Childs Nerv Syst (2011) 27:2023–2025
DOI 10.1007/s00381-011-1513-y

COVER PICTURE

A mysterious term *hippocampus* involved in learning and memory

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Published online: 6 July 2011

In medical nomenclature, a specific disease is named after the scientist who first described it, called eponym, but the origin of some terms does not fit into this category. During our search to uncover the meaning and origin of a mysterious term *hippocampus*, we uncovered a delightful narrative as follows:

The term hippocampus (Greek; *hippokampos*, sea horse; derived from the shape of a mythical half-horse *hippos* plus half-fish sea monster *kampos*) was a sea horse with a fish tail instead of hind legs [1]. In Greek mythology, it is believed that the sea horses (Greek, *hippocampi*) pulled the chariot of Poseidon, god of the sea and earthquakes, through the depth of the oceans [1]. On the Sacred Disease by Hippocrates (460–377 B.C.), it was stated that Poseidon caused certain types of epilepsy (http://classics.mit.edu/Hippocrates/sacred.html). In Roman mythology, Neptune, analogous to Poseidon, often drives a sea chariot drawn by *hippocampi* or by horses that could ride on the sea (http://en.wikipedia.org/wiki/Hippocamp). In Homer's Iliad, a poem about Ilion or Troy, Poseidon has an active role in the battle against the Trojan forces, and he was associated with dolphins and tridents in Greek art (Fig. 1) (http://en.wikipedia.org/wiki/Poseidon). Afterwards, it was likened to a silkworm, and lastly, Garengot (1742) used the term *cornu ammonis* (CA), horn of the ancient Egyptian god Amun, for the description of hippocampus [2] (http://www.caam.rice.edu/~cox/wrap/hippocampus.pdf).

Anatomically, the hippocampus or CA, located in the inferomedial portion of the temporal lobes, is part of the limbic cortex [3, 4]. It appears as two interlocking C's reminiscent of a sea horse on cross-sectional images [4]. The spiral appearance of the structure gave the name to the hippocampus, a major component of the brains of all mammals (Fig. 2) (http://en.wikipedia.org/wiki/File:Hippocampus_and_seahorse.JPG). In humankind, the hippocampus has projections to the prefrontal cortex and hypothalamus, and its volume is about 3.0 to 3.5 cm^3 in an adult human [4–6]. Radiologically, it is better appreciated on MR images (Fig. 3). On the coronal anatomic and histologic sections of the specimen of the hippocampal

Fig. 1 A Corinthian plaque illustrating Poseidon holding a trident, 550–525 B.C. From Penteskouphia (http://en.wikipedia.org/wiki/File:Poseidon_Penteskouphia_Louvre_CA452.jpg)

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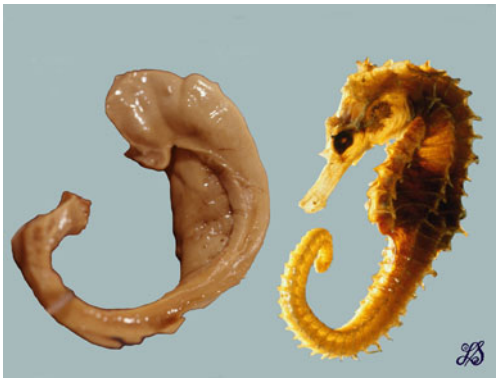

Fig. 2 This figure (used as cover illustration) shows a preparation of the human hippocampus and fornix compared with a sea horse with the back half of a fish (reprinted with courtesy of Laszlo Seress, Pécs University, Pécs, Hungary) (http://en.wikipedia.org/wiki/File:Hippocampus_and_seahorse.JPG)

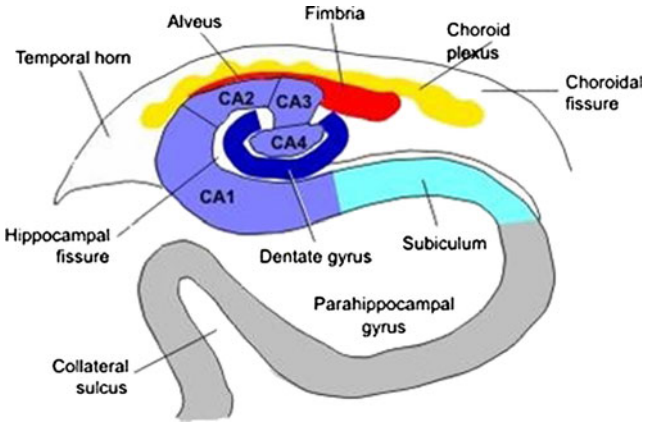

Fig. 4 A diagram in the coronal plane demonstrating the *CA1*, *CA2*, *CA3*, and *CA4* subfields of the hippocampus. Reprinted with courtesy of John R. Hesselink, UCSD Medical Center, San Diego, CA (http://spinwarp.ucsd.edu/NeuroWeb/Text/br-800epi.htm)

formation, the CA1, CA2, CA3, and CA4 subdivisions of the hippocampus are better identified [7] (http://spinwarp.ucsd.edu/NeuroWeb/Text/br-800epi.htm] (Figs. 4 and 5).

Clinically, atrophy of the hippocampus is referred to as mesial temporal sclerosis and has been implicated in causing seizures in children. On the other hand, stressed animals and depressed humans show impaired short-term learning and memory [8], because the hippocampus is a key structure involved in the ability to learn new cognitive skills and the formation of new memories about experiences [5]. During surgical interventions in awake patients, electrical activation of the hippocampus may also result in the reporting of a recent memory. Recently, there are different changes in the histological structure and a volumetric reduction of the hippocampus in animal models of stress and depression [5, 9] and MR imaging studies of depressed humans [10]. It has been suggested that specific histological changes in the hippocampus such as dendritic atrophy and synapses and neuronal apoptosis explain the clinical features of depression in humans [5]. Importantly, antidepressant drugs reverse depression in humans by reversing the histological effects of stress in the hippocampus, known as "hippocampal neurogenesis" in neuroplasticity theory [5]. Most recently, it has been speculated that the pineal neurohormone melatonin stimulates hippocampal neurogenesis in cognitive aging as depression [11]. Today, it is widely accepted that there is a strong relationship between the size of the hippocampus and memory performance in humans and animals.

In conclusion, the hippocampus is one of the few important anatomic structures in the brain for pediatric neurologists and neurosurgeons involved in surgical treatment of epilepsy and memory research. Apart from the

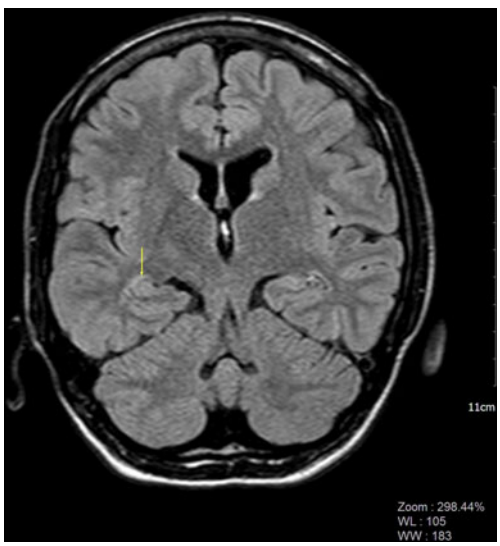

Fig. 3 A coronal FLAIR MR image illustrating normal signal within the normal right hippocampus (*arrow*). From the personal archive of our colleague Yelda S. Dayanır, Adnan Menderes University School of Medicine, Aydın, Turkey

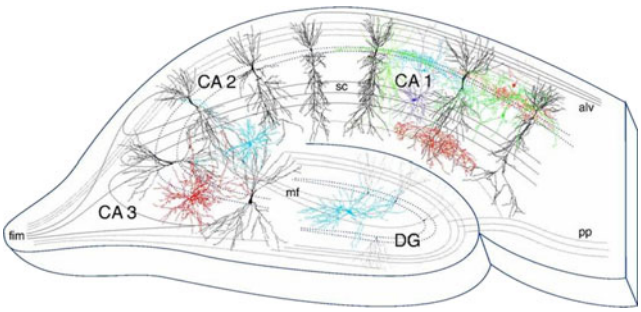

Fig. 5 A diagram demonstrating projection neurons and main synaptic pathways (*black*). Please note that the colors of inhibitory interneurons are different and that some of them function in concert (*red*). Abbreviations: *CA1* first cornu ammonis region in the hippocampal formation, *DG* dentate gyrus, *alv* alveus, *sc* Schaffer collateral pathway from CA3 neurons, *mf* mossy fiber pathway from DG neurons, *pp* perforant path axons, *fim* fimbria pathway. Reprinted with courtesy of M. Bruce MacIver, Stanford University, CA, USA (http://www.stanford.edu/group/maciverlab/hippocampal.html)

current advanced neurosurgical perspective, this article also provides us with an interesting insight into the mind of the early scientists and their first impressions of certain mythical heroes. It is of no doubt that this will augment the education of young neuroscientists.

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