

LYMPH NODE STRUCTURE IN THE SUMATRAN RHINOCEROS

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PLATE 24 AND TWO TEXT-FIGURES

(Received July 23rd, 1962)

SYNOPSIS

The histology is described, for the first time, of certain of the lymph nodes of the rare Sumatran Rhinoceros (*Didermocerus sumatrensis*). These have a marked structural resemblance to the spleen, but reveal no uniform evidence of being hæmolymph organs, though their metaplasia thereinto is indicated.

INTRODUCTION

EARLIER notices (Cave & Aumonier, 1960, 1962) gave some account of lymph node structure in the African Elephant (*Loxodonta africana*) and in three of the five extant species of rhinoceros, viz. the Great Indian Rhinoceros (*Rhinoceros unicornis*), the African White Rhinoceros (*Ceratotherium simum*) and the African Black Rhinoceros (*Diceros bicornis*). Opportunity has since been taken of making a comparable histological study of various of the lymph nodes of the rare Sumatran Rhinoceros (*Didermocerus sumatrensis*) and the findings thereof are submitted herewith. Since the Sumatran Rhinoceros, already threatened with extinction, is unlikely again to become available for detailed anatomical and histological study, it was deemed desirable—for reasons previously stated (Cave & Aumonier, 1962)—to record the results of this recent investigation of its lymph node histology.

MATERIAL AND METHODS

Microscopical examination was made of various groups of lymph nodes excised from the formalin-preserved viscera of an old female Sumatran Rhinoceros which died in the Basel Zoologischer Garten in September 1961. A detailed necropsy of the animal had been conducted by Dr. S. Lindt, of the Veterinär-pathologisches Institut of the University of Berne, the skeleton and the major viscera being afterwards preserved in the Basel Naturhistorisches Museum. Dr. Lindt very kindly supplied a copy of his necropsy findings, together with various paraffin wax blocked tissues for our examination. Dr. L. Forcart, Curator of the Basel Museum's Department of Zoology, generously forwarded the preserved viscera on loan for more detailed anatomical study. To both these gentlemen our gratitude is hereby tendered for the sympathetic and willing co-operation which alone rendered possible our investigation of *Didermocerus* lymph nodes.

Carotid, parabronchial, epipericardial, subphrenic, gastric, mesenteric and ileo-cæcal lymph nodes were excised from their formalin-preserved respective viscera: they were

paraffin wax blocked, sectioned serially at 10 μ thickness and the sections stained by hæmatoxylin and eosin and by hæmatoxylin and van Gieson's stain.

OBSERVATIONS

Examination of various of the deep cervical (carotid) nodes (Pl. 24, figs. 1, 2) reveals the following histological picture. The well vascularized node capsule is extremely thick and is composed of dense fibrous tissue wherein lie a few scattered plain muscle fibres: the marginal sinus is well marked. From the capsule trabeculæ of relatively enormous size pass to the interior of the node, carrying within them arterial vessels of surprisingly large size: the trabeculæ in many instances exceed the capsule in thickness, and contain relatively more fibrous tissue and plain muscle. Around them are very obtrusive paratrabecular sinuses, which are in continuity with the large marginal sinus.

The customary differentiation of the nodal tissue into cortex and medulla is wanting. The "medulla" is not centrally disposed but is diffusely distributed (recalling splenic arrangements) and the compact "cortical" lymphoid tissue does not form secondary nodules, but rather takes the form of an enormous mass, having within it scattered patches of "medulla". There is evidence of much widespread phagocytosis of hæmosiderin, the Prussian blue reaction demonstrating the presence of iron in abundance, and suggesting a nodal activity comparable to that of the spleen.

The nodal blood-vessels are relatively large: they do not manifest any sinusoidal endings but effect the ordinary type of capillary plexus.

The general intranodal irregular distribution of the "medullary" tissue and the extraordinary thickness of the nodal trabeculæ are perhaps the most obtrusive histological feature. "Cortical" tissue predominates. The looser "medullary" lymphoid tissue tends to lie nearer the capsule, while the denser, compact nodular or "cortical" lymphoid tissue appears to follow the trabeculæ in its distribution—almost a reversal of the customary pattern of cortico-medullary disposition.

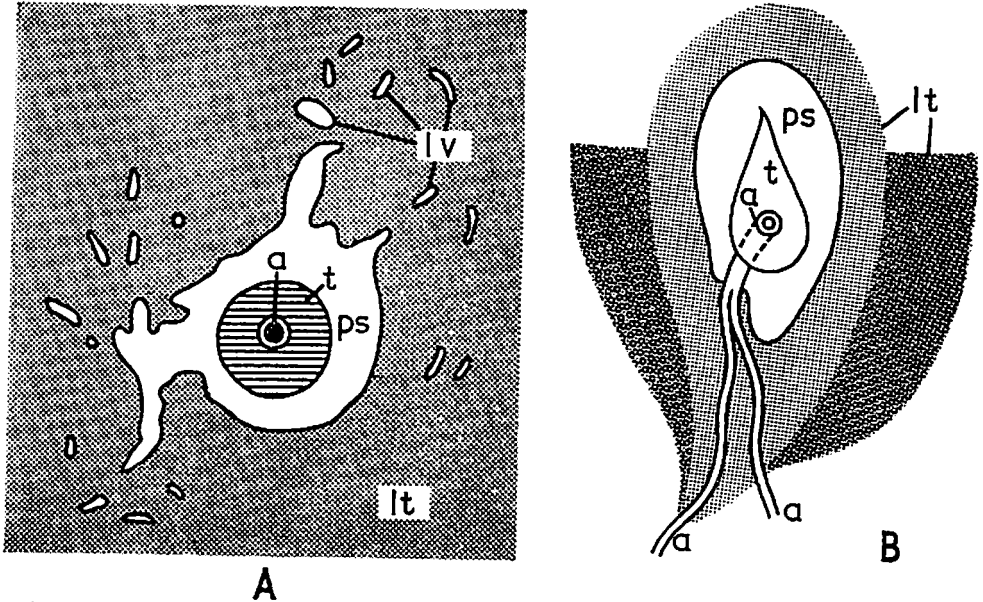
The wide paratrabecular sinuses, in continuity with the marginal sinus, send out numerous offshoots into the surrounding lymphoid tissue, which is seen to be occupied by a veritable lymphatic plexus (text-fig. 1A). Each paratrabecular sinus isolates an enormously stout fibro-muscular trabecula, encased within which is an arteriole from the capsular vascular plexus (text-fig. 1B). This intratrabecular arteriole, after a greater or lesser course within the substance of its trabecula, leaves this fibrous pillar and traverses the paratrabecular sinus to enter the lymphoid tissue. Therein it participates in the formation of the contained vascular plexus, from which, finally, emerges the definitive hilar vein.

All the available histological evidence suggests that the vascular plexus itself is in the nature of an arterio-venous anastomosis, for the intratrabecular arteriole is traceable, through successive sections, into continuity with the venous radicles of this plexus (text-fig. 2).

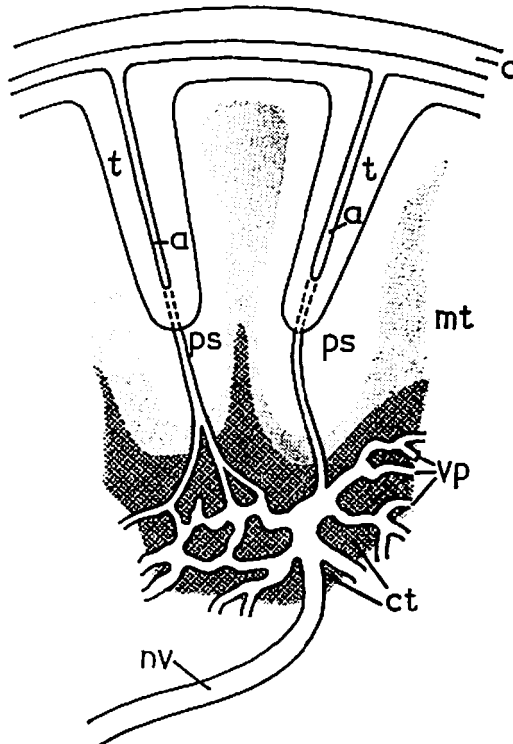
There is therefore within the lymphoid tissue of the node a rich lymphatic plexus and an equally definite vascular capillary plexus, wherein continuity is established directly between the trabecular arterioles and the radicles of the nodal vein.

Loose erythrocytes are absent from the tissue spaces.

In the parabronchial lymph nodes much the same histological pattern is apparent. The nodal capsule is composed of a thick layer of fibrous tissue containing a few scattered strands of plain muscle. The trabeculæ running inwards therefrom are incredibly large and thick, much thicker indeed than the capsule, which they resemble in structure. There is no



Text-figure 1.—Showing (A) the relationship of the peritrabecular sinus to the surrounding lymphatic plexus; (B) an intratrabecular arteriole crossing the paratrabecular sinus.
 a=arteriole; t= trabecula; p.s.= paratrabecular sinus; l.v.= lymphatic vessels; l.t.= lymphoid tissue.



Text-figure 2.—Showing, diagrammatically, the vascular arrangements of the *Didermoceros* lymph node.
 a=intratrabecular arteriole; c= capsule; t= trabecula; p.s.= paratrabecular sinus; m.t.= medullary tissue;
 c.t.= cortical tissue; v.p.= vascular plexus; n.v.= nodal vein.

regular pattern of differentiation of the lymphoid tissue into cortex and medulla. The nodal vasculature is well developed. No extravascular erythrocytes are present. Pigment deposits are discernible throughout the sections.

The general organization of the node is unlike anything seen hitherto in mammalian lymph nodes, so that the precise nature of the node is difficult of assessment. It resembles neither the ordinary type of lymph node nor a definite hæmolymp node, but appears to be an organ of an intermediate nature. It is reminiscent of the spleen in the distribution of its trabeculæ and lymphoid tissue nodules, but it differs therefrom in its lack of extravascular erythrocytes.

The epipericardial nodes reveal the same thick, vascular type of capsule and the same huge, thick trabeculæ, these latter containing each an arteriole and some of them containing (as an unusual feature) valved lymph channels. The marginal and paratrabeular sinuses are well developed, and the former contains a few erythrocytes. There is no clear cortico-medullary differentiation, merely a diffuse arrangement of "medullary" tissue, containing much hæmosiderin. The hæmolymp nature of this node is evidenced by the presence of erythrocytes in the tissue spaces. Macrophages, containing much hæmosiderin, are widely scattered throughout the node, being most noticeable in its more "diffuse" portions.

A flattish subphrenic node adherent to the inferior surface of the diaphragm is of purplish colour naked eye. Histologically it, too, shows an extremely thick, fibrous capsule which contains however a relatively large amount of plain muscle. Its trabeculæ are so enormously thick that they occupy most of the interior of the node. There is a somewhat random arrangement of the cortical and medullary tissue. The intertrabeular spaces are largely filled with pigment-containing reticulo-endothelial cells: where pigmentation is less marked, some loosely arranged lymphoid tissue is apparent: there is nowhere any "ordinary" or dense lymphoid tissue. This subphrenic node is unlike the spleen in showing no extravascular erythrocytes. It has possibly been affected by pathological change (Pl. 24, fig. 4).

The gastric and mesenteric lymph nodes manifest a notably rich blood supply. The extremely thick fibrous capsule of the individual node contains a little plain muscle and sends centralwards trabeculæ of extraordinary thickness and coarseness, each supporting interiorly an arteriole from the capsular vascular plexus (Pl. 24, fig. 3). A well developed marginal sinus is devoid of erythrocytes: smaller, dilated lymph sinuses (part of a plexiform arrangement of such vessels) are evident within the parenchyma. There is no clear zonal separation of the cortex and medulla; some secondary nodules, with relatively small attendant arteries, are distinguishable. Hæmosiderin deposits are widely scattered throughout the sections. Nowhere do extravascular erythrocytes occur. In the hilar region there is no medulla, strictly speaking, merely some relatively large paratrabeular sinuses containing lymphocytes. The intestinal lymph node is thus structurally unlike the hæmolymp nodes of other rhinoceros species studied previously.

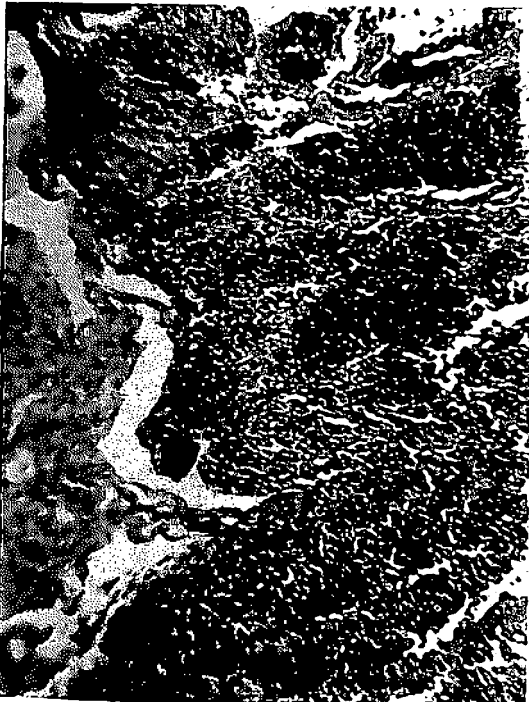
An ileo-cæcal lymph node is extremely vascular. The capsule, of fibrous tissue and plain muscle, contains abundant arteries and lymphatic vessels. The massive fibrous trabeculæ contain a little plain muscle and each supports a number of relatively large blood-vessels. The well developed marginal sinus contains no erythrocytes. The parenchyma shows no clear separation into cortical and medullary zones: it is predominantly cortical in nature, such patches of medullary tissue as do occur being diffusely distributed. Secondary nodules are distinguishable, though these are not very emphatically developed. The whole node is very unlike its human counterpart and, save in its lack of extravascular erythrocytes, it bears a general structural resemblance to splenic tissue.



1



2



3



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DISCUSSION

A summary of the present histological evidence shows the *Didermocerus* lymph node to be a highly vascular and active organ, with thick fibro-muscular capsule and much thicker fibro-muscular trabeculæ, the latter supporting intratrabecular arterioles which proceed directly into the parenchymal vascular plexus; marginal, paratrabecular and intraparenchymal lymph sinuses are emphatically developed and are devoid of erythrocyte content. The lymphoid tissue shows a variable arrangement of its cortex and medulla: a given node may consist principally of cortical tissue containing scattered patches of medulla, or medullary tissue may abound peripherally while the cortical tissue is centrally placed. Secondary nodules may or may not occur and are never obtrusive features of the node. Iron pigment is abundantly present throughout the parenchyma. The bulk of the histological evidence does not permit the certain attribution to the node of any hæmolymph function. It manifests a structure totally unlike that of the human node and much more akin to that of the spleen.

The absence (or the very moderate development) of secondary nodules in the nodes may be representative of nothing more than mere age-change. The variable mutual relationship of cortex and medulla observed in nodes from different regions is consistent with findings in other mammals (e.g. *Sus*), while the relative proportions of cortical and medullary tissue fall within the range of normal variation to be expected in the nodes of a particular individual.

In such structural particulars as the nature of its capsule, trabeculæ, vascular details and cortico-medullary arrangement, the lymph node of *Didermocerus* agrees histologically with the nodes of other rhinoceros genera examined (*Rhinoceros*, *Diceros*, *Ceratotherium*). It differs from these, however, in manifesting as a rule no evidence of hæmolymph function. It is much akin to the spleen architectonically, but it differs therefrom in its marked lack of extravascular hæmocytcs. It is indeed an organ of peculiarly distinctive nature and difficult of ready classification. That, under suitable conditions, it may assume the characteristics and function of a hæmolymph node seems to be plainly indicated by the histological evidence provided by the epipericardial nodes of the present specimen.

REFERENCES

- AUMONIER, F. J. & CAVE, A. J. E. (1960).—A note on the visceral histology of *Ceratotherium*. *J. R. micr. Soc.*, 78, 120.
 CAVE, A. J. E. & AUMONIER, F. J. (1962).—Elephant and rhinoceros lymph-node histology. *J. R. micr. Soc.*, 80, 209.

DESCRIPTION OF PLATE 24 (see after p. 76.)

- Fig. 1.—*Didermocerus sumatrensis*, ad. Carotid lymph node. Showing marginal sinus and the lymph sinuses of the lymphoid tissue. $\times 300$. Hæmatoxylin and eosin.
 Fig. 2.—*Didermocerus sumatrensis*, ad. Carotid lymph node. Showing intratrabecular arterioles traversing the paratrabecular sinus to enter the lymphoid tissue. $\times 300$. Hæmatoxylin and eosin.
 Fig. 3.—*Didermocerus sumatrensis*, ad. Mesenteric lymph node. Showing the peculiar distribution of the cortical and medullary tissue. $\times 100$. Hæmatoxylin and eosin.
 Fig. 4.—*Didermocerus sumatrensis*, ad. Subphrenic node. Showing fibrosis and phagocytosis of hæmosiderin. $\times 300$. Hæmatoxylin and eosin.