jugular bulb under a thin shell of bone in the operation, then compressing the HJB in order to expose the posterior wall of IAM. A smaller drill was used to remove the bone. The surgical management in this case avoided massive bleeding from jugular vein and removed the tumor in IAM.

In conclusion, with preoperative CT bone window assessment of the HJB and careful intraoperative management as mentioned above, we think that the vestibular schwannoma can be removed totally, especially in the IAM and avoid massive bleeding from HJB.

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