

Lymphatic pumping in response to changes in transmural pressure is modulated by erythrolysate/hemoglobin

Abstract:

Red blood cells and lysate products (erythrolysate) are observed consistently in lymph draining acute and chronic inflammatory reactions and from tissues subjected to trauma or surgical procedures. Using hemoglobin as a marker for erythrolysate, we have measured hemoglobin in lymph up to the 10^{-6} M range in a number of pathophysiological states. Data demonstrate that erythrolysate alters the pumping characteristics of lymphatic vessels. To test the effects of erythrolysate on lymphatic pumping, bovine lymphatics were suspended in an organ bath preparation with the vessels cannulated at both inflow and outflow ends. By raising the heights of the Krebs reservoir and the outflow catheters appropriately, a transmural pressure that stimulated pumping activity could be applied to the vessels. With a fixed transmural pressure of 6 cm H₂O applied to the ducts, sheep erythrolysate depressed pumping activity between 40% and 100%, with dilutions containing between 10^{-8} and 10^{-5} M hemoglobin. Although the active principle in the red blood cells has not been characterized, evidence from precipitation purification experiments suggests that hemoglobin is an important component. Once suppressed, pumping could be restored in many but not all vessels (often to control levels) by elevating the distending pressure above 6 cm H₂O. The relation between transmural pressure and fluid pumping is expressed as a bell-shaped curve, with pumping increasing up to a peak pressure (usually 8 cm H₂O) and declining at pressures above this level. By comparing pressure/flow curves, we were able to ascertain that hemoglobin shifted the lymphatic function curve to the right and, on average, reduced the maximum pumping capability of the vessels. We speculate that the presence of erythrolysate/hemoglobin in lymph may modulate the ability of lymphatic vessels to drain liquid and protein from the tissue spaces