Correspondence

The bulbocerebellar circumolivary bundle

During the course of a systematic study on the human vertebrobasilar arterial system (De Caro et al. 1995), our attention was drawn in one case to a strange morphology of the ventrolateral aspect of one side of the medulla. While initially our impression was that we were facing an actual malformation, review of the structure of the brainstem as described in most standard anatomical texts showed that it could correspond to the circumolivary fasciculus (Williams et al. 1995).

The subject was a 63-y-old man who had died from rupture of an atherosclerotic aneurysm of the abdominal aorta. The medical history was negative for neuropsychiatric pathology. Brain examination showed severe atherosclerosis of the cerebral arteries and hypoplasia of the initial segment of the right posterior cerebral artery. A recent infarct was found in the white matter of the right occipital lobe. After removal of the vertebrobasilar arterial system, the right pyramid showed a superficial groove extending from about 2 mm lateral to the foramen caecum obliquely downwards to the right anterolateral sulcus of the medulla, at the level of the superior margin of the inferior root of the hypoglossal nerve (Fig. 1 a). Due to this groove, the lateral part of the pyramid formed a ridge that crossed the anterolateral sulcus of the medulla passing between the 2 main roots of the hypoglossal nerve and then continued, below the inferior pole of the olive, over the lateral region of the medulla ending at the level of the posterolateral sulcus (Fig. 1 b). The general appearance was that of a small cord forming a loop around the anterior margin and the inferior pole of the olive, with a descending part (8 mm long), a horizontal part (6 mm long) and with a transverse diameter of 3 mm. After formalin fixation, the brainstem was cut in 8 transverse sections of the medulla stained with haematoxylin-eosin, Kluver-Barrera and luxol fast blue. The main findings were at the level of the upper half of the medulla where the structure previously described corresponded to a bundle of myelinated axons, separated from the lateral part of the right pyramid by a thin layer of neurons, corresponding to the arcuate nucleus, and by the anterior external arcuate fibres (Fig. 2 a, b). At the level of the rostral medulla the dorsal aspect of the bundle corresponded to a mass of neurons scattered in the right ventral medulla (Fig. 3 a, b) (a symmetric group of neurons was absent on the left side). The cluster of neurons consisted of randomly oriented roundish, medium size, mature nerve cells, similar to the typical olivary neurons. At this level the axons of the bundle showed an oblique course. The bundle was absent in the sections corresponding to the caudal pons where the fasciculi of the corticospinal tracts were nearly equivalent on both sides. The middle third of the right inferior olivary nucleus appeared larger with respect to the contralateral one due to a marked folding and duplication of its dorsal lamina (Fig. 2 a). At the level of the inferior pole of the olive the superficial bundle showed a horizontal course of its fibres (Fig. 4 a, b) and a progressive thinning towards the posterolateral sulcus where it became indistinguishable from the inferior cerebellar peduncle. In the serial sections of the medulla we were unable to find any intermediate group of neurons along the course of the nerve bundle which could be ascribed to the pontobulbar body.

The superficial aspect of the medulla in this case nearly corresponds to that of figure 8.154 (Jamieson, 1910) in Gray’s Anatomy (Williams et al. 1995) where the bundle is labelled as ‘Fasciculus circumolivaris’. The circumolivary fasciculus is a system of fibres which skirts below the inferior olive and is connected with the pontobulbar body. This nucleus belongs to the precerebellar nuclei which develop by migration ventrally and upwards of neuroblasts from the rhombic lip: the neuroblasts which do not reach the ventral pons remain in an ectopic disposition across the inferior cerebellar peduncle forming the pontobulbar body. Afferents to the nucleus have been claimed to traverse the pons descending with the corticospinal fibres, leaving in the medulla to ascend, recurving dorsally over the olive to the nucleus, as part of the pyramidal circumolivary fasciculus (Swank, 1934). The collateral origin of corticopontine fibres from the pyramidal tract was demonstrated by Ugolini & Kuypers (1986). Also the arcuate nuclei are considered precerebellar nuclei whose axons spread around the medulla, above and below the inferior olive. All these fibres, collectively the external arcuate fibres, enter the inferior cerebellar peduncle. Also some fibres of the striae medullares may travel ventrally, usually visible on the surface in the circumolivary fasciculus. Efferent circumolivary fibres join the arcuatocerebellar tract, also reaching the striae medullares to enter the contralateral inferior cerebellar peduncle. However, the precise relations of efferent and afferent fibres to the fasciculus remains uncertain.

For the right inferior olivary nucleus, the hyperconvoluted course of its dorsal lamina resembles the anomalous structure of the nucleus in thanatophoric dysplasia (Wongmongkolrit et al. 1983; Ho et al. 1984).

The morphological findings of our case are characterised by the presence of an accessory bundle of nerve fibres, extending from a neuronal heterotopia in the ipsilateral part of the rostral ventral medulla to the inferior cerebellar peduncle, and dysplasia of the inferior olivary nucleus. The consequent pseudohypertrophy of the right half of the upper medulla might be ascribed to an irregular migration of the neuroblasts of the rhombic lip with a mass of neuroblasts failing to reach their destination in the nuclei pontis and consequent neuronal colonisation of the rostral ventral medulla (His, 1891). Consequently, it could be
Fig. 1. (a) Ventral view of the medulla and caudal pons after removal of the vertebrobasilar arterial system. The right pyramid (Pyr) shows a superficial groove (arrow) extending from about 2 mm lateral to the foramen caecum obliquely downwards to the right anterolateral sulcus of the medulla, at the level of the superior margin of the inferior root of the hypoglossal nerve. The asterisk indicates the circumolivary bundle. The superior and inferior roots of the hypoglossal nerve are circled. O, bulbar olive. (b) Oblique view anterolateral of the right side of the caudal medulla. The lateral part of the pyramid forms a small cord (arrow) which, passing between the 2 main roots of the hypoglossal nerve, skirts below the inferior pole of the olive. Pyr, pyramid; O, bulbar olive. (c) Transverse section of the medulla. The right pyramid
Fig. 3. (a) Transverse section through the rostral medulla. The dorsal aspect of the bundle (arrow) is in relationship with a mass of neurons (arrowheads) scattered in the right ventral medulla. Klüver-Barrera, ×1. (b) Magnification of the boxed area in a. COB, circumolivary bundle; NH, neuronal heterotopy. The myelinated fibres show a nearly horizontal course. Klüver-Barrera, ×16.

Fig. 4. (a) Transverse section of the medulla close to the inferior pole of the olive. The superficial bundle (arrows) shows a horizontal anteroposterior course. Klüver-Barrera, ×1. (b) Magnification of the boxed area in a. The bundle is formed by nerve fibres without interposed neurons. Klüver-Barrera, ×16.

appears larger than the contralateral one due to the presence of a small lateral cord (arrow) separated from the main part of the pyramid by a thin whitish transverse stria.

Fig. 2. (a) Transverse section of the medulla. The superficial cord is well recognizable (arrow). The right inferior olivary nucleus shows marked folding and duplication of its dorsal lamina (arrowheads). The boxed area is shown in b. Klüver-Barrera, ×1. (b) Magnification of the boxed area in a. The superficial cord (COB, circumolivary bundle) is formed by a bundle of myelinated axons, separated from the lateral part of the right pyramid (Pyr) by a thin layer of neurons corresponding to the arcuate nucleus (ArcN) and by the anterior external arcuate fibres (AEExArcF). Klüver-Barrera, ×16.
suggested that the corticocerebellar system has an intermediate ‘nucleus’ of relay at a caudal level with respect to the nuclei pontis and a contingent of corticocerebellar projections which do not terminate in the nuclei pontis descend to the medullary level and then enter the ipsilateral inferior cerebellar peduncle. Therefore, the accessory bundle might be integrated into a corticobulbar-cerebellar projection, owing its existence to the incomplete migration of a group of neuroblasts destined for the nuclei pontis (Fig. 5).

The association of the neuronal heterotopia in the right upper ventral medulla with the dysplasia of the right inferior olivary nucleus is a singular finding. A casual association might be possible, but it would be more logical to consider these findings as being due to the same process, specified as an irregular migration of the neuroblasts of the rhombic lip which are considered to be the common precursors of the neurons of the olivary, arcuate and ventral pontine nuclei.

In conclusion, while the ‘circumolivary fasciculus’ generally comprises different systems of fibres (i.e. anterior external arcuate fibres, fibres of the striae medullares, collaterals of the corticospinal fibres) in the case reported here, it is mainly formed by an unusual bulbocerebellar bundle.

The circumolivary bundle, independently from its significance of normal structure or anatomical variation (even if clinically silent), due to its particular course and the possible marked development and asymmetry may modify the usual morphology of the ventrolateral aspect of the medulla and must be recognised by the neuroradiologist and neurosurgeon facing the structures of the posterior cranial fossa.

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