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THE RELATION OF THE LYMPHATIC SYSTEM TO HEMOLYMPH NODES IN THE SHEEP

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ABSTRACT:

Sublumbar lymphatic drainage was examined in fetal and adult sheep for potential connections with hemolymph (hemal) nodes. Despite numerous channels entering sublumbar lymph nodes there were no lymphatic communications with hemal nodes. In ovine ruminants hemolymph nodes are separate from the lymphatic system.

Since the earliest works on *Lymphonodus hemalis* (Nodus hemalis, hemolymph nodes or hemal nodes), a rigorous definition of these structures based on morphologic and physiologic criteria has been needed. From an anatomic standpoint, hemolymph nodes in ruminants have usually been considered separate from the lymphatic system (1-5). That this issue is not fully settled, however, is indicated by a recent description in cattle of apparently direct communications between lymphatics and hemolymph nodes (6). To clarify whether hemolymph nodes are independent or interdependent of the lymphatic system we reexamined sublumbar lymphatics of fetal and adult sheep and determined the relationship with hemolymph nodes using techniques described by Fabian (7).

MATERIALS AND METHODS

Adult and fetal sheep were used in this study and divided into three groups. Sheep sex was not determined.

Group 1: Fetal sheep in the size range of 2-40 cms were fixed and preserved in 7% formalin (35 specimens).

Group 2: Fresh fetal sheep>30 cm were obtained from the local slaughterhouse (8 specimens).

Group 3: Adult sheep (11 specimens).

Fetal sheep were dissected using stereoscopic microscopy and an attempt was made to detect possible differences between sublumbar hemolymph nodes and "ordinary" lymph nodes by chronologic fetal age. Different size nodes from the sublumbar region were also examined using optical microscopy. Even when fetal sheep were>20 cm it was usually necessary to color nodes to facilitate visualization.

With fresh fetal sheep, patent blue violet was first injected either into the interdigital space or regional lymph nodes to visualize sublumbar lymphatics. αbenzopyrone (Venalot) was also injected into the lymphatics to promote dilatation and was followed thereafter by "Japanese ink" to outline lymphatic pathways and their interconnections.

Each adult sheep was sacrificed with an intravenous overdose of sodium pentobarbital, and the abdomen opened. Sublumbar lymphatics were readily identified and "Venalot" and Japanese ink injected directly into a lymphatic channel. In some sheep the thoracic duct was cannulated (8) and the lymphatic system instilled with Japanese ink either antegrade or retrograde.

RESULTS

Fig. 1 schematically demonstrates the anatomy of the sheep sublumbar area. In small and medium size fetal sheep, identification of nodes was extremely difficult because of location, small size and ongoing development of the renal (mesonephros) system. Neither by microdissection nor optical microscopy were lymph and hemal sublumbar nodes distinguishable in these fetuses.

In large fresh fetal sheep, lymphatics were consistently able to be cannulated but there were no connections between lymphatic channels and "nodes" that later formed hemal nodes in adult sheep. There were numerous communications, however, between iliosacral lymphatics and lymph nodes (Fig. 2), as confirmed histologically. Similarly in adult sheep there were no connections between lymphatics and hemal nodes although there were numerous connections with paralumbar lymph nodes (Fig. 3,4).

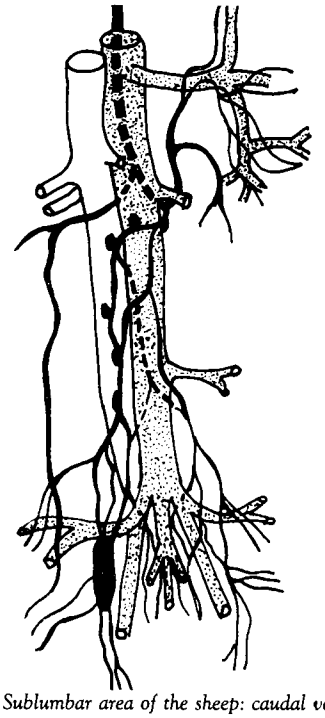

Fig. 1: Sublumbar area of the sheep: caudal vena cava (white), abdominal aorta (speckled), lymphatics and lymph nodes (black) (after Grau). (12)

DISCUSSION

Since Warthin in 1902 (9) wondered whether "hemolymph nodes" are *sui generis* structures, many investigators have pursued this question. It is now generally accepted that true hemal nodes exist in ruminants (but probably not normally in other domestic animals), and that even among domestic ruminants (e.g. ox, goat, sheep) there are morphological differences of hemolymph nodes (10-14). In cattle, however, because true lymph nodes reside in close proximity to hemolymph nodes extreme care is required to avoid confusion about connections between lymphatic channels and hemal nodes.

Whereas mature sheep exhibit a clear

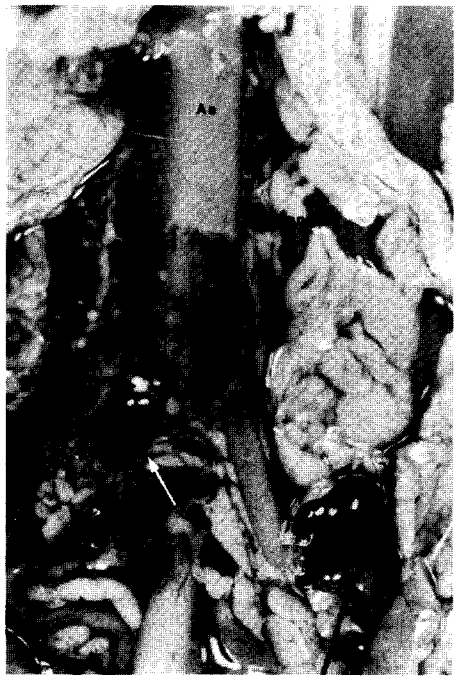

Fig. 2: Connection between sublumbar lymphatics and regional lymph nodes after injection of Japanese ink into a fetal sheep of 35 cm length. Arrow signifies a lymph node. Lnn hm (hemolymph node) Aa (abdominal aorta).

distinction between hemal nodes and true lymph nodes, this separation has been less clearly defined in the past in fetal ruminants. Jordan (15) and Winqvist (16), for example, propose that these nodes are identical. Tondury and Kubik (17), on the other hand, maintain that even before birth hemal and true lymph nodes have differentiated while Fabian claims that histologically they are already distinguishable. Finally, Zietzschmann and Krolling (18) view lymph and hemal nodes as indistinguishable early in utero, but with time a gradual differentiation ultimately occurs. According to these last authors, a hemal node may represent a biological involution within the lymphatic system.

The present study tends to confirm that hemal nodes are indistinguishable from true lymph nodes in fetal sheep<20 cm. In those >35 cm slight differences with aging occur in color and microscopy, owing to the increased presence of blood. In mature sheep, however, these nodal differences are clearly identifiable and there is no direct connection between lymphatics and hemal nodes.

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Fig. 3: Sublumbar lymphatics of an adult sheep after injection with Venalot and Japanese ink demonstrating connection with lymph node (arrow) but not hemal nodes (Lnn hm).

Fig. 4: Lymphatics of an adult sheep after injection with Venalot and Japanese ink demonstrating connection (arrow) with lymph node but not hemal node. Note the different tone and texture of the hemal node (Lnn hm) (Aa-abdominal aorta), Vcc (caudal vena cava).

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