

Histological features of the renal arteries in Indian pig (*Sus scrofa domestica*) *

Padmasri B¹ Pramod kumar D² Purushotham G³ and Raghavender K B P⁴

Abstract

Histological features of renal arteries of pig revealed a typical muscular artery structure with three layers within outwards viz., tunica intima, media and adventitia. Sub-endothelial connective tissue was minimal and limited by clear undulating internal elastic membrane. Tunica media in all three renal arterial segments *i.e.*, proximal, middle and distal from aorta to the renal hilus. Around twenty rows of smooth muscle cells were arranged in circular fashion in tunica media. Their outer boundary was limited by fragmented thin wavy outer elastic membrane. Tunica adventitia comprised predominantly collagen and few elastic fibres which encroached into margins of tunica media and formed a circular out line around longitudinal bundles of smooth muscle. The outer elastic membrane was split into more than one row in distal segments and was seen coursing in between layers of smooth muscle.

Key words: Renal artery, pig

Introduction:

Arteries comprise three distinct layers viz, tunica intima, media and adventitia whose structural proportion varied with the size and function of the particular artery. Tunica intima of muscular artery consists elongated flattened endothelial cells resting on areolar connective tissue. Increased amount of smooth muscle fibers with internal and external elastic membranes are seen in tunica media. Tunica adventitia comprises collagen and elastic fibers predominantly and vasa vasorum. Small nutrient arteries and veins occur in the wall of larger vessels (Aughey and Frey 2001 in mammals and Eurell *et al.*, 2006 in domestic animals).

Fewer strands of elastic fibers are seen in tunica media. Inner and outer layer of smooth muscle are arranged longitudinally and circularly in renal artery. Longitudinally oriented smooth muscles are present in the tunica intima between the endothelium and internal elastic membrane (Bacha and Bacha 2000 in dogs and cats respectively). Transition from elastic to muscular arteries may either be gradual or abrupt and the site of transitional zone for each vessel varied among species and individual animals (Eurell *et al.*, 2006 in domestic animals) and in dogs by Nowrozani and Asmarian (2014).

* Part of M.V.Sc thesis approved in PVNRTVU, Hyd, India.

1) M.V.Sc student, Dept. of Vety. Anatomy, CVSc, Hyd, India

2) Professor & Univ. Head, Dept. of Vety. Anatomy, CVSc, Hyd.

3) Professor, Dept. of Vety. Anatomy, College of Veterinary Science, Hyd.

4) Professor & Univ. Head, Dept. of Vety. Surgery & Radiology, CVSc, Hyd.

MATERIALS & METHODS

Renal artery samples were collected from twelve adult apparently healthy pigs from local slaughter house immediately after slaughter along with kidneys, part of aorta, venacava and ureter. Tissue samples of right and left renal arteries were taken from all specimens at three places of the main trunk viz., one closer to the aortic origin, other in the middle of its course and the third closer to the hilus of kidney. Samples were preserved in 10% NBF solution and later were processed for routine paraffin method (Singh and Sulochana 1997). About 4-5 μ m thick paraffin sections were stained for routine H & E and other special staining techniques such as Mallory's triple stain method (Singh and Sulochana, 1997) and Verhoeff's stain for demonstration of elastic fibres (Culling 1974).

RESULTS & DISCUSSION:

In the present investigation all three renal arterial segments taken from proximal, middle and distal parts of main renal artery on both sides revealed typical microscopic features of a muscular artery. The arterial wall consisted of three layers within outwards viz., tunica intima, tunica media and tunica adventitia are relatively thinner (Fig. 1). In all of the above specimens the tunica media consisted of relatively thin coat of smooth muscle cells mostly arranged in circular fashion and content of elastic fibres in tunica media was negligible.

The intima of renal artery was looked as if the single layer of endothelial cells were attached to the IEM (Figs. 2). These observations are in agreement with the findings of Vaish *et al.* (2003) in adult goats, Alessandro *et al.* (2006) in pigs and Gholami and Haghighat (2007) in post natal sheep. They further mentioned that sub-endothelial connective tissue was minimal or almost absent in these animals.

In three specimens the IEM was very clear, single and wavy in nature (Fig. 6), subendothelial tissue was minimal and the epithelial cells were seen embracing the IEM (Fig. 4) which was also described by David *et al.*, (1987) in buffalo which had a pronounced sub-endothelial connective tissue with 4 to 5 laminae.

In the present study the relatively thicker tunica media consisted circularly oriented smooth muscle cells (Figs. 3) whose nuclei were elongated and parallel to the cell profile (Figs. 4). In between rows of smooth muscle tiny narrow spaces were seen which contained longitudinally coursing capillaries (Figs.3). Outer part of tunica media was enveloped by connective tissue which contained a network of collagen which predominantly encroached and formed bundles of smooth muscle in outer part of tunica media (Fig. 7). the outer elastic membrane was split into more than one row and was seen coursing circularly in between

layers of smooth muscle (Figs. 4) close to the surface of tunica media capillaries were seen (Fig. 5) in distal segments of pigs.

Cellular profile in outer adventitia was mainly fibrocytes which were intermingled with blood vessels amongst collagen fibers but the collagenous tissue was dense in the adventitia and it entered outer layers of tunica media which contained high amounts of collagen fibres in pigs (Fig. 7) and relatively few elastic fibres. these findings are in agreement with description of muscular and renal arteries by Osborne-Pellegrin *et al.* (1978) in mammals, Vodenicharov and Cirnuchanov (1995) in swine, Vaish *et al.* (2003) in goats, Alessandro *et al.* (2006) in post natal sheep, Eurell and Frappier (2006), Khan *et al.* (2006) and Samuelson (2007) in domestic animals, Gholami and Haghighat (2007) in sheep, Norouzani *et al.* (2008) in cats, Nowrozani (2010; 2011) and Nowrozani and Asmarian (2014) in renal artery of adult dogs.

CONCLUSION:

Three tunics were relatively thinner. Single layer of endothelial cells, IEM with negligible amounts of sub-endothelial connective tissue was seen in tunica intima. In tunica media few circularly oriented smooth muscle cells with elongated nuclei lying parallel to the cell profile entered the spaces between the folds of translucent IEM. The outer elastic membrane was split into more than one row and was seen coursing circularly in between layers of smooth muscle in distal segments of renal artery. Collagenous tissue was dense and relatively less elastic fibers were seen in tunica adventitia.

Ethical Approval:

As per international standard or university standard ethical approval has been collected and preserved by the authors.

Consent: NA

LITERATURE CITED

1. Alessandro, D., Neri, E., Moscato, S., Dolfi, A., Bartolozzi, C., Calderazzi, A., & Bianchi, F. (2006). Immediate structural changes of porcine renal arteries after angioplasty: A histological and morphometric study. *Micron*, 37(3), 255-261.
2. Aughey E, Frye F. (2001) Comparative veterinary histology. Manson Pub.

3. Bacha Jr WJ, Bacha LM. (2012) Color atlas of veterinary histology. John Wiley & Sons; Jan 19.
4. Culling C. F. A. (1974) Handbook of histopathological and histochemical techniques. 3rd edition. Butterworths., London.
5. David H Cormack (1987) Ham's Histology, 9th edition. J.B. Lippincott Company. 433-435.
6. Eurell J A and Frappier (2006). Dellman's Textbook of Veterinary Histology. 6th Edition, Chp. 12. Blackwell Publishing Professional 2121 State Avenue, Ames, Iowa 50014, USA.
7. Gholami, S. O. G. H. R. A., & Haghighat Jahromi, M. (2007). Histomorphologic study of the renal artery in post-natal life of sheep (*Ovis aries*). *Iranian Journal of Veterinary Research*, 8(4), 360-364.
8. Khan, H., Khan, A. A., & Faruqi, N. A. (2006). Comparative histology of coronary arteries in mammals. *J. Anat. Soc. India*, 55(1), 27-30.
9. Nowrozani, F. R. & Asmarian Sh. (2014). A microscopic study of the aortic branches structure in the Adult male dog, *Journal of Physiology and Pharmacology Advances*, 4(7): 396- 400.
10. Ramezani Nowrozani, F. (2011). Structure of the orifice of the renal artery in the abdominal aorta in adult male dog. *Iranian Journal of Veterinary Research*, 12(1), 67-72.
11. Nowrozani, F. R. (2010). Investigation of Smooth Muscle Cells at the Junction of Renal Artery from Abdominal Aorta in Male Adult Dog. *J Anim Vet Adv*, 9, 1242-1244.
12. Norouzani, F. R., Haghighat, M., & Gholami, S. (2008). Morphometry of renal artery in two sexes of sheep at different ages. *J Anim Vet Adv*, 7, 889-91.
13. Osborne-Pellegrin, M. J. (1978). Some ultrastructural characteristics of the renal artery and abdominal aorta in the rat. *Journal of anatomy*, 125(Pt 3), 641.
14. Samuelson D A. (2007). Textbook of Veterinary Histology, Saunders, Philadelphia and London. pp. 40–90.
15. Singh U B and Sulochana S. (1997). Handbook of histological and histochemical Techniques. Premier publishing house, Hyderabad.
16. Vaish, R., Parmar, M. L., Malik, M. R., & Taluja, J. S. (2003). Ontogeny of axillary and femoral arteries of goats (*Capra hircus*). *Indian Journal of Animal Sciences (India)*.
17. Vodenicharov, A., & Cirnuchanov, P. (1995). Microscopical and ultrastructural studies of the renal artery in domestic swine. *Anatomia, histologia, embryologia*, 24(4), 237-240.

ILLUSTRATIONS

Fig.1 Photomicrograph of proximal segment of left renal artery of pig showing three layers – tunica intima (1), media (2) and adventitia (3) (H&E – 4x)

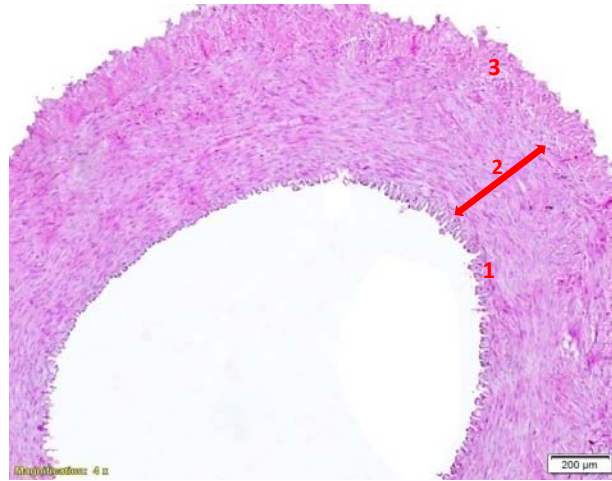


Fig. 2 Photomicrograph of distal segment of right renal artery of pig showing tunica intima with endothelium and internal elastic membrane. (H&E – 60x)

(→) internal elastic membrane
E - endothelium



Fig. 3 Photomicrograph of proximal segment of left renal artery of pig showing tunia media filled with smooth muscle fibers and blood vessels. (H&E – 10x)

1 – Vasavasorum
2 – connective tissue fibers
T.m – tunia media

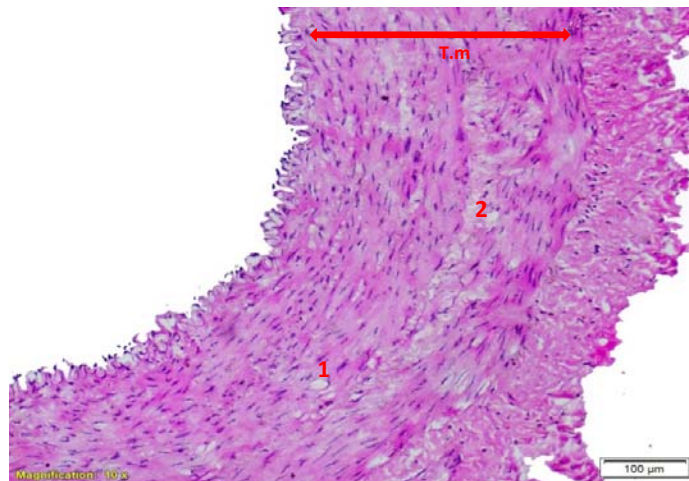


Fig. 4 Photomicrograph of distal segment of right renal artery of pig showing tunica media with wavy smooth muscle cell nuclei and outer elastic laminae. (H&E Stain – 20x)
OEL – outer elastic laminae

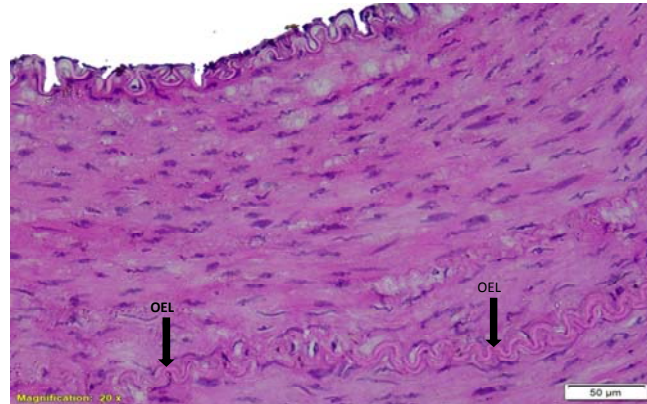


Fig. 5 Photomicrograph of middle segment of right renal artery of pig showing blood vessels (*) in between tunica media and adventitia. (H&E – 40X)
T.m – tunica media
T.a – tunica adventitia

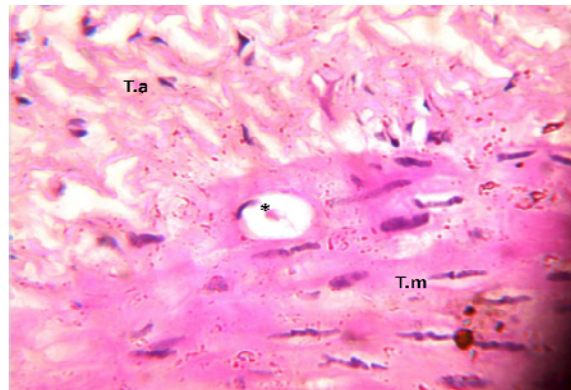


Fig. 6 Photomicrograph of proximal segment of left renal artery of pig showing internal elastic membrane and tunica media with smooth muscle cells (Verhoeffs Stain – 10x)
IEM – internal elastic membrane
SMC – smooth muscle cells



Fig.7 Photomicrograph of renal artery of pig showing collagen fibers (blue colour) enchroching smooth muscle bundles on outer parts of tunica media (T.m).
(Massons trichrome stain – 6x)

