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Surgical Anatomy of the Human Nucleus Accumbens: Mavridis' Area and Other Clarifications in Stereotactic Space

Ioannis N. Mavridis

Department of Neurosurgery, 'K.A.T.-N.R.C.' General Hospital of Attica, Athens, Greece

I read the recent article by Salgado and Kaplitt [1] on the nucleus accumbens (NA) with great interest. They presented a comprehensive review of the anatomical, pharmacological and physiological attributes of the NA, with emphasis on those features most relevant to surgeons who may consider the NA as a target for future therapeutic studies [1]. The purpose of this communication is to clarify some issues regarding the surgical anatomy of the NA presented by these authors.

At first, I would like to thank Salgado and Kaplitt [1] for mentioning several results of my study regarding the stereotactic and microsurgical NA anatomy [2] in the Surgical Anatomy Section of their review article. However, there are some clarifications and corrections of unintended errors that should be made regarding a few points of their paper.

First, the authors mentioned that 'in coronal sections 2 mm anterior to the anterior commissure (AC), the NA was found 6–9 mm anterior to the rostral border of the AC and 1–2 mm inferior to the AC regardless of hemisphere' [1]. It is correct that the NA is always found 6–9 mm *lateral to the midline* and *from 1 mm superior to 2 mm inferior* to the AC regardless of the hemisphere (area G) [2].

Second, they mentioned that 'in transverse sections 4 mm ventral to the AC-PC (intercommissural) plane, the NA was always located between 1.8 and 3.6 mm anterior to the AC, regardless of age, sex or gender' [1]. It is correct that the NA is always located between 1.8 and 3.6 mm anterior to the AC, regardless of the *side* or gender (standard zone T) [2].

Third, they mentioned that 'coronal examination at sections 2 mm rostral to the border of the AC determined that the NA was located 3.8–10.7 mm anterior to the rostral border of the AC and 0.8–3.7 mm inferior to the AC'. Actually, it is correct that in coronal examinations at sections 2 mm rostral to the *anterior* border of the AC the NA is located 3.8–10.7 mm *lateral to the midline* and 0.8–3.7 mm inferior to the AC (area E) [2].

Salgado and Kaplitt [1] further mentioned that 'sagittal sections 8 mm lateral to the midline defined an area –3.8 to 7.0 anterior to the rostral border of the AC and 1.5–3.7 mm inferior to the AC, regardless of sex, age, and hemisphere examined'. It is correct that these sections define an area –3.8 to 7.0 mm anterior to the rostral

border of the AC and *from 1.5 mm superior to 3.7 mm inferior* to the AC regardless of the side or gender (standard area F) [2].

Finally, they mentioned that 'combining both magnetic resonance imaging (MRI) and gross anatomical findings, it was determined that in a coronal slice 2 mm anterior to the rostral border of the AC, the area within 6–8 mm lateral to the midline and 0.8–2.0 mm inferior to the AC contained the NA in every gross specimen and radiologic image analyzed'. Again, it is correct that this combination revealed that the area within 6–9 mm lateral to the midline and 0.8–2.0 mm inferior to the AC contained the NA in every specimen and image analyzed (standard area M) [2]. Thus, this area, nowadays called 'Mavridis' area' (MA) [3–9], is the brain

Fig. 1. MA of the human brain (left hemisphere, coronal section at level Y = 2, zoom on basal ganglia). 1 = NA; 2 = anterior limb of the internal capsule; 3 = head of the caudate nucleus; 4 = putamen; 5 = external capsule; 6 = claustrum; 7 = extreme capsule; 8 = frontal horn of the lateral ventricle; 9 = body of the corpus callosum; I = inferior; L = lateral; M = medial; S = superior (modified from Mavridis [10]).

region defined by coordinates 6, 9, 2, 2, -0.8 and -2 (X, X', Y, Y', Z and Z') in stereotactic space (fig. 1), with the anterior border of the AC at the midline defining the stereotactic reference point with coordinates 0, 0 and 0 (X, Y and Z) [2, 3, 10].

MA constitutes the most reliable stereotactically standard part of the NA, regardless of the side or gender [3, 10] and is, therefore, the most accurate stereotactic anatomical guide for targeting the NA in humans [6]. In agreement with Salgado and Kaplitt [1], the MA presents an ideal target for the positioning of electrodes for deep brain stimulation (DBS) of the NA. The MA has been further proposed as the target area of only one of the electrode contacts (contact 1 or 2) and, interestingly, as the target area for contact 0 in DBS of the anterior limb of the internal capsule (ALIC) and even as the target for a combined NA-ALIC DBS (which has been repeatedly described for treating psychiatric disorders) [8].

Finally, I definitely agree with Salgado and Kaplitt [1] that the NA is a complex, fascinating and potentially rich target for stereotactic neurosurgical interventions and that to date clinical applications of focal surgical interventions into the NA represent only the beginning of what may become a very important area of clinical exploration for stereotactic neurosurgeons.

Disclosure Statement

The author declares to have no conflicts of interest.

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