

Introduction Galen of Pergamon (AD 129-c. 200) stands in history as one of the first to acknowledge the importance of the brain as the hegemonikon or 'regent part' of the body. Despite the limitations of Galen’s anatomical technique, he was able to lay the foundation of vascular neuroanatomy and neurosurgery. This study reviews the literature of Galenic understanding of anatomy and theorised function of neurovascular structures. Methods Published works of Galen were consulted to critically review his anatomical methodology in dissection as well as his understanding neurovascular structure and function. These works included <i>On Anatomical Procedures</i>, <i>On the Doctrines of Hippocrates and Plato</i>, and <i>On the Use of Parts</i>. These sources were supplemented with available modern and ancient literature to critically appraise its understanding of Galen. Results Galen’s methods, recorded in “On Anatomic Procedures” involved a combination of dissection and vivisection of animal subjects. Central to the Galenic understanding of neurovascular structures and function are both the retiform plexus and the choroid plexuses. Despite this anatomical error, Galen is able to provide a highly detailed account of the blood supply of the choroid plexuses and theorise their role in CSF production. In addition to anatomical dissection, Galen conducted a series of vascular ligation experiments of the internal carotid artery and theorised the presence of additional sources of vascular supply, the later termed Circle of Willis. The anatomy of the retiform plexus The retiform plexus is a vascular structure associated with the pituitary infundibulum and the floor of the third ventricle. However, this particular structure is absent in primates and only present in mammals such as goats, pigs, sheep and bovine sources, providing further evidence that Galen <td> more commonly used these as his dissection subjects. Galen provides descriptions of the retiform plexus in both his works <i>On the Use of Parts</i> and in <i>On Anatomical Procedures</i> where he likens the vascular structure to a layered ‘fisherman’s net,’ an arrangement of highly complex small arteries that arise from the internal carotid artery surrounding the pituitary gland and protected by a fold of dura. Physiology of the retiform plexus The function of the retiform plexus was unclear to Galen, however, he believed it to be an important vascular structure of the brain and intimately connected with the formation of the psychic pneuma. It is apparent that the complex vascular anatomy of the retiform plexus and its anatomical position close to the ventricular system provided evidence to Galen that this structure is responsible for the transformation of vital pneuma into its psychic form. Despite the absence of this structure in humans, it is clear that in Galen’s argument of this structure and its theoretical function provided him with what he regarded as proof of the hegemonikon status of the brain and ventricular system. The origin of the choroid plexus Galen also details the blood supply to the choroid plexus, highlighting arterial supply from the internal carotid through the base of the skull and venous drainage at the torcular Herophilii. It would seem apparent from the association with Herophilus, that he must have had an appreciation of these plexuses. Although Galen stated that the final transformation of vital pneuma occurs as a result of the choroid, the precise function of venous drainage is less clear. Choroid physiology is however not as well described by Galen as its counterpart; the retiform plexus. The carotid ligation experiment Experimentation with pressure and incision into the ventricles, demonstrated that the ventricles contained pneuma (CSF), however, not how it was produced. Galen surmised that incision of the ventricles caused the body to be deprived of both motion and sensation as the 'pneuma' </td> <td> were to escape. It was less certain, how the pneuma first came to reside in the ventricles. In line with the vascular theory of psychic pneuma Galen details experiments conducted with ligation of the carotid artery. It was noted that despite exposure and ligation, the subject remained relatively undisturbed. Presumably this resulted from an intact circle of Willis and patent collateral flow from the contralateral carotid and vertebrobasilar systems. This observation led Galen to erroneously theorize that a second source of psychic pneuma could be generated through the act of breathing and inhaling through the nasal passages. Galen postulated that a second source of air entered the brain via the olfactory tracts to be converted into psychic pneuma in the lateral ventricles. Conclusion Although his methods had clear limitations, Galen was able to come to an understanding of mammalian cerebrovascular structures that was to remain the foundation for generations to come and the origin of our modern anatomical understanding. References <u>Ancient Sources:</u> Galen, "De Usu Respirationis" in Galen: On Respiration and the Arteries , eds. D. Furley & J.S. Wilkie, Princeton: Princeton University Press, pp. 194. Galen, On the doctrines of Hippocrates and Plato, ed. P. De Lacy (trans.). 1978-1984, Berlin: Akademie-Verlag. Galen, De usu partium. Helmreich G. (trans.) 1968. Amsterdam: A. M. Hakkert. Galen , On Anatomical Procedures. Singer, C. (trans.). 1956. London: Oxford University Press. Galen, On Anatomical Procedures: The Later Books. Duckworth, W.L.H. (trans.).Cambridge: Cambridge University Press. <u>Modern Sources:</u> DeGutierrez-Mahoney, C.G. & Schechter, M.M. 1972, "They myth of the rete mirabile in man", Neuroradiology, vol. 4, pp. 141-158. Harris, C.R.S. 1973, The heart and the vascular system in ancient Greek medicine, from Alcmaeon to Galen, Oxford: Clarendon Press. Rocca, J. 2003, Galen on the Brain: Anatomical Knowledge and Physiological Speculation in the Second Century A.D. Boston: Brill. Rocca, J. 1998, "Galen and Greek Neuroscience (Notes Towards a Preliminary Survey)", Early Science and Medicine, vol. 3, no. 3, pp. 216-240. </td>	more commonly used these as his dissection subjects. 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