ANATOMIC VARIATIONS IN THE GIRAFFE CONFERRING PROTECTION FROM INTRACRANIAL HEMORRHAGE AND ORTHOSTATIC HYPOTENSION

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RESEARCH QUESTION

Can our understanding of human cerebral hypertensive and hypotensive disorders be improved by utilizing the giraffe as a model to study vascular adaptations?

BACKGROUND

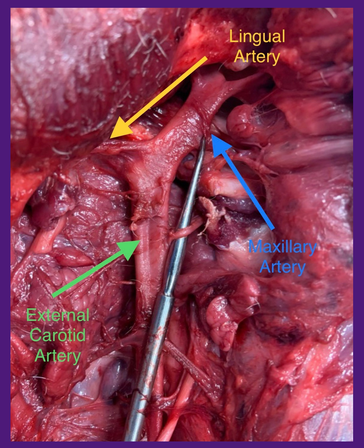
Humans can suffer hemorrhagic strokes at blood pressures over 220/110, causing widespread death and disability throughout the world. In other populations, when blood pressures drop to 90/60 through dysregulation of the autonomic nervous system, patients may experience palpitations, dizziness, and syncope. These extreme changes in blood pressure can result in extreme morbidity and limitations in quality of life. The giraffe, on the other hand, can sustain these extreme variations in blood pressure throughout the day via changes in body position, yet dysautonomia or strokes are not commonly seen in these animals. This investigation aims to publish the first brain MRI of the giraffe on an infant and adult giraffe and will study the gross anatomic structures. The eventual goal of this project is to translate many of the cerebral and cardiac adaptions of the giraffe into discovery of therapeutics and protective measures for strokes and dysautonomia states in humans.

METHODS

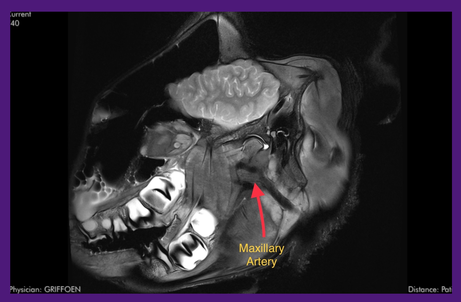
To investigate the unique cerebrovascular giraffe adaptations, we propose a comparative analysis of 1) the gross anatomic structures of the giraffe neck vasculature and 2) a brain MRI of both infant and adult giraffe. Via partnerships with zoos across the county, giraffe specimen were enrolled in the study after death from natural causes. A post-mortem dissection was performed 30 minutes after time of death to identify anatomy. Two other giraffes, one infant and one adult, were imaged one week from time of death to obtain brain MRIs.

CEREBROVASCULAR ANATOMY OF AN ADULT AND INFANT GIRAFFE

The common carotid artery, a non-collapsible structure, transitions into the external carotid artery in the giraffe, while the internal carotid artery is obliterated in utero



The external carotid artery gives rise to the lingual, maxillary, and occipital artery



FIRST BRAIN MRI OF A GIRAFFE

The maxillary artery originates from the external carotid artery and gives rise to the carotid rete, lowering the intracerebral blood pressure

The carotid rete, a net-like structure that helps normalize cerebral pressure, is found in the cavernous sinuses originates from the maxillary artery

RESULTS

The post-mortem dissection revealed a non-collapsible common carotid artery that progressed into the external carotid artery, followed by bifurcation into the maxillary and lingual artery. An internal jugular vein was also present, which was collapsible in nature. The vertebral venous plexus was unable to be identified, though further efforts will be committed to identify the structures from fixed vertebral sections. A brain MRI without contrast from the infant and adult giraffe was significant for a unique carotid rete originating from the external carotid artery.

FUTURE DIRECTIONS

The study aims to test the proximal and distal segments of the internal carotid artery for expression of fibroblast growth factor receptor 1 (FGFR-1). Higher expression of FGFR-1 in the proximal segment of the common carotid artery is expected compared to the distal segments, as rapid changes in head positioning can vastly alter blood pressure requiring adaptive mechanisms in vasoconstriction and vasorelaxation

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