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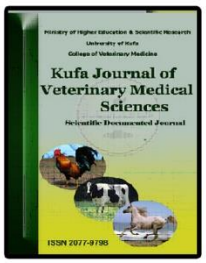

Histological Study Of Many Branches Of Aorta In Local Dog

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Abstract

The aorta is the main artery in the body, originating from the left ventricle of the heart and extending down to the abdomen ,the study aimed to classify the regions and the main branches of the aorta anatomically and histologically by several technique .Twenty doges (13-14 kg) weight and approximately (1.5 year) age collected from basra market of animals ,after the anaesthesed the animals the aorta dissected and the specimen where fixed in formalin solution 10% for 48 hr or 72 hr , after that the specimen were washed in tap water until removed all formalin from the section ,made several histological section about 10 (mm) and stained with H&E and special stain such as vangesion ,PAS , Mallory , wegart stain, then the section observed under the light microscope, The result of histological study involved that all part of aorta consist of three tunics and the elastic and muscular density differ with the part of aorta .

Key words: **aorta, histology, artery**

الخلاصة:

شريان الابهر من الشرايين الرئيسيّة في الجسم, ينشأ من البطين الايسر من القلب ويمتد إلى الاسفل إلى البطن. الدراسة هدفت الى تصنيف مناطق والتفرعات الرئيسية للابهر نسيجيا بواسطة عدة تقنيات. 20 كلب محلي معدل اوزانه (13-14)كغم وبإعمار تتراوح(1-1.5) سنة , حيث جمعت من سوق البصرة للحيوانات بعد ذلك تم قتل الحيوانات بإعطائها جرعة عالية من المخدر, ثم استخرج الابهر وتم وتثبيته في الفورمالين بتركيز 10% لمدة 48 او 72 ساعة, بعد ذلك تم غسل العينات بالماء جيدا لإزالة الفور مالين المتبقي , ثم عملت عدة مقاطع نسيجية بسمك حوالي 10مايكرون بعد ذلك تم تصبيغها بالصبغة العادية الهيماتوكسلين والصبغات الخاصة الاخرى مثل صبغة الفانجيزن, الباص ,ملوري وصبغة الويكارت بعد ذلك تم فحص المقاطع النسيجية تحت المجهر الضوئي اظهرت الدراسة بان كل اجزاء الابهر تتكون من ثلاثة طبقات نسيجية و ان الكثافة المطاطية والعضلية للأبهر تختلف باختلاف الاجزاء.

Introduction

Anatomic texts when referring to mural aortic architecture and describing the large aortic ramifications classify these vessels with an elastic pattern. The large arteries directly branching from aorta, such as the carotid and subclavian arteries, were structured by several elastic lamellae and fibers in their coats. Also, the parietal and visceral collaterals originated from those vessels, e.g. the vertebral and external iliac arteries, presented a relative major number of smooth muscle cells in their parietal coats (1)(2)(3).Perhaps, some papers suggested presence of a mixed structure from the abdominal part of aorta, in which equilibrium in the mural distribution of smooth muscle cells and connective matrix components were verified, with a minor number of elastic lamellae and fibers

occurring (4)(5)(6)(7)(8). The predominance of aorta elastic tissue in mammals is accomplished by interconnections among elastic lamellae and connective dense lamellae throughout connective dense fibers. Complex networks were seen, including smooth muscle cells intermingled with elastic and connective dense lamellae and fibers, mainly disposed into the aortic medial layer structure (4))(5)(6)(7)(8).

Materials And Methodes

Twenty adult male local doges (13-14 kg) weight and approximately (1.5 year) age collected from basra market of animals, the dogs of two groups were anaesthetic formed by ketamine hydrochloride (20 mg /kg BW) . (10)and xylazine hydrochloride (1.5 mg/kg BW) (11).the abdominal wall was incised and muscular coetaneous flaps ,were reflected laterally ,peritoneal cavity were opened by incision made for the dissection of the muscles and skin ,the aorta were identified and specimens of aorta and branches were removed and washing in buffer slain from blood then immersed in neutral formalin 10% for the following histological and histochemicales studies, sections were processed for paraffin sectioning. Haematoxylin-eosin and Weigert Van gieson and Mallory stained10_ thick sections observed under light microscope .(9).

Statically analysis :

The data were analysis as mean ± SD using the studet test and $P<0.05$ was consid ered to be significant count .The result were photographic using a Nikon digital camera.

Histological parameters:

the wall thickness measured by venire digital calliper by applying the section of artery between the two edges of the calliper, the lumen circumflex measured by using of string which applying it around the artery then measuring the length of the string by calliper .The area surface of each artery were measured by multiplying the wall thickness by lumen circumflex X length of section according to (12).

The muscular and elastic density were measured as single eye observation in high power magnification (+1,+2,+3,+4,+5)according to (13)(14). The total number of muscular fibre were measured by multiply area surface with muscular density according to (14)(15) .

Result

The present study demonstrate that the arteries generally consist of three layers (tunica intima, tunica media, tunica adventitia.(Fig 1) .The tunica intima contain simple squamous epithelium which named endothelium and also this layer contain sub endothelial layer which consist of loose connective tissue .(Fig 2) External to tunica intima there was shown internal elastic lamina. (Fig 3) .The tunica media consist of smooth muscles fiber arranged in layer and occupied with elastic and collagen fiber.(Fig 4) .External to tunica media , the present study showed an external elastic lamina. (Fig 5).The tunica adventitia which have collagen and elastic fiber.(Fig 6)

Table (1) showe the type of the aortic part.

part of aorta	Elastic density	Muscular density	Type
Aortic root	+4	+1	Elastic
Ascending aorta	+4	+1	Elastic
Aortic arch	+4	+1	Elastic
Thoracic aorta	+4	+1	Elastic
Abdominal aorta	+3	+2	Elastic

Table (2) show same part of aorta

Branch of aorta	**Proximal part**			**Distal part**		
	Elastic density (E.D)	Muscular density (M.D)	Type	Elastic density (E.D)	Muscular density(M.D	Type
right coronary A	+1	+4	Muscular	+1	+4	Muscular
Left coronary A	+1	+4	Muscular	+1	+4	Muscular
Brachiocephalic A	+4	+1	Elastic	+4	+1	Elastic
Left subclavian A	+4	+1	Elastic	+4	+1	Elastic
Bronchoesophagus A	+4	+1	Elastic	+3	+2	Elastic
Renal arteries	+3	+2	Elastic	+1	+4	Muscular

As shown in table (2)the wall thickness /mm of aortic root ,ascending aorta , aortic arch, thoracic aorta, and abdominal aorta was 2.15,2.10,2.01,2.70.,1.30 respectively, while the lumen circumflex /mm was 22.10,21.36,20.44,19.54,17.60 respectively.

The area surface /mm² of aortic root ,ascending aorta, aortic arch, thoracic aorta, and abdominal aorta was 475.13,448.5,410.8,332.18,228.8 respectively , while the muscular densities was +1,+1,+1,+1,+2 respectively. The total number of muscle fiber by multiplying the area surface of arteries with muscular density was 475.5 in aortic root 448.5 in ascending aorta,410.8 in aortic arch , 332.18 in thoracic aorta and 475 in abdominal aorta. The pulsatory power of the aortic root ,ascending aorta ,aortic arch ,thoracic aorta and abdominala aorta was 1,582.24,1,493.50,1,367.96,1,106.15 and 1,521.81 respectively .

Table (3) showe the pulsatory power of aortic parts depending on the wall thickness ,lumen circumflex, area surface, muscular fiber density and total number of muscle fiber.

Part of aorta	Wall thickness Mm	Lumen circumflex Mm	Area surface mm^3	Muscular density	Total number of muscle fiber	Pulsatory power
Aortic root	2.15	22.10	475.15	+1	475.15	1,582.24
Ascending aorta	2.10	21.36	448.5	+1	448.5	1,493.505
Aortic arch	2.01	2.44	410.8	+1	410.8	1,367.964
Thoracic aorta	1.70	19.54	332.18	+1	332.18	1,106.1594
Abdominal aorta	1.30	17.60	228.8	+2	457	1,521.81

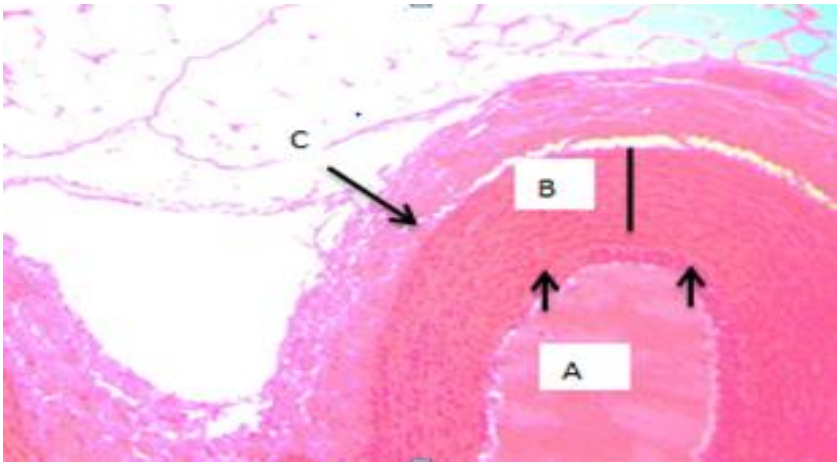
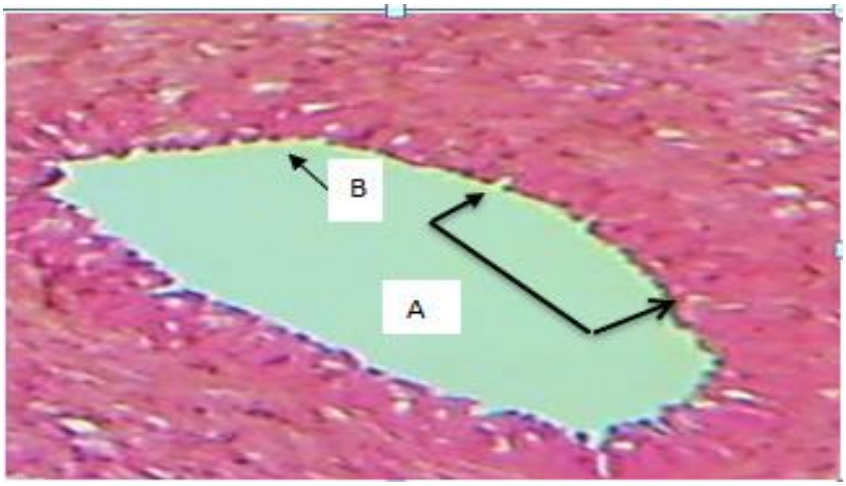


Figure1 cross section of coronary artery how: (A) tunica intima (B) tunica media (C) tunica adventitia (X40) (H&E)



Figure(2)cross section of left renal artery show :(A) the endothelium (B) sub endothelium (X40)(vangesion stain).

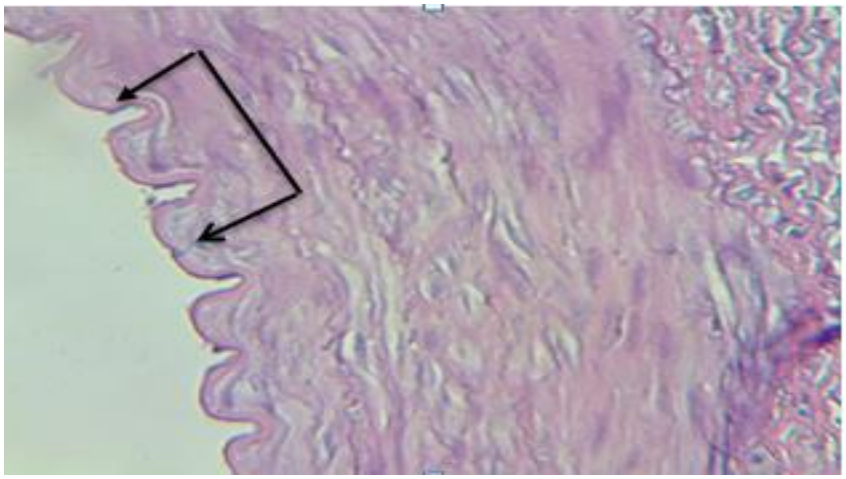


Figure3 across section of abdominal aorta show: internal elastic lamina(H&E)(X40)

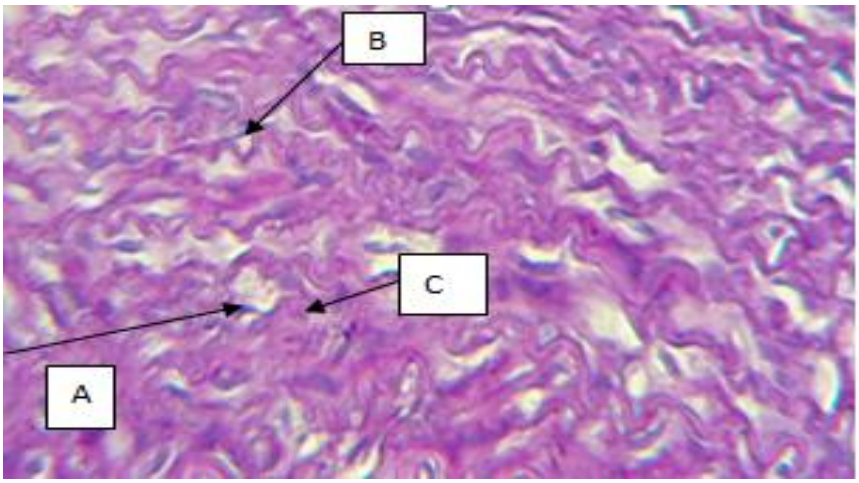


Figure4 cross section of the abdominal aorta show : tunica media consist of :(A) smooth muscle fiber (B) elastic fiber (c) collagen fiber. PAS stain (X40)

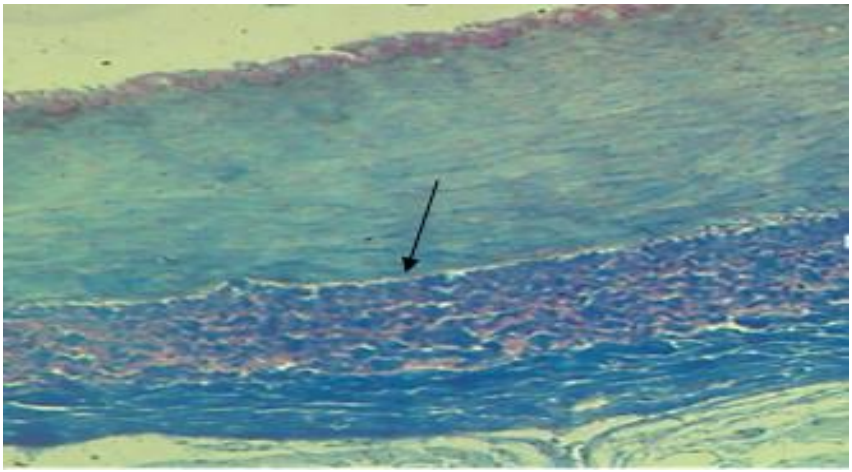


Figure 5 cross section of right renal artery show the external elastic lamina (Malory stain) (X40)

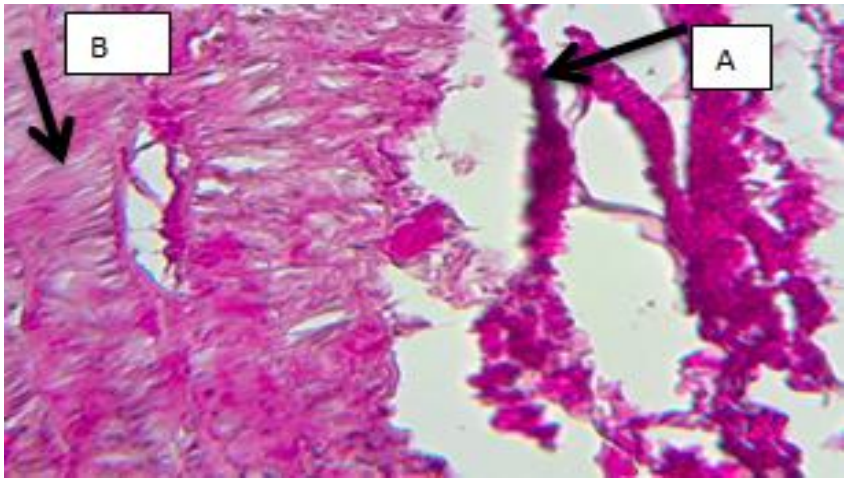


Figure6 cross section of abdominal aorta show:(A) collagen (B) elastic fiber in tunica adventitia .vangieson stain(X40)

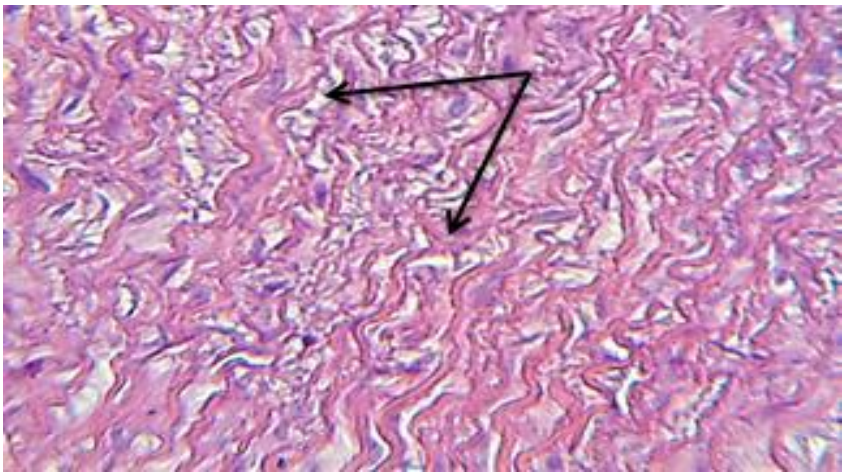


Figure 7 cross section of the ascending aorta show the elastic type(abundant elastic fiber↑↑) (proximal part) (H&E) (X40)

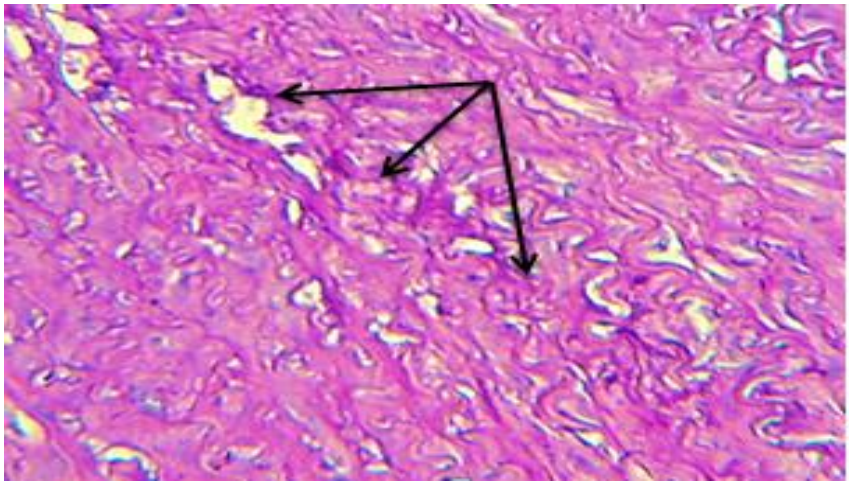


Figure 8 cross section of right coronary artery show the muscular type (abundant smooth muscle↑↑) (distal part) (PAS stain)(X40)

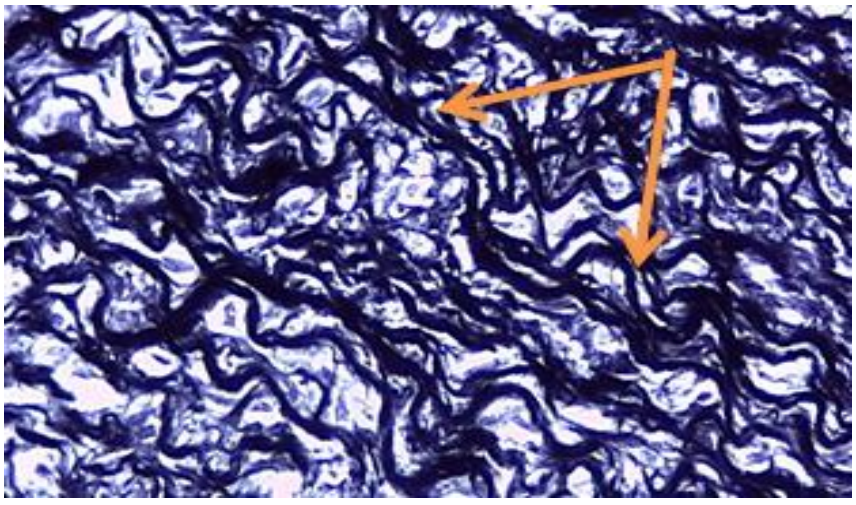


Figure 9 Cross section of left subclivian artery show the elastic type(abundant elastic fiber↑↑) (verhoffs stain)(proximal part)(X160)

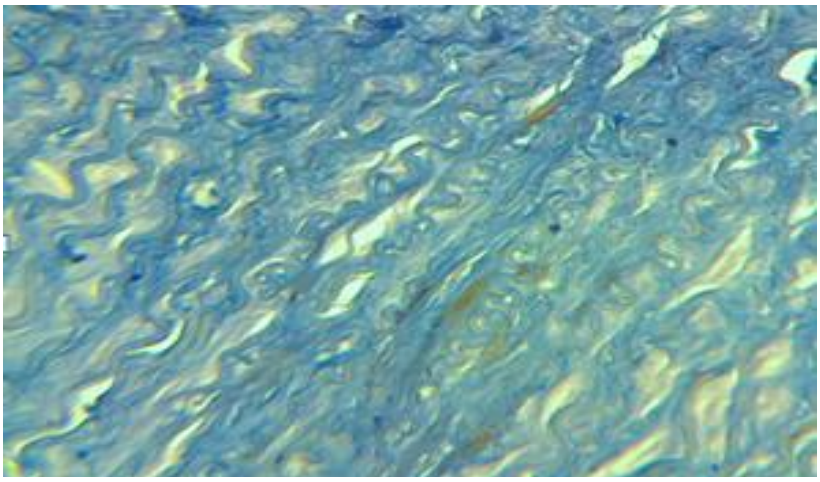


Figure 10 Cross section of thoracic aorta show the elastic type (abundant elastic fiber↑↑) (Mallory stain)(proximal part)(X160)

Discution

The present study showed that the tunica intima consists of endothelium and sub endothelial layer ,but when the size of artery is decrese the sub endothelial layer become thinner and loss gradually.(16).

The present study showed that the external to the tunica intima there is internal elastic lamina ,present of internal elastic lamina which have degree of crinkling appearance in the renal artery of domesticated animals(17). The present study showed that the tunica media consist of smooth muscle fiber and collagen and elastic fiber , that between smooth muscle fibers the elastic lamella located which is produced by elastin also these cell bounded by collagen , also the role of collagen and elastin in the rigidity and flexible firmness of vessels(20) , the elastin is predominant component in extracellular matrix in media(21), the primary material in the extracellular matrix of tunica media is collagen (22), the tunica media of aorta have about 80-90% of full collagen and have two type of collagen |and ||.(23).

The present study show that the tunica adventasia have collagen and elastic fibre , the high amount of the elastic fibre in the adventasia in large arteries have role in the management of the arterial pressure in the dog.(24).

The present study shows that the renal artery is of muscular type. the renal artery also muscular type.(25)

The histochemestry study show abundant elastic fibre demonstrated by haematoxylin and wegarts stain and verhoffs stain, verhoffs stain used for elastic fibre ,elastin element have forcefull attraction to the iron elemant that present in the verhoffs stain(26) , the elastic fibre determined by vangesion verhoffs stain that verhoves stain can be detained in the elastic fiber than other tissues by lets the other companent to unstained and remaining colorizing the elastic fibr(27), collagen and other connective tissue demonstrated by verhoffes

stain(28).the reorganization of crude and fine elastic fibre not easy to be done by this stain in the artery(29) ,sodium thiosulphat extract the overmuch ioden , and to allowing differences the hematoxilin stained tissue(26), The present study showed that the abundant smooth muscle and collagen demonstrated by PAS, the action of PAS stain massing in the tunica media but present in intima and tunica adventitsia and intima of coronary artery.(30).

The present study showed that the pulsatory power differ in aortic root, ascending aorta ,thoracic and abdominal aorta and it is lowest in thoracic aorta and highest in aortic root and this depending on the smooth muscle fibre , Pulsatory power of an artery effects only the number of smooth muscle fibres present in its tunica media., for that in all study when the muscle density increase the pulsatory power well increase (14)(15).The present study showed that the aortic root , ascending aorta and aortic arch have similar pulsatory power so that the muscular density of these arteries id relatively similar, the arterial elasticity is directly proportional to arterial proximity to the heart and arterial muscularity is directly proportional to arterial distance from the heart An abnormally high arterial pressure will undoubtedly increase the load born by the arterial wall.(13).

References :

1-Viegas, K. A. S.; Orsi, A. M.; Simões, K. & Crocci, A. J. (2004) Histoarquitetura das artérias subclávia e vertebral esquerdasno cão (*Canis familiaris*). *Biosci. J. (Uberlândia), 20(2)*:163-9.

2-Martini, F. H.; Timmons, M. J. & Tallitsch, R. B.(2009). *Anatomia Humana*.6a ed. Porto Alegre, Artmed.

3-Tortora, G. J. & Grabowski, S. R.(2012). *Corpo Humano: Fundamentos de Anatomia e Fisiologia*. 8a. ed. São Paulo, Artmed.

4-Viegas, K. A. S.; Orsi, A. M.; Matheus, S. M. M.; Francía-Farje,L. A. D.; Orsi, D. C. & Mello, J. M. (2001). Características estructuralesde la aorta de conejo (*Oryctolagus cuniculus*). *Rev. Chil.Anat., 19(2)*:131-7.

5-Orsi, A. M.; Stefanini, M. A.; Crocci, A. J.; Simões, K. & Ribeiro,A. A. (2004). Some segmental features on the structure of the aorticwall of the dog. *Anat. Histol. Embryol., 33(3)*:131-4.

6-Mello, J. M.; Orsi, A. M.; Padovani, C. R.; Matheus, S. M. M. &Eleutério, M. L.(2004). Structure of the aortic wall in the guinea pigand rat. *Braz. J. Morphol. Sci., 21(1)*:3 5-8.

7-Mello, J. M.; Torrejais, M. M.; Matheus, S. M. M.; Domeniconi,R. F.; Simões, K. & Orsi, A. M.(2007). Características ultraestruturaisdo segmento abdominal da aorta de rato albino. *Acta Sci.Biol. Sci. (Maringa), 29(4)*:343-8.

8-Mello, J. M.; Orsi, A. M.; Domingues, R. J. S.; Molinari, S. L. &Araújo, A. M. M.(2009). de Arquitetura da parede vascular de segmentostorácico e abdominais da aorta de macaco prego(*Cebus apella*). *Braz. J. Vet. Res. Anim. Sci. (São Paulo),46(1)*:40-7.

9-Luna, Lee G.(1968) Manual of histologic staining methods of the Armed Forces Institute of Pathology.New York, Blakiston Division, McGraw-Hill (OCoLC)557717098

10-Thurmon JC, Tranqcuilli WJ, Benson GJ, eds.(1996). Veterinary

Anesthesia,3rd edn. William & Wilkins, Baltimore.

11-Bargai, U.(1982) The effect of xylazine hydrochloride on theradiographic appearance of the stomach and intestine in thedog. Vet. Radiol. 23:60-63.

12-Keshaw Kumar. **(1998)** Area of arterial wall. Vijnana Parishad AnusandhanPatrika. vol. 41 (3) : 211-215.

13-Keshaw Kumar. (2001) . Microstructure of human arteries. Journal of Anatomical Society of India vol. 50 (2) : 137-140.

14-Keshaw Kumar. **(2015) .** Laws of Arterial elasticity or muscularity.

InternationalJournal of Scientific Research vol. 4 (4) : 19-21.

15-Keshaw Kumar. (2002) . Effect of tangential pressure of pulsation on tunica

mediaof human arteries. Journal of Anatomical Society of IndiaVol.51 (1) : 35-

38.

16-Dellmann HD, Eurell J (1998). Text book of veterinary histology. 5th

edition. Williams & Wilkins, Baltimore, Maryland; pp 239-240.

17-Vodenicharov A, Cirnuchanov P. (1995). Microscopical and ultrastructural studies of the renal artery in domestic swine. Anatomia, Histologia, Embryologia.; 24(4):237-40. doi: 10.1111/j.1439-0264.1995.tb00042..

18-Bruel, A.; Oxlund, H.(2002). Growth hormone influences the content andcomposition of collagen in the aorta from old rats. *Mech. AgeingDev*, *123*, 627-635.

19-Karnik, S. K., Brooke, B. S., Bayes-Genis, A., Sorensen, L., Wythe, J. D., Schwartz, R. S., Keating, M. T. and Li, D. Y. (2003) A critical role for elastin signaling in vascular morphogenesis and disease. Development, 130, 411–423

20-Bruel, A.; Oxlund, H.(2002). Growth hormone influences the content andcomposition of collagen in the aorta from old rats. *Mech. AgeingDev*, *123*, 627-635.

21-Karnik, S. K., Brooke, B. S., Bayes-Genis, A., Sorensen, L., Wythe, J. D., Schwartz, R. S., Keating, M. T. and Li, D. Y. (2003) A critical role for elastin signaling in vascular morphogenesis and disease. Development, 130, 411–423.

22-Beenakker, J. W. M.; Ashcroft, B.A.; Lindeman, J.H.N.; Oosterkamp,T.H.(2012). Mechanical properties of the extracellular matrix of theaorta studied by enzymatic treatments. *Biophys. J, 102*,1731-1737.

23-Silver, F. H.; Horvath, I.; Foran, D. J. **(2001).** Viscoelasticity of the vesselwall: the role of collagen and elastic fibers. *Crit. Rev. Biomed.Eng.*, *29*, 279-301.

24-Ushiki T. (**2002).** Collagen fibers, reticular fibers and elastic fibers: a comprehensive undestanding from a morphological viewpoint. Archives of Histology & Cytology.; 65(2):109-26.

25-Junqueira LC, Carneiro J, Kelly RO. **(2005)**.Basic histology (text and atlas). McGraw-Hill Medical Pub., New York.; 205..

26-Parry N. Re: Verhoeff-van Gieson Stain.(2014). Aspecial histology stain for elastic fibers[Web log post]. Accessed on: March25, 2015. Available from: http://bitesizebio.com/19952/verhoeff-van-gieson-staina-special-histology-stain-for-elastic-fibers/.

27-Carson FL, Hladik C.(2009). Histotechnology: Aself-instructional text. Chicago, ASCPPress.

28-Kazlouskaya V, Malhotra S, Lambe J, IdrissMH, Elston D, Andres C. (**2013).** The utility of elastic Verhoeff-van Gieson staining indermatopathology. J Cut Path;40:211-25.

29-Ellis RC. Re.(2002): Problems in histopathological technique [Web log post]. Accessedon: June 18, 2014. Available fromhttp ://www. Ichworld .com/ royellis/ problems/problem27.htm.

30-Vaish, R., Parmar, M.L., Malik, M.R. and Taluja, J.S. (2003). Ontogeny of axillary and femoral arteries of goats (Capra hircus). Indian J. Animal Sci., 73 (5) : 498-50.