IS THE BULBUS ARTERIOSUS OF FISH HOMOLOGOUS TO THE MAMMALIAN INTRAPERICARDIAL THORACIC ARTERIES?

Authors: A. López-García, M.C. Fernández, A. Fernández-Tamayo, A.C. Durán, B. Fernández

Work center(s): Department of Animal Biology, Faculty of Science, University of Málaga

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Summary

Two major findings have significantly improved our understanding of the embryology and evolution of the arterial pole of the vertebrate heart (APVH): 1) a new embryonic presumptive cardiac tissue, named second heart field (SHF), forms the myocardium of the outflow tract, and the walls of the ascending aorta (AA) and the pulmonary trunk (PT) in mammals and birds; 2) the bulbus arteriosus (BA), previously thought to be an actinopterygian apomorphy, is present in all basal Vertebrates, and probably derives from the SHF. We hypothesized that the intrapericardial portions of the AA and the PT of mammals are homologous to the BA of basal vertebrates. To test this, we performed 1) a literature review of the anatomy and embryology of the APVH; 2) novel anatomical, histomorphological, and embryological analyses of the APVH, comparing basal (*Galeus atlanticus*), with apical (*Mus musculus* and *Mesocricetus auratus*) vertrebrates. Evidence obtained: 1) Anatomically, BA, AA, and PT are muscular tubes into the pericardial cavity, which connect the distal myocardial outflow tracts with the aortic arch system. Coronary arteries run through or originate at these anatomical structures; 2) Histologically, BA, AA, and PT show an inner layer of endothelium covered by circumferentially oriented smooth muscle cells, collagen fibers, and lamellar elastin. The histomorphological differences between the BA and the ventral aorta parallel those between intrapericardial and extrapericardial great arteries; 3) Embryologically, BA, AA, and PT are composed of smooth muscle cells derived from the SHF. They show a similar mechanism of development: incorporation of SHF-derived cells into the pericardial cavity, and distal-to-proximal differentiation into an elastogenic cell linage.

In conclusion, anatomical, histological and embryological evidence supports the hypothesis that SHF is a developmental unit responsible for the formation of the APVH. The BA and the intrapericardial portions of the great arteries must be considered homologous structures.

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