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Morphogenesis and patterning of the developing vasculature

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Blood and lymphatic vessels play essential roles in all adult and developing vertebrates including supplying oxygen and nutrients, removing wastes, and maintaining fluid homeostasis. The vertebrate vascular system also plays important roles in pathological processes such as cancer and cardiovascular disease. The genetically and experimentally accessible zebrafish and its optically clear embryo provide an ideal model for exploring the early development and assembly of the vasculature. Using multiphoton time-lapse imaging of transgenic zebrafish, we have obtained *in vivo* evidence supporting a century-old model proposed by Florence Sabin for the assembly of vascular tubes by intra- and inter-cellular fusion of endothelial vacuoles. We have also demonstrated that the zebrafish possess a well-developed lymphatic vascular system, and have used similar imaging methods to perform *in vivo* lineage tracing of the cellular origins of lymphatic endothelial cells. Our results show that early lymphatic endothelial cells emerge from venous endothelium. The early vasculature develops with a highly stereotypic and evolutionarily conserved anatomy, and we have studied the genetically programmed cues that guide this patterning. Our results have highlighted an important new role for previously characterized neuronal guidance factors in patterning developing blood vessels. We will discuss some of these findings in more detail.

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