

MYOCARDIAL STRUCTURE AND VASCULARIZATION OF THE HEART VENTRICLE IN HOLOCEPHALI: IMPLICATIONS FOR HEART EVOLUTION

Myocardial Structure and Vascularization of the Heart Ventricle in Holocephali: Implications for Heart Evolution

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It has been classically assumed that the ventricle of the primitive vertebrate heart was composed of spongy myocardium, supplied exclusively by oxygen-poor, luminal blood. This notion based on two facts, namely: (1) extant agnathans have a spongy ventricular myocardium, and (2) in avian and mammalian embryos, the formation of trabeculated myocardium precedes the appearance of compact myocardium. Recently, it has been proposed that like elasmobranchs, the early gnathostomes possessed a fully vascularised ventricle composed of mixed myocardium. Aiming to throw new light on this issue, we studied the structure and vascularisation of the ventricular myocardium in four holocephalan species of the families Chimaeridae and Rhinochimaeridae. *Chimaera monstrosa*, *Hidrolagus affinis* and *Harriotta raleighana* have a spongy myocardium covered by a thin layer of cardiac muscle. In *H. raleighana*, the compacta is reduced to an extremely fine rim. In all three species there is a well-developed coronary artery system consisting of subepicardial vessels which give off branches that penetrate the myocardial trabeculae. *Rhinochimaera atlantica* has no compacta and its ventricular coronary artery system is reduced to subepicardial vessels that do not enter the spongy layer. This report is the first to show that in wild living vertebrates, a coronary artery system supplying the whole myocardium exists in the absence of a well-developed compacta. This is consistent with the notion derived from experimental work done by other authors that myocardial cell proliferation and coronary vascular growth rely on genetically separated programs. Our findings suggest that the mixed ventricular myocardium is primitive for chondrichthyans, and that the lack of compacta in some holocephalans is a derived character. Moreover they give support to the hypotheses that the mixed myocardium is the primitive condition in gnathostomes, and that the absence of a compacta in different actinopterygian taxa is the result of its repeated loss during evolution.

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