CHANGES IN BLOOD DISTRIBUTION

IN DEVELOPING LOWER VERTEBRATES

(*DANIO RERIO* AND *XENOPUS LAEVIS*)

Thorsten Schwerte[1],
Regina Fritsche[2] and Bernd Pelster[1]

[1]Institute for Zoology and Limnology, University of Innsbruck, Austria
[2]Institute for Zoophysiology, University of Gothenborg, Sweden

EXTENDED ABSTRACT ONLY – DO NOT CITE

The vasoactivity of adrenaline and other vasoactive hormones is well described in adult vertebrates. Very little, however, is known about cardiovascular control mechanisms in developing embryos and larvae. It is already well establishes that the innervation of the ventricle becomes functional only late during development, but blood born hormones may control cardiovascular performance much earlier.

New optical methods (digital motion analysis) were applied to investigate shape and performance of the cardiovascular system in free living embryos and larvae of lower vertebrates, i.e. fish and amphibians. By subtracting the odd and even field of a video frame any movement that occurred within the 20 ms necessary for the acquisition of one field was visualised. The length of the shifting vectors, generated by this subtraction, represented a direct measure for the velocity of a moving particle, i.e. an erythrocyte in the vascular system. By accumulation of shifting vectors generated from several subsequent video frames a complete trace of the routes, on which erythrocytes moved, was obtained. Thus, a cast of the vascular system, except for those tiny vessels that are not entered by erythrocytes, was obtained. Because the grayscale value of any given pixel or any given group of pixels increased with the number of erythrocytes passing it, digital motion analysis could also be used to visualise the distribution of blood cells in transparent tissues.

Using these techniques we measured changes in the diameter of dorsal and intersegmental blood vessels and in the distribution of erythrocytes following an application of :

- the alpha-adrenergic agonist phenylephrine
- the peptide endotheline
- the nitric oxide donor sodium nitroprusside (SNP)
- L-NAME as an antagonist to nitric oxide.

In zebrafish larvae phenylephrine produced a significant vasoconstriction at the entrance of the intersegmental vessel and a significant reduction in erythrocyte supply to the intersegmental vessel, while the diameter of the dorsal artery and vein was unaffected. In *Xenopus laevis* endotheline (ET-1) provoked a significant vasoconstriction in a main artery supplying the head of the larvae. In the presence of endotheline the NO-donor SNP provoked a significant vasodilation (fig. 1), which was not observed in the absence of endotheline.

Thus, this study clearly suggests that, prior to establishing functional control of the vascular bed via the autonomic nervous system, vascular tone in larval tissues is regulated by a complex interaction of vasoactive hormones. Furthermore, the production of vasoactive substances by endothelial cells appears to be of major importance for the control of peripheral resistance at this stage of development. The use of digital video imaging techniques turned out to be a comfortable tool for cardiovascular research.

Acknowledgement

Supported by the FWF (P-12571-BIO)

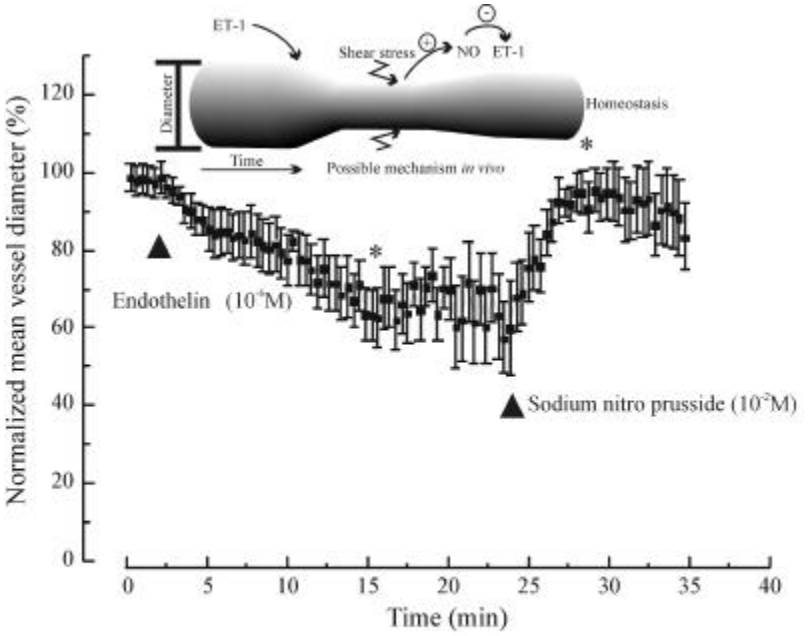

Fig. 1: Effect of Endothelin (ET-1) and Sodium Nitro Prusside on the vessel diameter of the main head artery in *Xenopus* larvae (stage NF 50-53). The insert shows the probable mechanism *in vivo*.