

# Smooth muscle distribution in the capsule and trabeculae of the caprine superficial cervical lymph node

O. M. Faroon<sup>1</sup>, R. W. Henry<sup>1</sup> and F. K. Al-Bagdadi<sup>2</sup>

<sup>1</sup>The University of Tennessee, College of Veterinary Medicine, Department of Animal Science, Knoxville, TN, USA;

<sup>2</sup>Louisiana State University, School of Veterinary Medicine, Department of Veterinary Anatomy and Fine Structure, Baton Rouge, LA, USA

**Summary.** This study centers around the dichotomy found in the literature concerning the presence of smooth muscle cells in the trabeculae and capsule of lymph nodes. Various superficial lymph nodes (mammary, mandibular, popliteal, subiliac, and superficial cervical) of the goat were collected and examined by light and electron microscopy. Smooth muscle cells were demonstrated in the capsule and trabeculae of lymph nodes independent of the blood and lymph vessels.

**Key words:** Lymph node — Smooth muscle — Goat (caprine) — Light and electron microscopy

## Introduction

The presence of smooth muscle in the capsule of the lymph node was first observed by Orsos (1926). Belleli (1939), cited by Battezzati (1972), described smooth cells between the connective tissue and elastic fiber bundles of the capsule. Banks (1981) characterized the capsule as being of white fibrous connective tissue that rarely contains elastic tissue and smooth muscle. However, Banks (1986) did not mention the presence of smooth muscle. Greep and Weiss (1973) stated that the capsule has dense connective tissue with some muscle. Comparini (1958), cited by Battezzati (1972), observed smooth muscle in the capsule at the hilus as the collecting ducts enter the lymph node. He concluded that the muscular coat of afferent lymph vessels continue into the capsule. Folse et al. (1975) found smooth muscle independent of blood or lymph vessels both in the capsule and trabeculae of human and bovine lymph nodes. Other authors, Cohen (1975), Elias (1978), Borysenko et al. (1979) and Ham (1979), describe the capsule and trabeculae as dense collagenous connective tissue, which extends inward

as strands or trabeculae. These fibrous trabeculae intermingle with a fine meshwork of reticular fibers which make up the stroma. However, they did not indicate the presence of smooth muscle cells, suggesting their absence.

Literature on light and transmission electron microscopy of the lymph node is well documented for the human and for many economically important mammals. However, very little information is available on the smooth muscle of caprine peripheral lymph nodes. This study was conducted to demonstrate the presence or absence of smooth muscle in caprine peripheral lymph nodes and the distribution pattern of smooth muscle if present.

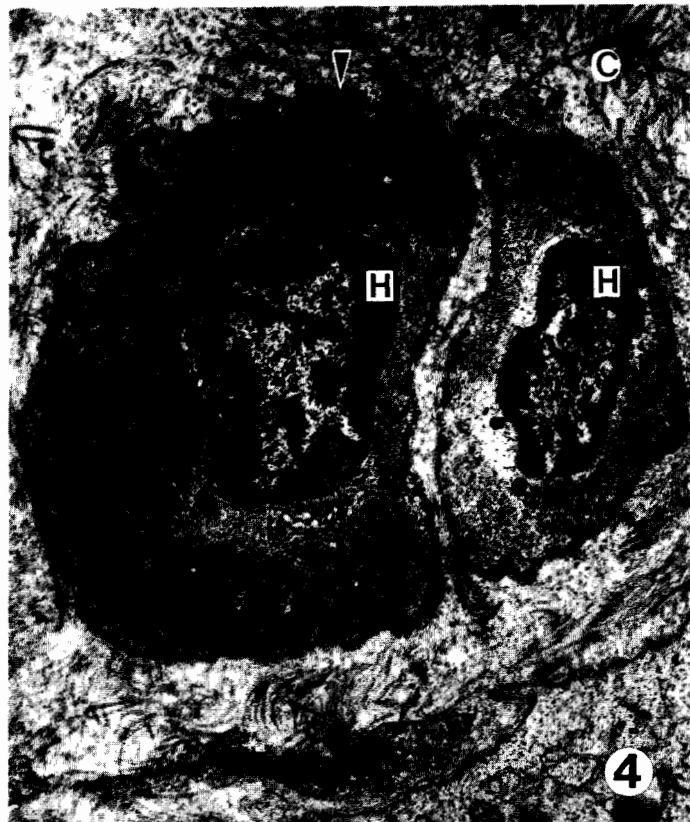
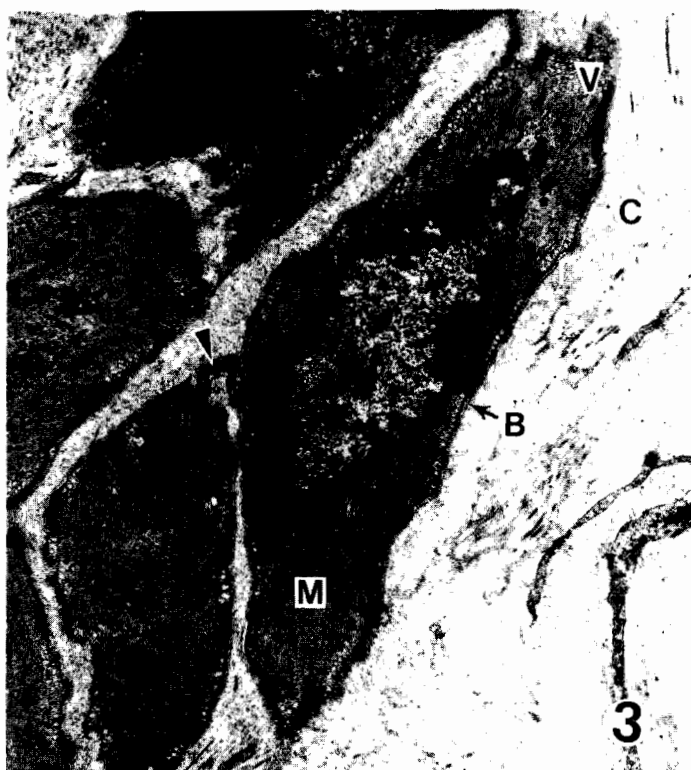
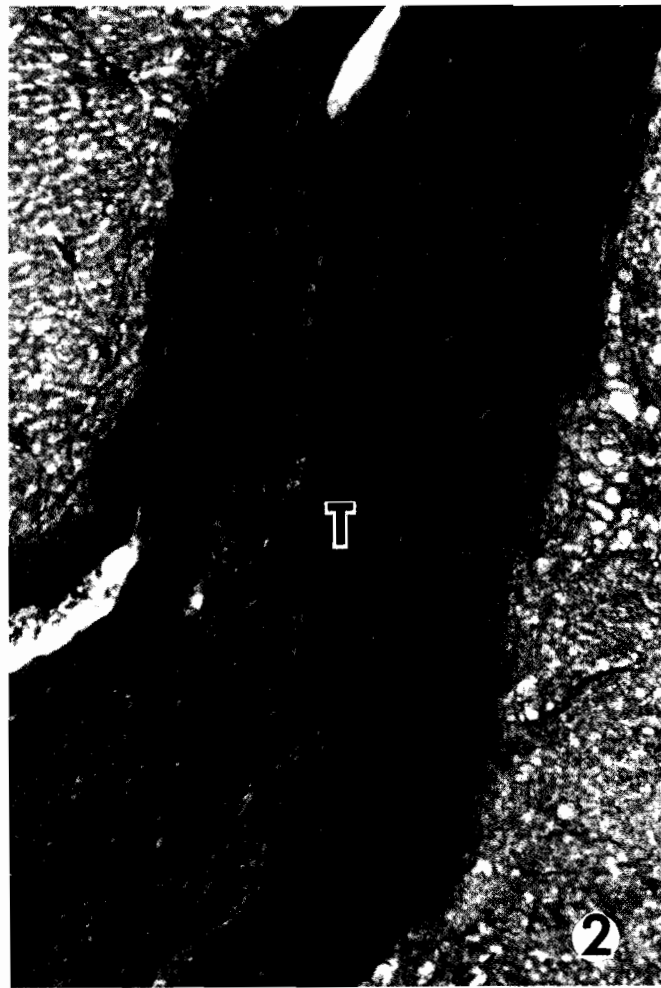
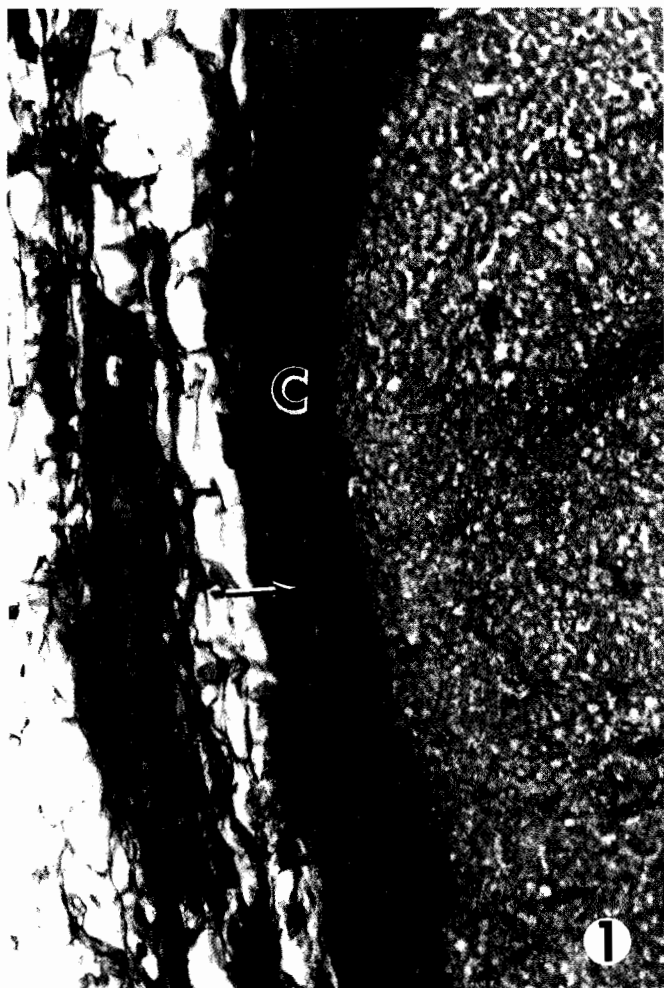
## Materials and methods

Eight healthy adult mixed breed female goats were used in this study. The goats were dewormed with levamisole phosphate 13.65%, subcutaneously at a rate of 2cc/cwt and were kept under clinical observation for three weeks. Each goat was anesthetized with chloropent (50 cc/cwt) via the jugular vein and the mammary, mandibular, popliteal, subiliac, and superficial cervical lymph nodes were removed. Transverse sections were taken of each node and placed in 10% buffered formalin or 3% glutaraldehyde in 0.1 M sodium cacodylate buffer at pH 7.4. Specimens were prepared and processed for routine light microscopy in paraffin and for transmission electron microscopy. Specimens for light microscopy were stained with Milligan's trichrome stain (Humason, 1972). TEM specimens were postfixed in 1% OSO, and embedded in epon 812.

## Results

Study of the lymph node samples by light microscopy shows they contain smooth muscle in their trabeculae and capsule. Serial sections confirm these cells were not those of the wall of blood or lymph vessels. Small smooth

Offprint requests to: O. M. Faroon, BVM&S, MSc; P.O. Box 1071, College of Veterinary Medicine, The University of Tennessee, Knoxville, TN 37901-1071, USA



**Fig. 1** Caprine Popliteal Lymph Node. The capsule (C) is bordered by adipose tissue and contains free smooth muscle fibers (arrow). Milligan's trichrome,  $\times 200$

**Fig. 2.** Caprine Mandibular Lymph Node. Thick trabecula (T) contains collagen bundles and both transverse and longitudinally sectioned smooth muscle cells. Milligan's trichrome,  $\times 300$

**Fig. 3.** Caprine Superficial Cervical Lymph Node. Longitudinal sections of smooth muscle cells are surrounded by collagen fibers (C). Cellular bridges (arrowhead) join cells where the basal lamina (B) is not continuous. Abundant myofibrils (M) are present in the sarcoplasm with vesicles (V) at the periphery. Uranyl acetate and lead citrate,  $\times 23,000$

**Fig. 4.** Caprine Superficial Cervical Lymph Node. Cross sections of smooth muscle cells are surrounded by collagen fibers (C) and have irregular sarcolemma surrounded by the basal lamina (arrowhead). Heterochromatin (H) is clumped along the nuclear envelop. Uranyl acetate and lead citrate,  $\times 33,000$

muscle bundles were found scattered among the fibrous connective tissue of the capsule and trabeculae (Figs. 1, 2). The smooth muscle cells stained magenta with Milligan's trichrome stain and were localized in the inner third of the capsule but throughout the trabeculae. Most cells had a parallel orientation; but occasional random orientation was seen. Each cell was elongated and fusiform in shape. One centrally located nucleus was found in each cell. Both longitudinal and cross sectional profiles were observed in the capsule and trabeculae. When viewed with the electron microscope the appearance of the smooth muscle cell was typical. Longitudinal sections of cells were fusiform; while cross sectional profiles were rounded with an irregular cell membrane. The cytoplasm was filled with vesicles (Figs. 3, 4). A thin basement membrane was present along with thin cytoplasmic connections between cells (Fig. 3). The nuclei were elongate ovals with an irregular contour (shallow indentations). Heterochromatin formed a thin band near the nuclear envelop while euchromatin occupied the center of the nucleus. Appropriate sections show a prominent nucleolus. The cytoplasm was abundant and filled with dark granules. The oval to rounded mitochondria were small and few in number. A small Golgi apparatus was seen at one pole of the nucleus. Myofilaments course parallel to the longitudinal axis of the smooth muscle cell. Little rough endoplasmic reticulum was observed.

## Discussion

Contrary to Cohen (1975), Elias (1978), Borysenko et al, (1979), and Ham (1979) this study confirms the presence of smooth muscle cells in the capsule and trabeculae of the caprine superficial lymph nodes. Comparini (1958) concluded that the muscular coat of afferent lymph vessel continued into the capsule. Orsos (1928) and Belleli (1939) and Greep and Weiss (1973) did not mention whether the smooth muscle cells in the capsule and trabeculae were part of the blood and lymph

vessel or not. Our studies show these smooth muscle cells were independent of the lymphatic and blood vessels. The cross and the longitudinal sections which were observed indicate that the smooth muscle courses in various directions. Our investigation confirms the study done with human and bovine lymph nodes by Folse et al. (1975). However, they did not mention the function of the cells. Our conclusion is these smooth muscle cells help to regulate quantity and flow of blood and lymph within the lymph nodes. Contraction of these cells upon adrenergic stimulation leads to discharge of the lymph and blood into the systemic circulation. However, additional studies are needed.

*Acknowledgements.* This work was supported in part by The University of Tennessee, College of Veterinary Medicine, Department of Animal Science and The Louisiana State University, School of Veterinary Medicine, Department of Veterinary Anatomy and Fine Structure.

## References

- Banks W.J. (1981). Applied Veterinary Histology. Williams & Wilkins, Baltimore. pp 322-326.
- Banks W.J. (1986). Applied Veterinary Histology 2nd ed. Williams & Wilkins, Baltimore. pp 330-339
- Battezzati M. and Donini I. (1972). The Lymphatic System Rvsd ed., Translation by Vilfrido Cameron-Curry. John Wiley & Sons, New York. pp 11-56.
- Belleli F. (1939). Sulla presenza di fibre muscolari lisce e di fibre elastiche in alcune linfoghiadole superficiali e profondi dell'uomo. *Monit Zool. Ital.* 50: 146.
- Borysenko M., Borysenko J., Beringer T. and Gustafson A. (1979). Functional Histology. Little, Brown & Co, Boston. pp 95-97.
- Cohen A. (1975). Handbook of Microscopic Anatomy for the Health Sciences: The CV Mosby Co., St. Louis. pp 52.
- Comparini L. (1958). La minuta struttura dei collettori linfatici superficiali e profondi delle arti dell'uomo. Siena, Tip. Nuova.
- Elias H., Paul J.E. and Burns E.R. (1978). Histology and Human Microanatomy 4th ed. Wiley Med Pub., John Wiley & Sons, New York & Toronto. pp 232-236.
- Folse D.S., Beathard G.A. and Granholm N.A. (1975). Smooth muscle in lymph node capsule and trabeculae. *Anat. Rec.* 183: 517-522.
- Greep R.O. and Weiss L. (1973) Histology 3rd ed. McGraw-Hill Book Co., New York. pp 432-436.
- Ham A.W. and Cormack D.H. (1979). Histology 18th ed. J B Lippincott Co., Philadelphia & Toronto. pp 344-346.
- Humason G L. (1972). Animal tissue techniques 3rd ed. W H Freeman & Co., San Francisco. pp 197-199.
- Orsos F. (1926) Das Bindegewebsgerüst der lymphknoten im normalen und pathologischen Zustand. *Birtr. Z. Path Anata.* 75:15-134.

Accepted May 15, 1987