

Ventricular myocardial trabeculation in chondrichthyans. Evolutionary implications.

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The formation of trabeculae (trabeculation) in vertebrates occurs during cardiac development in the three structural types of ventricular myocardium, namely, compact, spongy and mixed. The compact type is mainly composed of compacted muscular fibers and the spongy type of muscular trabeculae. The mixed type, with an inner trabecular and an outer compact layer, has been proposed as the primitive condition in gnathostomes. In vertebrate models, trabeculation initiates following two alternative mechanisms: (1) in chicken and mouse, the endocardial cells evaginate towards the two-layered myocardium; (2) in zebrafish, cardiomyocytes from the mono-layered myocardium invaginate towards the endocardium. Trabeculation in the mixed myocardium has not been described yet. We have studied the mixed myocardium formation in the dogfish (*Scyliorhinus canicula*, Elasmobranchii) using light, scanning and transmission electron microscopy. At stage 27, the ventricle consists of a two-layered myocardium internally lined by endocardium, both separated by cardiac jelly. Trabeculation starts at stage 28, when small spaces between cardiomyocytes appear, the cardiac jelly become thinner and the endocardium focally contacts the myocardium. At stage 29 the spaces between cardiomyocytes increase in size and get lined by the endocardium, shaping the presumptive trabeculae. At later stages, the trabeculae increase in complexity and the outer cardiomyocytes proliferate and get compacted, delineating the definitive trabeculated and compact myocardia. We conclude that early trabeculation in elasmobranchs matches that described in tetrapods. Thus, the mechanism of trabeculation of the mixed ventricular myocardium has been conserved in the formation of the compact myocardium of tetrapods. Additional studies in actinopterygians with different myocardial types may uncover how trabeculation has evolved during the evolution of gnathostomes.

Keywords: Trabeculation, myocardium, chondrichthyans, evolution, gnathostomes

Funding: CGL2017-85090-P, FPU15/03209, UMAJI75 and FEDER