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As part of this Symposium, the following additional Poster Presentations were discussed:

MORPHOLOGICAL CHARACTERISTICS OF TERMINAL BLOOD VESSELS AND INITIAL LYMPHATICS. A COMPARATIVE STUDY OF SEM.

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The delicate vessels in the blood microcirculation and in the beginning of the lymphatic system are closely interrelated in their structural and operational features. Thus, the term "capillaries" has been used in the past for terminal blood vessels as well as for initial lymphatics. In fact, the differences between both types of vessels on the light microscopic level are very small justifying parallel terminology.

Electron microscopy has led to new knowledge of the fine structural properties of microvessels in both vascular systems, enabling a clearer classification of different vessel types in the blood capillary bed. Similarly, scanning electron microscopy (SEM) provides better understanding of the morphology and function of initial lymphatics and reveals the unusual structural features of these microvessels.

Scanning electron micrographic findings in the microvasculature of the tongue, skin, and some other organs are therefore presented here and interpreted in light of their comparative morphological and functional significance.

MATERIALS AND METHODS

Tissue preparation

Interstitial (for lymphatics) or arterial (for blood microvessels) perfusion of the organ is carried out with physiologic solution and 2.5% glutaraldehyde. Dehydration is performed in a graded series of alcohol and critical point, drying materials mounted, sputtered with gold, and the specimens examined in the AMR 1200 (Leitz, W. Germany). Experimental edema is created by increased perfusion pressure during fixation.

Corrosion casts

Injection of Mercox^{R} into the tissue (lymphatics) or from the left ventricle of the heart (blood vessels) is carried out, the tissues macerated after hardening of the resin with KOH, and specimens washed in rinsing distilled water, air dried, sputtered, and mounted in casts.

RESULTS

These studies display the general morphologic features of the initial lymphatics, including thin endothelium, wide and variable vascular diameter, and sparse basement membrane resembling blood sinusoids rather than true blood capillaries. They also exhibit some highly specialized structures. The pattern of endothelial cells, the well-developed system of open junctions with simple valve functions, and the occurrence of prominent and branched endothelial cells in initial lymphatics are special morphological characteristics of this vessel type. In precollectors the pattern of endothelial cells more closely resembled that of venules.

Although the mode of fixation within the fiber system of the connective tissue is basically the same in blood capillaries and initial lymphatics, the reticular fiber sheath surrounding the lymphatic endothelium is a structure of great functional significance in the process of lymph formation. The reticular fibers as a link in the tissue-lymphatic interface have been neglected in current theories on lymph formation and may account for the transfer of pulling forces from the tissue to the thin endothelium and thereby control the permeability of the entire system of open junctions.

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ENZYME HISTOCHEMICAL DIFFERENCES BETWEEN LYMPHATICS AND BLOOD CAPILLARIES

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The enzyme-histochemical reactions have been performed using the human skin specimens. The blood capillaries show positive alkaline phosphatase, endogenous peroxidase, acid p-nitrophenyl phosphatase and aminopeptidase whereas the lymphatic capillaries reveal all negative above reactions but weak positive alkaline

phosphatase. Other enzymes such as LDH, G-6-P, G-6-PDH, ornithin cabamoyl transferase, Na-K-ATPase, Mg-ATPase, Ca-ATPase, fructose-1, 6-diphosphatase, glycogen synthetase and phosphorylase are not different in the two capillaries. In conclusion, the lymphatic capillary is functionally different from the blood capillary and this difference can be used for the histochemical differentiation of the two capillaries.

LYMPHATICS AND THE MICROCIRCULATION OF SKELETAL MUSCLE

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The mechanism of lymphatic pumping and fluid movement from the interstitium into the lymphatic system needs to be clarified, particularly in organs such as skeletal muscle where the lymphatics in the tissue proper have no smooth muscle in their wall. Recent evidence suggests that such lymphatic vessels are expanded and compressed by the surrounding tissue structures, the arterioles, via vasomotion and pressure pulsation, and by skeletal muscle fiber contractions.

PATHOPHYSIOLOGY OF DISORDERS OF INNER EAR MICROCIRCULATION AND ENDOLYMPH

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Disturbances of longitudinal inner ear fluid flow from the stria vascularis to the endolymphatic sac (ELS) where it is filtered and resorbed leads to endolymphatic hydrops associated with Meniere's disease. Histologic studies of ELS provide insight into the development of this derangement. Fibrosis of both ELS stroma and capillary-laden perisacular tissue with luminal epithelial damage in Meniere's disease and perisacular vasculitis in patients with concomitant systemic autoimmunity point to impaired resorptive capacity as the basis for hydrops. Moreover, our immunohistochemical studies of ELS from patients with Meniere's disease or acoustic neuroma demonstrate varying quantities and distribution of T-lymphocytes, macrophages, immunoglobulins, and complement components in perivascular and luminal subepithelial tissue. Whether local immune proteins and cells play a regulatory role in fluid balance and circulation (perhaps by controlling fluid oncotic pressure), or represent an abnormal response leading to imparied resorption, and whether perisacular fibrosis occurs as an initial or late event remains unclear. Yet excess endolymph accumulates, whether by impaired resorption or overproduction or both, and audiovestibular dysfunction occurs.

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"ARE LYMPHATICS DIFFERENT FROM BLOOD VESSELS?": KEY QUESTIONS POSED BY PARTICIPANTS

Are lymphatics and lymph drainage simply an efficient way to clear tissue fluid (a superhighway as opposed to a tortuous, perilous backroad), or is it essential to optimal transport and "exposure" to the immune system (e.g. nodes)?

Is fibrosis in longstanding lymphedema syndromes related to protein, albumin, globulins, or is it an immunotype-cellular event involving mast cells, macrophages, lymphokines, and eicosanoids?

Can lymphatic propulsion be facilitated by vasoactive drugs and edemas be treated with such agents?

What are the fine structural differences between blood capillaries and post-capillary venules and the initial lymphatics?

Can one always positively tell between them with the electron microscope without putting tracers into the initial lymphatics?

What are the forces involved in the uptake of lymph from the tissues; are these their relevancies (e.g. in colloid osmotic pressure being exerted across large pores) between open junctions and fenestrae in blood capillaries?

What are the dimensions of initial and collecting lymphatics in most tissues of the body, under conditions of tissue compression and of relaxation?

What is the fine structure like, and what are the quantitative parameters, of the initial and collecting lymphtics in vertebrates other than mammals? And, indeed, of mammals other than rats and mice?

At the level of the microcirculation, one of the key questions is "lymph formation." What are the forces that drive interstitial fluid into a lymphatic channel?

Inside and outside of an organ, what lymphatics have no smooth muscle, and which lymphatics have their own smooth muscle with rhythmic contractions?

If no smooth muscle is present, how does a lymphatic channel expand and contract?

What is the role of arteriolar vasomotion and pressure pulsation in lymph formation? Why do many lymphatics follow the arterioles?

Is lymph formation determined primarily by extrinsic forces acting on the lymphatic capillary or by the active contractile properties of the vessel?

What would be the consequences at the interstitial level of modulating the activity of the lymph pump?

Do nerves or humoral factors modulate lymphatic activity *in vivo*?

Does the activity of the lymph pump always mirror the transvascular filtration rate?

Do lymphatic capillaries contract even without the presence of smooth muscle cells?

How do interstitial fluid, capillary filtrate, and lymph differ and what is the basis for the difference?

Does the wall of collectors reveal differences in structure of media and adventitia?

What is the basis of and participation of adluminal and abluminal transport in lymphatics of diameter 0.2-2.0mm?

What is the basis of the cellular and humoral composition of lymph in lymphatics?

What is the structure of the network of collectors (branching, interconnections)?

What physical properties of lymphatics (compliance, elongation, etc.) are unique to them?

Does endothelium contract based on its cytoskeletal components?

What is the nature of the links between lymphatic migration and recirculation and endothelial surfaces of lymphatics and blood vessels?

Can lymphatics become more like blood vessels and vice versa *in vivo* under pathologic conditions and can their endothelium component transform in tissue culture?