Lymphology 9 (1976) 75-77

The Bicuspid Nature of the Valves of the Peripheral Collecting Lymphatic Vessels of the Dog

Douglas R. Gnepp

Washington University Department of Pathology 660 South Euclid Avenue, St. Louis, Missouri

Summary

A controversy presently exists about the structure of lymphatic valves, the bicuspid structure vs. the funnel-like architechture. This present study, along with a review of the literature was undertaken in an attempt to clarify this controversy.

Twenty lymphatic valves from the collecting lymphatic channels draining the back paw region in four dogs were examined and several were photographed. The bicuspid nature and the three dimensional anatomy of these valves is clearly demonstrated.

Introduction

The anatomy of lymphatic valves has been investigated by several authors. *Florey* (1) using guinea pigs, *Kampmeier* (2) using human embryos and fetuses and *Oehmke* (5) in man concluded that the typical valve of the lymphatic system is the bicuspid type. *Ogo* (6) using adult cadavers describes lymphatic valves having one to five cusps, the bicuspid type being the most common, then in decreasing order of occurrence the monocuspid, tricuspid, tetracuspid and lastly the pentacuspid valve. *Webb* (9) using motion pictures of the mesentery in in the living rat elegantly demonstrated the bivalvular nature and action of the lymphatic valves. *Vajda* and *Tomcsik* (8) in their work on cats described mono, bi, and tri cuspid valve structures. *Takada* (7) studying lymphatic valves of rabbits and mice described bi, tri, and tetra cuspid structures. *Lauweryns* (3–4) on the other hand, using serial sectioning and stereomicroscopy on adult and infant human lungs found one out of 26 valves examined was bicuspid while the remaining valves "appeared to be a simple cone or funnel-like formation". He extrapolated these observations to other areas of the human body by comparing the similarity of histologic sections through pulmonary lymphatics to tissue sections through other areas of the body stating (4): "the cone or funnel-like lymphatic valvular architecture corresponds to a widespread basic structural pattern occurring throughout the human body". It was because of Lauweryns' observations and extrapolations to tissues other than the lung and my own personal observations that this study was undertaken in an attempt to clarify the three dimensional structure of lymphatic valves.

Materials and Methods

Mongrel dogs weighing approximately 45 pounds were anesthetized with sodium pentabarbital Two bundles of prenodal lymphatics, just distal to the popliteal lymph node and running parallel to and on either side of the saphenous vein were exposed using a dermal flap and tied off just distal to the lymph node. These lymphatics were carefully isolated and cleaned and one was cannulated using siliconized PE 10 tubing. After a successful cannulation the vessel was dissected distally, tieing off all collateral and branching vessels. A # 31 lymphangiography needle was inserted distally into the vessel and a glutaraldehyde solution was perfused through the isolated segment of lymphatic. The expanded vessel was tied off, removed and placed in a vial with the same fixative. After fixing the lymphatic, each valve was isolated, placed on end and carefully photographed with a dissecting microscope. One was then chosen (Fig. 1) for embedding in paraffin, serial sectioning at 25 micron intervals, and staining with hematoxylin and eosin.

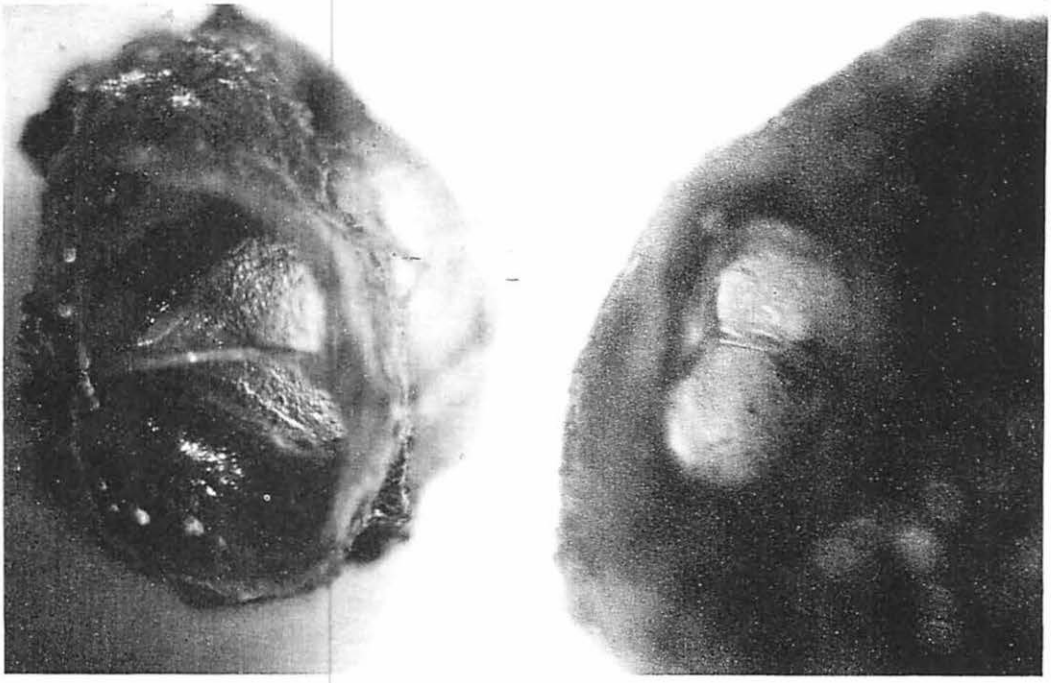

Fig. 1 A lymphatic valve in a large collecting vessel: a) Proximal surface, b) Distal surface – The vessel diameter is approximately 3 mm.

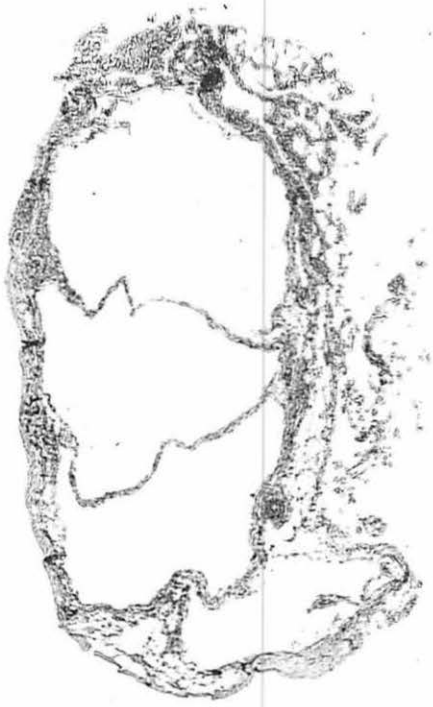

Fig. 2 A representative H and E section through the valve pictured in Fig. 1, magnified approximately twenty times normal size.

Results

Twenty valves were examined in four animals. All the valves running along the course of the collecting lymphatics examined were bicuspid in structure. These valves opened in a direction allowing proximal lymph flow. Figure 1a and b is a picture looking into both ends of one lymphatic vessel. The three dimensional structure and bivalvular nature is clearly demonstrated.

Serial sections through the valve pictured in Figure 1 were made. Figure 2 is a representative section demonstrating the histologic arrangement of the bivalvular leaflets.

This study did not include examination of valves at the junction or bifurcation of two vessels.

Discussion

The valves in the collecting lymphatics of the dog have clearly been demonstrated in this study to be of the bivalvular variety, although as other authors have pointed out, in man

they may have from one to five cusps. There were no "conical" shaped valves found in this present study or in any of the work done by *Ogo* (6) and *Kampmeier* (2). The only conclusion one can make from the above is that the conical or truncated valve structure is not a part of the large collecting lymphatic channels and that *Lauweryns'* extrapolation from the lung to other areas of the body, specifically the peripheral collecting lymphatics, is unwarranted.

However, a second possibility must be considered. That is there may be two distinctly different populations of valves, the first being the cuspid valves, ranging from one to five cusps in the collecting lymphatics, and second being a conical funnel-like structure in the lung. This issue has yet to be resolved.

References

1 *Florey, H.:* Observations on the contractility of lacteals. J. Physiol. Lond. 62 (1926-27) 267-272

2 *Kampmeier, O.F.:* The genetic history of the valves in the lymphatic system of man. Amer. J. Anat. 40, Nr. 3 (1928) 413-457

3 *Lauweryns, J.M., A. Baret, L. Boussauw:* The pulmonary lymphatics: Macroscopic and microscopic studies. Amer. Rev. Resp. Dis. 101 (1970) 448

4 *Lauweryns, J.J.:* Stereomicroscopic funnel-like architecture of pulmonary lymphatic valves. Lymphology, 4 Nr. 4 (1971) 125

5 *Oehmke, H.J.:* Periphere Lymphgefäße des Menschen und ihre funktionelle Struktur. Zeitschrift für Zellforschung 90 (1968) 320-332

6 *Ogo, M.:* Über die Lymphgefäßklappen des Menschen. Acta. Anat. Nippon. 6 (1933) 807-828

7 *Takada, M.:* The ultrastructure of lymphatic valves in rabbits and mice. Amer. J. Anat. 132 (1971) 207-218

8 *Vajda, J., M. Tomcsik:* The structure of the valves of the lymphatic vessels. Acta. Anat. 78 (1971) 521-531

9 *Webb, R.:* Observations on the propulsion of lymph through the mesenteric lymphatic vessels of the living rat. Anat. record. 57 Nr. 4 (1933) 345-50

Douglas R. Gnepp, 7144 Amherst Ave., University City, Mo., 63130 USA