Habenula

In neuroanatomy, habenula (diminutive of Latin habena meaning rein) originally denoted the stalk of the pineal gland (pineal habenula; pedunculus of pineal body), but gradually came to refer to a neighboring group of nerve cells with which the pineal gland was believed to be associated, the habenular nucleus.

Currently, the Terminologia Anatomica term refers exclusively to this separate cell mass in the caudal and dorsal aspect of the dorsal thalamus (the epithalamus), embedded in the posterior end of the medullary stria from which it receives most of its afferent fibers. By way of the fasciculus retroflexus (habenulointerpeduncular tract) it projects to the interpeduncular nucleus and other paramedian cell groups of the midbrain tegmentum.

The habenula consists of a pair of small epithalamic nuclei located adjacent to the dorsomedial thalamus.

The habenula receives input from the brain via the stria medullaris thalami and outputs to many midbrain areas involved in releasing neurotransmitters, such as dopamine, norepinephrine, and serotonin.

Despite increasing interest in imaging the habenula due to its critical role in mediating subcortical reward circuitry, in vivo neuroimaging research targeting the human habenula has been limited by its small size and low anatomical contrast. In a work, Kim et al developed an objective semi-automated habenula segmentation scheme consisting of histogram-based thresholding, region growing, geometric constraints, and partial volume estimation steps. This segmentation scheme was designed around in vivo 3T myelin-sensitive images, generated by taking the ratio of high-resolution T1w over T2w images. Due to the high myelin content of the habenula, the contrast-to-noise ratio with the thalamus in the in vivo 3T myelin-sensitive images was significantly higher than the T1w or T2w images alone. In addition, in vivo 7T myelin-sensitive images (T1w over T2*w ratio images) and ex vivo proton density-weighted images, along with histological evidence from the literature, strongly corroborated the in vivo 3T habenula myelin contrast used in the proposed segmentation scheme. The proposed segmentation scheme represents a step toward a scalable approach for objective segmentation of the habenula suitable for both morphological evaluation and habenula seed region selection in functional and diffusion MRI applications [1].

1)
Kim JW, Naidich TP, Ely BA, Yacoub E, De Martino F, Fowkes ME, Goodman WK, Xu J. Human habenula segmentation using myelin content. Neuroimage. 2016 Jan 27. pii: S1053-8119(16)00063-X. doi: 10.1016/j.neuroimage.2016.01.048. [Epub ahead of print] PubMed PMID: 26826517.