THE LYMPHATIC VASCULAR SYSTEM: SECONDARY OR PRIMARY?

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ABSTRACT

It has generally been accepted that the blood vascular system is primary and the lymphatic vascular system secondary. Diseases of the blood vascular system are the leading cause for mortality and morbidity in developed nations. In contrast, lymphedema is seldom life-threatening and can generally be well-managed by combined physiotherapy. During ontogeny, the blood vessels and the heart develop much earlier than the lymphatic vessels. However, there is growing evidence that the first vascular system occurring during ontogeny and phylogeny has lymphatic functions. Defense mechanisms are crucial for all organisms irrespective of their size. Macrophages precede the emergence of erythrocytes during ontogeny, and their circulation in the hemolymphatic (more accurately, lymphohematic) system of insects, which do not possess erythrocytes, shows that the lymphatic function is primary whereas the nutritive function is secondary, needed only in larger organisms. In molluscs and arthropods, which have an open vascular system, hemocyanin has both oxygen transporting and defense functions. In vertebrates, the early blood vessels have structural characteristics of lymphatics and express the lymphendothelial receptor flt-4 (Vascular Endothelial Growth Factor Receptor-3). Later, flt-4 becomes restricted to the definitive lymphatics, which are either formed from the primary vessels or from mesodermal lymphangioblasts. The primary lymphatic function has become overruled by the nutritive function in blood vessels of larger animals. The circular movement of cells is driven by a blood heart, which, however, is not an unique organ. Lymph hearts are present in lower vertebrates, still develop transiently in birds, and are vestigial in the contractile lymphangion which “circulates” immune cells. We conclude that the definitive lymphatics are perhaps secondary in mammals, but the blood vascular system seems to develop on the basis of an ancestral lymphatic system with lymph hearts.