Int.J.Curr.Microbiol.App.Sci (2018) *7*(4): 3063-3068

International Journal of Current Microbiology and Applied Sciences
ISSN: 2319-7706 **Volume 7 Number 04 (2018)**
Journal homepage: http://www.ijcmas.com

Original Research Article https://doi.org/10.20546/ijcmas.2018.704.347

Scanning Electron Microscopic Features of the Renal Arteries in Indian Goat (*Capra hircus*) and Pig (*Suscrofa domesticus*)

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Keywords

Renal artery, Goat, Pig

Article Info

Accepted:
23 March 2018
Available Online:
10 April 2018

A B S T R A C T

Scanning electron micrographic observations of renal arteries of goat and pig which revealed a thin tunica intima enveloped by packed layer of smooth muscle cells in media in both species. Endothelium was wavy in outline on internal aspect of renal arteries in goats and pigs. It presented cushion like foldings which were aligned across the longitudinal axis of the artery. Outer parts of tunica media were anchored by fine collagen fibrils and elastic fibers to the collagen tissue in adventitia. In case of pig, tunica adventitia of renal arteries was relatively thicker than that of the goat. Internal diameter of pig renal artery was more than the goat renal arteries. Internal elastic membrane was comparatively thin wavy structure with invaginations into the tunica media.

Introduction

Renal artery comprised well developed three layers *viz,* tunica intima, media and adventitia whose structural proportion varied with the size and function of the particular artery (Vodenicharov and Cirnuchanov, 1995). The endothelium was the only cell type found in the tunica intima while tunica media consisted of pure population of smooh muscle cells and fewer strands of elastic fibers are seen in muscular artery (Pease and Sandra, 1960). The inner elastic membrane is separated into two and occasionally three membranes of various thickness, among which single smooth-muscle fibres are found (Alekseevskih, 1969) which was a normal event in adult humans (Evans, 1960). Outer elastic membrane is of regular thickness (Alekseevskih, 1969). Apart from an outer elastic membrane, some authors have described a collagen and an elastic adventitia (Fourman and Moffat, 1971). The renal artery shows a gradual transition from elastic to muscle type from its enit to hilus (Obsorne-Pellegrin, 1978).

Materials and Methods

Renal artery samples were collected from twelve adult apparently healthy goats and pigs For SEM studies fresh one cubic mm tissue pieces of renal arteries of goats and pigs were taken and fixed in 2.5 % glutaraldehyde in 0.1 M phosphate buffer (pH 7.2) for 24 hrs at 4 °C and post fixed in 2 % aqueous osmium tetroxide for 4 hrs. Post fixation samples were

dehydrated in series of graded alcohols and dried to critical point drying. Samples were mounted over stubs with double sided carbon conductivity tape and thin layer of gold was coated in automated sputter coater and scanned under Scanning electron microscope.

Results and Discussion

SEM studies revealed that cross sections of three renal artery segments in both species displayed a thin tunica intima surrounded by a packed layer of smooth muscle cells in media which in turn was enveloped by a network of predominantly collagen and few elastic fibres in outer adventitia (Fig. 1) which was relatively thicker in pig specimens (Fig. 2). Endothelial layer was seen in a wavy pattern on the internal aspect of both species. It appeared cushion like and were aligned across the longitudinal axis of the artery. This wavy cushion like foldings were evenly spaced apart (Figs. 1 and 3) which was akin to the mention of arterial cushions on endothelial wall which helps in directing and regulating the blood flow in organs (Ono *et al.,* 1979; Casellas *et al.,* 1989 in rat renal arteries and vascular casts in eleven different organs respectively). They reported that these arterial cushions were valve like which help in regulating blood flow in smaller vessels.

Approximate average of tunica intima at three places was about 36.7 µm and 40 µm, tunica media was 269 µm and 117.9 µm and adventitia was about 126 µm and 93.3 µm (Figs. 4 and 5) in goat and pig respectively. It contained endothelial and sub epithelial connective tissue, Endothelium was a sheet of squamous cell layer which was present in wavy undulating manner and had tiny spaces in between the folds of pig specimens (Fig. 3). The elevations were across the longitudinal axis of the artery and were separated by shallow clefts, which in few places were a little deep (Fig. 6).

Fig.1 Scanning electron micrograph of cross section of renal artery of goat showing three tunics (SEM- 70X)

1 - tunica intima, 2 – tunia media, 3 – tunica adventitia, E – endothelium

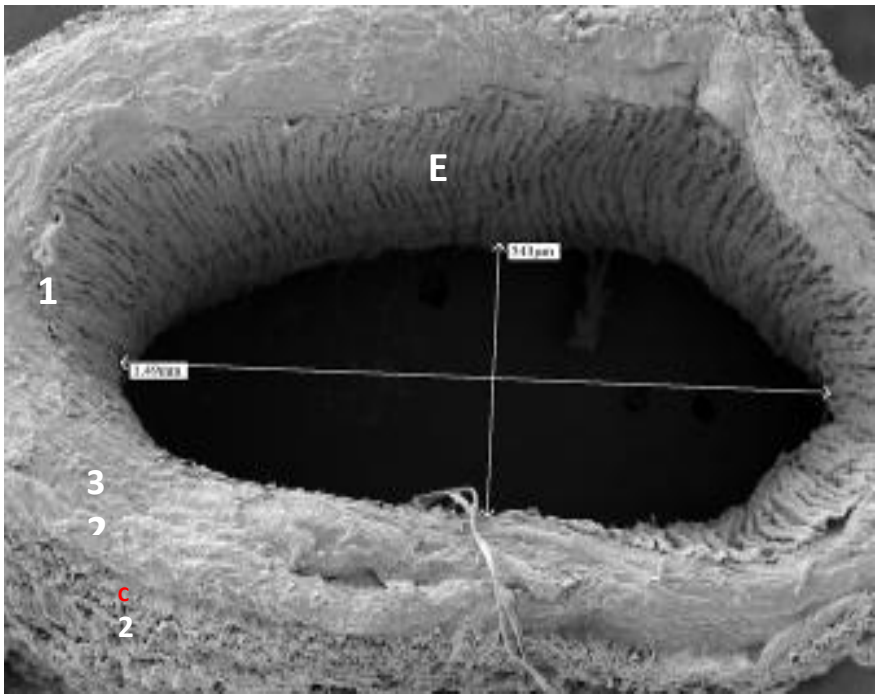


Fig.2 Scanning electron micrograph of cross section of renal artery of pig showing all three layers

(SEM – 120X)

1 – tunica intima, 2 – tunica media, 3 – tunica adventitia

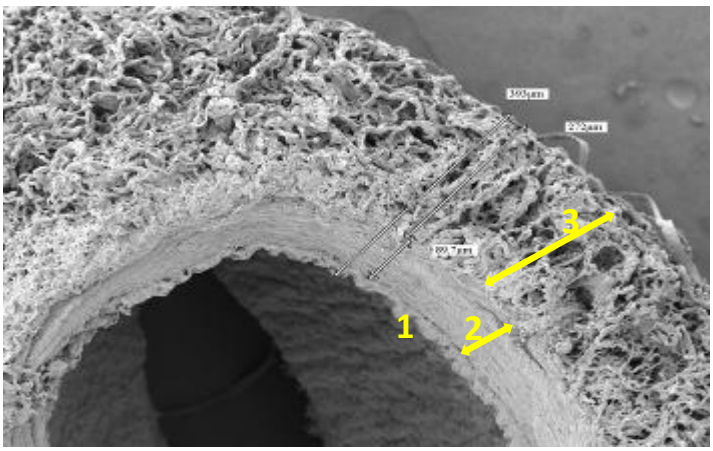


Fig.3 Scanning electron micrograph of cross section of renal artery of pig showing wavy pattern of endothelium (*) and smooth muscle cell (SMC) layers in tunica media

(SEM – 500X)

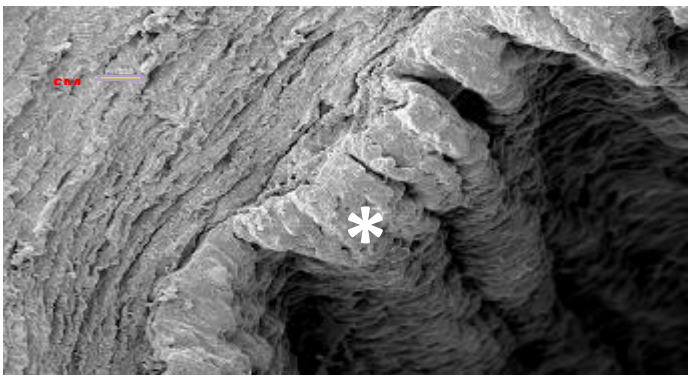


Fig.4 Scanning electron micrograph of cross section of renal artery of goat showing measurements of all three layers

(SEM- 180X)

1 – tunica intima, 2 - tunica media, 3 – tunica adventitia

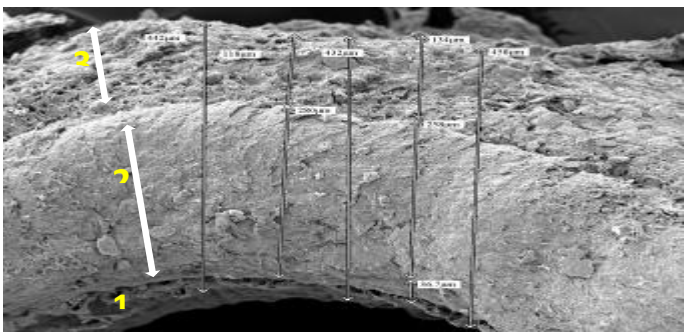


Fig.5 Scanning electron micrograph of renal artery of pig showing measurements of all three layers

(SEM – 120X)

1 – tunica intima, 2 – tunica media, 3 – tunica adventitia

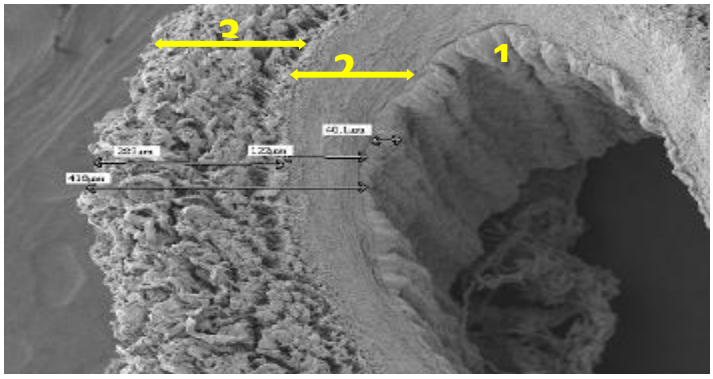


Fig.6 Scanning electron micrograph of renal artery of goat showing wavy endothelium (E) and smooth muscle cells (SMC) in tunica media

(SEM – 500X)

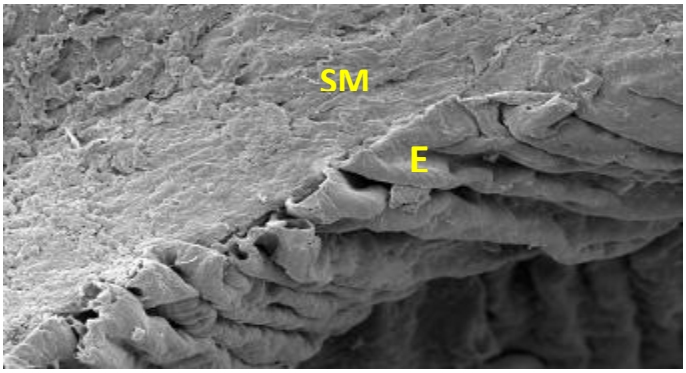


Fig.7 Scanning electron micrograph of renal artery of goat showing deep invaginations (*) of internal elastic membrane (→) in some planes

(SEM – 2500X)

E - endothelium

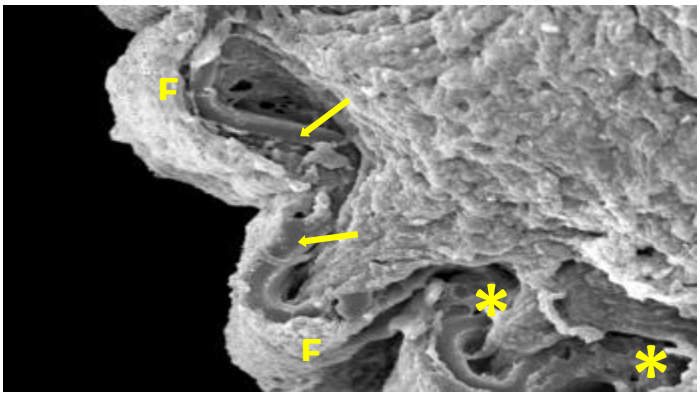


Fig.8 Scanning electron micrograph of cross section of renal artery of goat showing outer elastic laminae (→)

(SEM – 1500X)

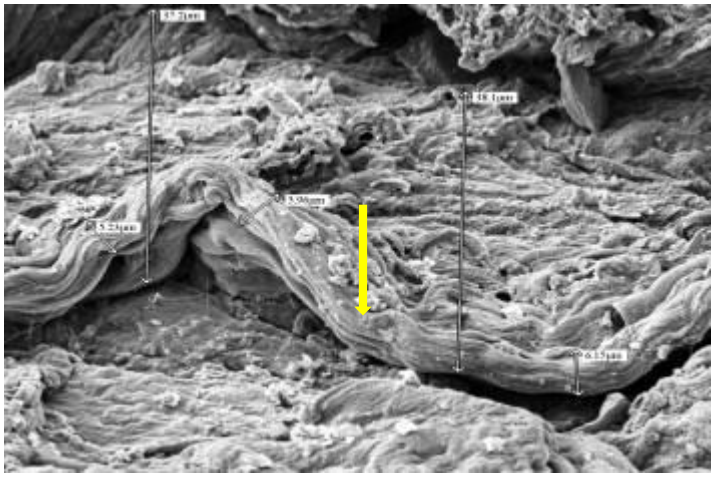
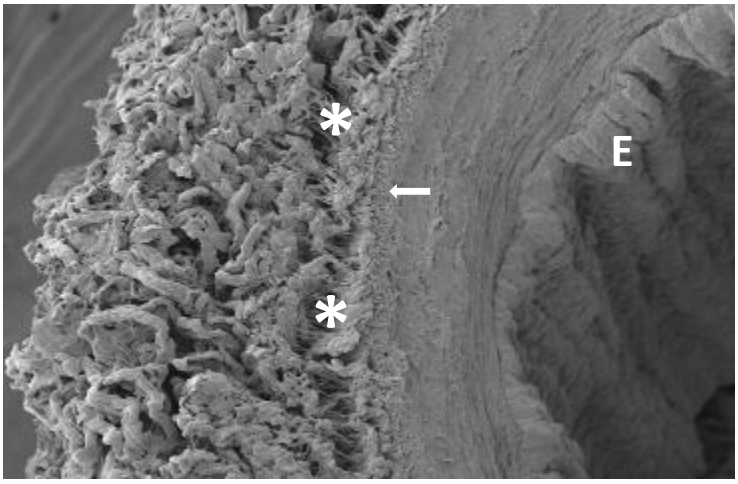


Fig.9 Scanning electron micrograph of cross section of renal artery of pig showing wavy pattern of endothelium (E) and dense collagen fibers in tunica adventitia

(SEM – 200X)

(→) elastic fibers, (*) collagen fibers



Internal elastic membrane (IEM) was a solid continuous line which was wavy in appearance with deep invaginations in goats (Fig. 7) whereas in pigs it was thin and linear limiting the tunica intima. Below the IEM the media was packed smooth muscle cells in compact layers and few of its fibres predominant collagen fibres and few elastic fibers were seen filling up the troughs in the IEM (Fig. 3 and 7) where they were arranged spirally in renal artery of rat, similar to those in the aorta which was akin to the findings of the Alekseevskih (1969) and Obsorne-Pellegrin (1978).

Outer elastic lamina (OEL) was two and more stranded in a wavy pattern and was in between the media and outer adventitia (Fig.

8) beyond the OEL fine collagen fibrils and elastic fibres anchored the collagen tissue in connective tissue of tunica adventitia which had comparatively thick collagen fibers than elastic fibers as a labyrinth network of connective tissue (Fig. 9) in pigs were in total agreement with similar findings in various arteries by Ushiwata and Ushiki (1990) in rat brain; Fujiwara and Uehara (1992) in monkey mesentery, Higuchi *et al.,* (2000) in rat cardiac vessels and Janzen *et al.,* (2000) in human vessels who stated that which probably may help resist the stretching force of vigorously pumping heart.

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How to cite this article:

Padmasri, B., D. Pramod Kumar, G. Purushotham and Raghavender, K.B.P. 2018. Scanning Electron Microscopic Features of the Renal Arteries in Indian Goat (*Capra hircus*) and Pig (*Suscrofa domesticus*). *Int.J.Curr.Microbiol.App.Sci.* 7(04): 3063-3068.
doi: https://doi.org/10.20546/ijcmas.2018.704.347