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The influence of race on the position of the jugular bulb

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Abstract

The position of the jugular bulb (JB) is of great clinical significance to the otologist. A high and laterally situated jugular bulb may pose difficulties when dealing with the middle ear while a high and medially sited jugular bulb can create problems in neuro-otological surgery. This paper aims to study possible racial differences in the position of the jugular bulb.

Fine-cut computed tomogram (CT) scans of temporal bones (in the axial plane) of 34 Caucasians and 34 Chinese were studied. The position of the jugular bulb was determined with reference to the midpoint of the lumen at the inferior limit of the cochlea (mpC).

Of the 60 Caucasian and 58 Chinese temporal bones with identifiable jugular bulbs, 33 jugular bulbs of the Caucasian (55 per cent) and 34 jugular bulbs of the Chinese (58.6 per cent) were at the same height or higher than the mpC ($p = 0.2$; chi-squared test). The midpoint of the jugular bulb was 8.67 ± 1.73 and 8.61 ± 2.49 mm posterior to the mpC for the Caucasian and Chinese respectively ($p = 0.2$; t-test). However, the midpoint of the jugular bulb of eight Caucasian (24.2 per cent) and 22 Chinese (64.7 per cent) were medial to the mpC ($p<0.001$; chi-squared test).

Race does not influence the height of the jugular bulb nor its position in the sagittal plane but can influence whether a high jugular bulb is medially or laterally situated.

Key words: Tomography, X-ray, computed; Temporal bone; Racial stocks

Introduction

The position of the jugular bulb particularly if it is high, is of great clinical significance to the otologist and neuro-otologist. A high and laterally situated jugular bulb can pose diagnostic and surgical difficulties when dealing with the middle ear. On the other hand, a high but medially sited jugular bulb may interfere with the surgical access to the internal auditory meatus. There have been a number of earlier papers describing its position in relation to ear structures (Graham, 1977; Zorzetto and Tamega, 1979; Yagi, 1992), mastoid pneumatization (Wadin and Wilbrand, 1986; Orr and Todd, 1988), skull base configuration (Kumar *et al.*, 1989) and to the position of the sigmoid sinus (Graham, 1977). There have been however, no earlier studies investigating possible racial differences in the position of the jugular bulb and this was the aim of the present paper.

Methods and materials

Fine-cut computed tomogram (CT) scans (in the axial plane) of the temporal bones of Caucasian and Chinese patients who were investigated for various middle and inner ear symptoms, were studied. The scans of all Chinese adult patients carried out over the past three years in the two hospitals were retrieved and analysed. An equal number of scans of adult Caucasian patients of a similar sex ratio carried out over the same period were randomly selected for comparisons with those of the Chinese. For either race, the scans where there was a possible distortion of the anatomy of the jugular bulb such as those with glomus jugulare tumours were excluded.

From each scan, the jugular bulb on each side if present, was identified and its height determined in relation to the ipsilateral inferior limit of the basal coil of the cochlea. The midpoint of the lumen at the inferior limit of the basal coil of the cochlea was marked mpC and if the jugular bulb was high enough to be seen also at this cut of the CT scan, its midpoint was marked mpJB (Figure 1). The position of mpJB relative to that of mpC in the coronal and sagittal planes were then determined as shown in Figure 1.

Results

The scans of 34 Chinese and 34 Caucasian patients of age range 23 to 68 years (mean 42.5 years) and age range 26 to 70 years (mean 45.6 years)

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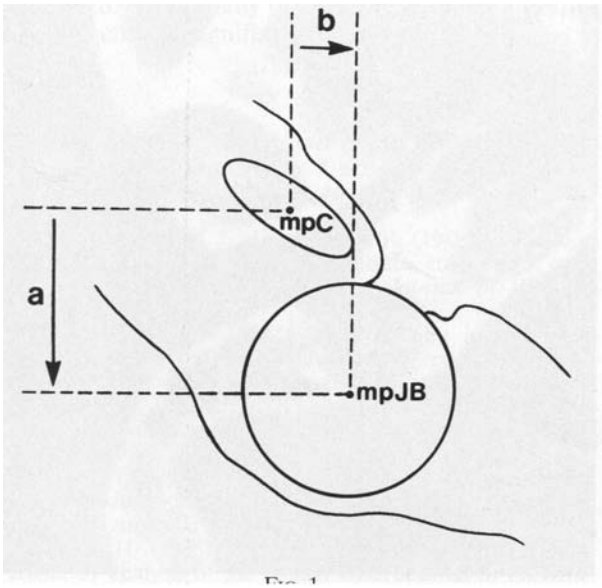

FIG. 1

Diagram to illustrate how the position of the midpoint of the jugular bulb (mpJB) relative to that of the lumen at the inferior limit of the basal coil of the cochlea (mpC) is determined in the sagittal (a) and coronal (b) planes.

respectively were studied. Sixteen males and 18 females were studied for each race.

In eight temporal bones from Caucasians and in 10 from the Chinese, the jugular bulbs could not be identified even at a level down to the jugular foramen. Of the 60 temporal bones of Caucasians and 58 temporal bones of Chinese with identifiable jugular bulbs, 33 jugular bulbs of the Caucasians (55 per cent) and 34 jugular bulbs of the Chinese (58.6 per cent) were of the same height or higher than the inferior limit of the basal coil of the cochlea (Table I), but this difference was not statistically significant (p = 0.2; chi-squared test).

As shown in Table II, the mpJBs of eight Caucasians (24.2 per cent) and 22 Chinese (64.7 per cent) were medial to mpCs (Figures 2 and 3), with the rest of the mpJBs having either a lateral or an immediate posterior relationship to the mpC (Figures 4 and 5). By the chi-squared test, this difference is statistically significant (p<0.001).

For the position of mpJB relative to mpC in the sagittal plane, mpJB was 8.67 ± 1.73 and 8.61 ± 2.49 mm posterior to mpC for the Caucasian and Chinese

TABLE I

SHOWING THE RELATIONSHIP OF THE HEIGHT OF THE JUGULAR BULB (JB) TO THE INFERIOR LIMIT OF THE BASAL COIL OF THE COCHLEA IN THE CAUCASIAN AND CHINESE RACES

	JB lower	JB same level or higher	Total
Caucasian	27	33	60
Chinese	24	34	58
Total	51	67	118

Chi-squared = 0.158; p = 0.2.

TABLE II

SHOWING RELATIONSHIP OF THE POSITION OF THE JUGULAR BULB (JB) TO THE INFERIOR LIMIT OF THE BASAL COIL OF THE COCHLEA IN THE CAUCASIAN AND CHINESE RACES

	JB medial	JB not medial	Total
Caucasian	8	25	33
Chinese	22	12	34
Total	30	37	67

Chi-squared = 11.22; p<0.001.

race respectively but this was found not statistically significant using the t-test (p = 0.2).

Discussion

This paper is the first study on possible racial differences in the position of the jugular bulb. The finding that there was indeed a difference in the position of the jugular bulb of the Caucasian and the Chinese is not surprising as racial differences in the morphology of the human cranium are well known (Wood-Jones, 1930–1931; Johnson *et al.*, 1989). Kumar *et al.* (1989) maintained that the skull base configuration played a role in determining the position of the jugular bulb. Holland (1986) suggested that there were racial differences in the structure of the skull base which could possibly be used for forensic studies in race identification.

The present study revealed that there was a tendency for the high jugular bulb in the Caucasian to be situated more laterally (Figure 4) when

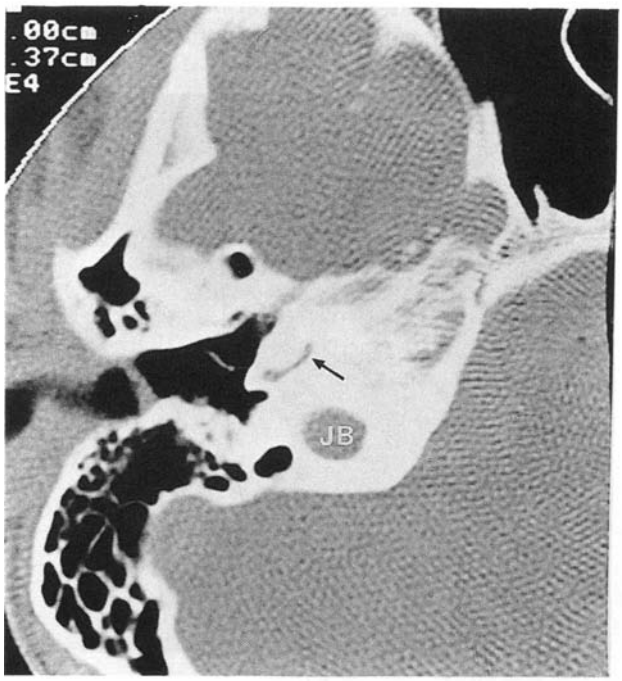

FIG. 2

CT scan (axial plane) of the right temporal bone showing an example of a high jugular bulb (JB) which is medially related to the inferior basal coil of the cochlea (arrowed).

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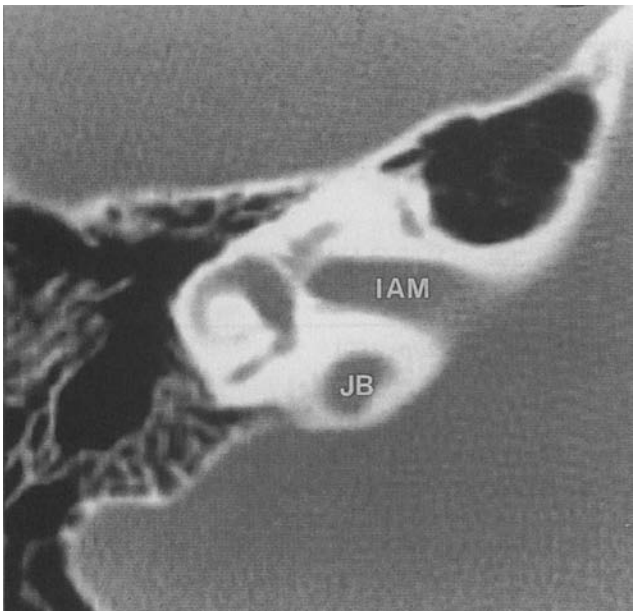

FIG. 3

CT scan (axial plane) of the right temporal bone showing the close relationship of a high, medially situated, jugular bulb (JB) to the internal auditory meatus (IAM).

FIG. 4

CT scan (axial plane) of the left temporal bone of a patient with a high jugular bulb (JB) which is laterally related to the basal coil of the cochlea (arrowed).

compared to the Chinese. A laterally situated jugular bulb of normal height lies beneath the floor of the posterior part of the hypotympanum, a position classically described in Western textbooks (Warwick and Williams, 1975; Bailey, 1987). A high jugular bulb in a lateral position may protrude into the middle ear (Figure 5) and it is reported that 25–27 per cent of jugular bulbs protrude into the middle ear to a varying degree (Zorzetto and Tamega, 1979; Savic and Djeric, 1987). There have been numerous reports of dehiscent high jugular bulbs in the middle ear causing clinical problems. It may present as a diagnostic problem by appearing as a bluish discolouration of the tympanic membrane, seen otoscopically (West *et al.*, 1974), by causing conductive hearing loss (Moretti, 1976) and by producing pulsatile tinnitus (Kennedy *et al.*, 1986). It can also present as a surgical problem by bleeding profusely when it is injured inadvertantly during middle ear surgery (Farrell and Hantz, 1977; Graham, 1977).

FIG. 5

CT scan (coronal plane) of the left temporal bone of the same patient as in Figure 4 showing the high, laterally situated, dehiscent jugular bulb (JB) protruding into the posterior part of the middle ear.

The present study showed high jugular bulbs in the Chinese patients tended to be more medially situated (Figure 2) when compared to the Caucasian patients. In a study of Japanese temporal bones, Yagi (1992) also found the majority (62 per cent) of jugular bulbs having a medial relationship to the cochlea. This is not surprising as according to Brace *et al.* (1989), the modern Japanese are related to the Chinese, Koreans, South-east Asians and the Yagoi rice agriculturists who entered Japan in 300 BC; and together they make up a mainland-Asia cluster of related populations.

A medially situated high jugular bulb can also result in diagnostic and surgical difficulties. When associated with a diverticulum, it has been reported to result in sensorineural hearing loss and Ménière-like symptoms by compression of the endolymphatic duct/sac or internal auditory canal (Jahrsdoefer *et al.*, 1981; Hannell and Fagan, 1987). Surgically, it can interfere with the surgical access to the endolymphatic sac (Graham, 1977) and to the internal auditory canal via the retrosigmoid or translabyrinthine approaches (Figure 3) (Rauch *et al.*, 1993).

Conclusions

Race does not influence the height of the jugular bulb nor its position in the sagittal plane. However, it does influence whether a high jugular bulb has the

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tendency to be medially or laterally situated and this has great clinical significance.

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