

Gross anatomical studies on the arterial supply of the manus region in the rabbit

Rezk H. M. and *El-Bably S. H.

Lecturers of Anatomy and Embryology, Fac. Vet. Med. Cairo Univ.

Abstract

The present study was carried out on ten adult freshly slaughtered, apparently healthy rabbits of both sexes. The animals were anesthetized and the common carotid arteries were cannulated and flushed with normal saline. Then animals were injected with colored gum milk latex. The arterial supply of the manus in the rabbit formed of dorsal and palmar branches, each divided into superficial and deep sets of arteries. The palmar branches formed of the ulnar A., median A. and its large branch (the radial A.). While, the dorsal branches formed of the superficial antebrachial artery, dorsal carpal branch of the radial artery and the union between the ulnar artery with palmar branch of the caudal interosseus artery.

Key words: Rabbit; Arterial supply; Manus; digital arteries.

Introduction

The rabbit being used as a pet and experimental animal (*Shively, 1979, Nicholson, 2001 and Meredith, 2009*) due to its easily housing and cheap reproduction. Although, the arterial supply of the hind paw has been studied by *Farag, (2002)* the available literature on the pattern of distribution of the arterial supply of the manus region in this animal was only illustrated on diagrams by *Popesko, Rajtova and Horak (2003)*. So, the present work was conducted to provide more anatomical information on the arterial supply of this region.

Material and methods

The current study was conducted on ten adult freshly slaughtered,

apparently healthy rabbits of both sexes, weighing 1.5-3kg and aging 5-8 months, it obtained from the animal unit of department of physiology-Veterinary Medicine-Cairo University. These animals were anesthetized and bled through the common carotid arteries cannulation. The vessels were thoroughly washed with warm normal saline solution.

The animals were injected with 150 ml of 60% gum milk latex colored red with Rotring® ink. through the common carotid artery (*Tompsett and Wakelly, 1965*).

The animals were left in a refrigerator for about 48-72 hrs. The fore limbs were taken and put in a mixture of 10% formalin, 2% phenol and 1% glycerin then left

about 48 hrs before the routine dissection. The obtained results were photographed using Sony® digital camera 12.1 mp, 4x.

The nomenclature used was that recommended by the *Nomina Anatomica Veterinaria* (N.A.V) (2005).

Results

The arterial blood supply of the manus region in the rabbit is formed of smaller dorsal and larger palmar sets of branches. These sets are mainly achieved by the median, ulnar, radial and superficial antebrachial arteries.

A. mediana

The median artery (1/1; 2/1; 3/1) considered the direct continuation of the brachial artery in the forearm region distal to the origin of the caudal interosseus artery. It descends along the caudal aspect of the radius to its distal third where it gives off the radial artery, then it continues caudodistally to the palmar aspect of the carpus where it trifurcated into; the 2nd, 3rd and 4th palmar common digital arteries.

Aa. digitales palmares communes II, III, IV

The 2nd, 3rd and 4th palmar common digital arteries (1/5) represented the superficial set of the arteries supplying the palmar aspect of the manus and digits. They arise from the median artery on the palmar aspect of the carpus. Each of these vessels descends in the interosseus space between the metacarpal bone of the same number and the

neighboring one to the level just above the fetlock joint where it bifurcated into the lateral proper palmar digital artery of the same digit and the medial proper palmar digital artery of the neighboring one.

The palmar common digital arteries communicated with the corresponding dorsal common digital arteries before they bifurcate through the II, III and IV interdigital arteries (1/8).

Aa. digitales palmares proprea

The medial (1/6) and lateral (1/7) proper palmar digital arteries passes along the corresponding palmar aspect of the digits to the distal phalanx where they ended by the terminal arch. Along their course showed anastomoses with each others on the level with the middle phalanx (1/9).

A. radialis

The radial artery (1, 2, and 3/2) arises from the medial aspect of the median artery on a level with the distal third of the caudomedial surface of the radius. It bifurcated into; the dorsal and palmar carpal branches. The palmar carpal branch (3/10) passed on the palmar surface of the carpal bones. It gives off the first palmar common digital artery (1/5; 3/5) between the metacarpus of first and second digits. Then, it anastomoses with the confluence of ulnar artery and palmar branch of the caudal interosseus artery forming the superficial and deep palmar arches. The dorsal carpal

branch of the radial artery (1/3; 3/3; 4, 5/3) passed to the dorsal surface where it detached the 1st dorsal common digital artery (4/15) at the level of the carpal joint. The later branch bifurcated into 1st and 2nd medial proper dorsal digital arteries.

A. Ulnaris

The ulnar artery (1/4; 2, 3/4) was derived from the common interosseus artery on a level just below the proximal extremity of the radius. It passed on the caudolateral aspect of the radius, where it received enforcement from the palmar branch of the caudal interosseus artery (5/18) at the level of the accessory carpal bone. It supplied the lateral proper palmar digital artery V (1/7), and then courses over the palmar surface of the carpal joint to form the superficial and deep palmar arches with the palmar branch of the radial artery.

Arcus palmaris superficialis

The superficial palmar arch (2/11) was formed by the connection between the palmar branch of the radial artery and the confluence of ulnar artery with palmar branch of the caudal interosseus artery. It was formed under the extensor tendons over the interosseus muscles. It detached branches to I-IV interosseus muscles (2/21) at the palmar surface of metacarpal bones.

Arcus palmaris profundus

The deep palmar arch (3/12) was formed by the connection between the palmar branch of the radial

artery and the confluence of ulnar artery with palmar branch of the caudal interosseus artery. It was formed at a higher level from the superficial arch in direct contact the proximal extremity of the metacarpal bones. It detached I-IV palmar metacarpal arteries (3/13); each one passed on the palmar aspect of the corresponding metacarpus representing the deep palmar set of arteries supplying the manus. They terminated by connection with the palmar common digital artery of the same digit.

A. antebrachialis superficialis

The superficial antebrachial artery (4, 5/14) was derived from the brachial artery at the proximal extremity of the radius. It passed on the caudomedial aspect of the radius then reflected on the cranial surface of the radius near its middle. It detached the 2nd dorsal common digital artery at the distal third of the radius, and then bifurcated into 3rd and 4th dorsal common digital arteries on the dorsal aspect of the corresponding metacarpus.

Aa. digitales dorsales communes

II, III, IV

The 2nd, 3rd and 4th dorsal common digital arteries (4/15) represented the superficial set of the arteries supplying the dorsal aspect of the manus and digits. They arose from the superficial antebrachial artery on the dorsal aspect of the carpus. Each of these vessels descended in the interosseus space between the metacarpal bone of the same

number and the neighboring one to the level just above the fetlock joint where it bifurcated into the lateral proper dorsal digital artery of the same digit and the medial proper dorsal digital artery of the neighboring one.

The dorsal common digital arteries communicated with the corresponding palmar common digital arteries before they bifurcate through the II, III and IV interdigital arteries (1/8).

The medial (4/16) and lateral (4/17) proper dorsal arteries supplied branches to the proximal and middle phalanges, then joined each others on the distal end of middle phalanx to form A. coronalis of the third phalanx (4/22).

Aa. metacarpeae dorsales II, III, IV

The dorsal carpal branch of the radial artery communicated with the united palmar branch of the caudal interosseus and ulnar arteries to form the dorsal carpal rete (5/19) on the dorsal aspect of the carpal joint. It detached I-IV dorsal metacarpal arteries (5/20) from the distal aspect of the rete, each artery passed on the dorsal aspect of the corresponding metacarpal bone to which it supply then terminated in the corresponding dorsal common digital artery. They representing the deep dorsal set of arteries supplying the manus.

The dorsal common digital artery communicated to the corresponding palmar common digital artery through interdigital artery named 2nd, 3rd and 4th interdigital artery respectively.

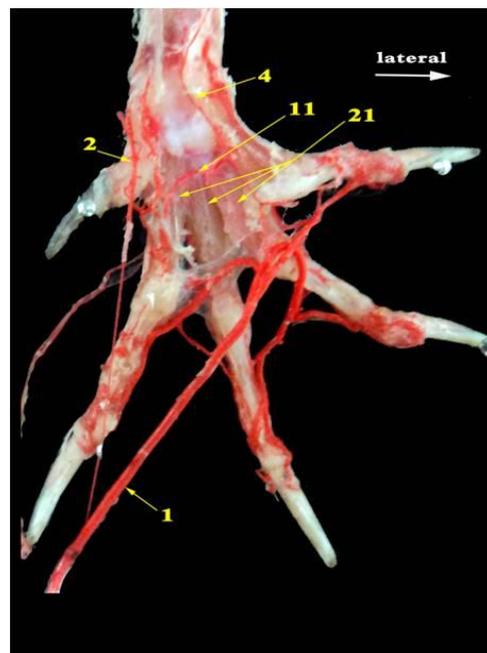
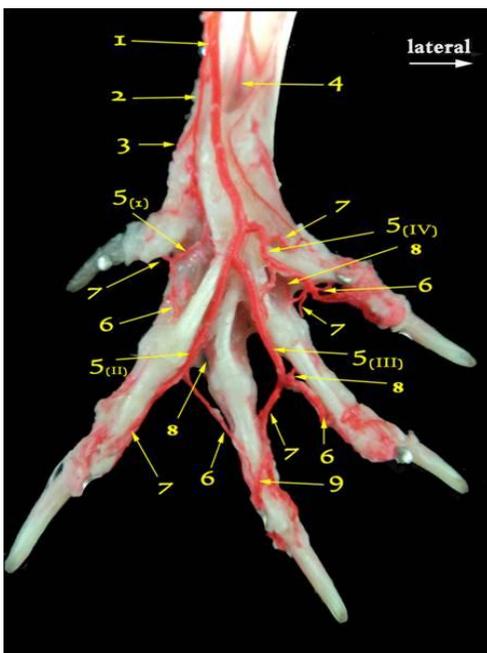


FIG.1: A photograph showing the arterial supply of the palmar aspect of the right manus in rabbit (**Superficial layer**):

FIG.2: A photograph showing the arterial supply of the palmar aspect of the right manus in rabbit (**Deep: 1st layer**):

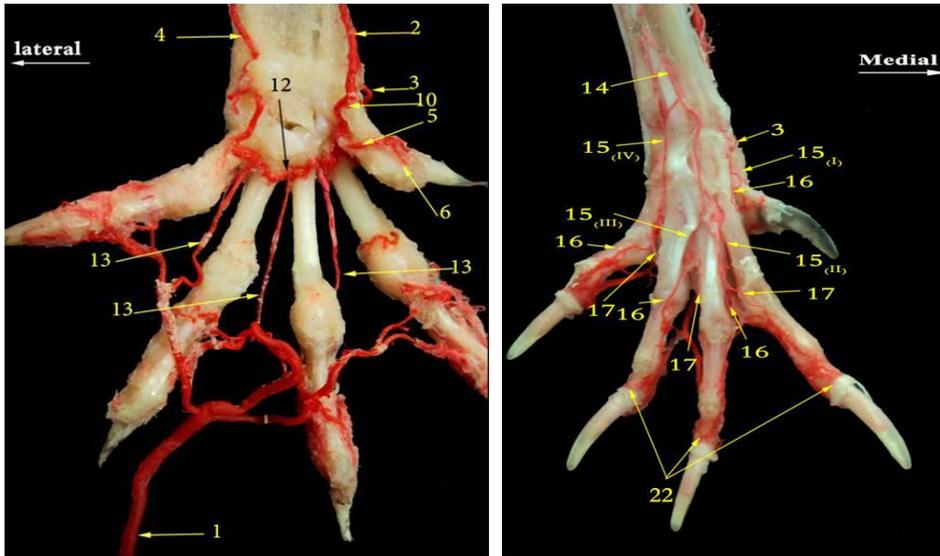


FIG.3: A photograph showing the arterial supply of the palmar aspect of the left manus in rabbit. (**Deep: 2nd layer**):

FIG.4: A photograph showing the arterial supply of the dorsal aspect of the left manus in rabbit. (**Superficial layer**):

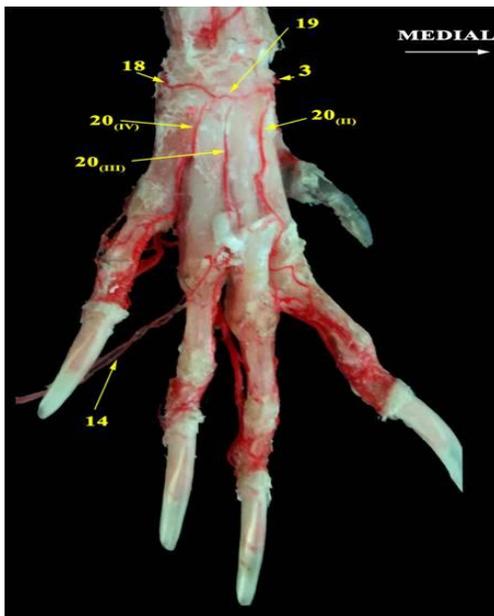


FIG.5: A photograph showing the arterial supply of the dorsal aspect of the left manus in rabbit (**Deep layer**):

Legend of figures:

- 1- A. mediana.
- 2- A. radialis.
- 3- Ramus carpeus dorsalis of 2.
- 4- A. ulnaris.
- 5- Aa. digitales palmares communes.
- 6- A. digitalis palmaris propria axialis.
- 7- Aa. digitales palmares proprie abaxiales.
- 8- Aa. interdigitales.
- 9- Ramus anastomoticus.
- 10- Ramus carpeus palmaris of 2.
- 11- Arcus palmaris superficialis.
- 12- Arcus palmaris profundus.
- 13- Aa. metacarpea Palmares.
- 14- A. antebrachialis superficialis.
- 15- Aa. digitales dorsales communes.
- 16- Aa. digitales dorsales proprie axiales.
- 17- Aa. digitales dorsales proprie abaxiales.
- 18- Ramus palmaris a. interossea caudalis.
- 19- Rete carpi dorsale.
- 20- Aa. metacarpee dorsales
- 21- Mm. interossei.
- 22- Aa. coronales.

Discussion

The arterial supply of the manus in the present work was formed of dorsal and palmar branches, each divided into superficial and deep sets of arteries. These findings was supported by *Popesko et al, (2003)* in rabbit, *Sisson and Grossman (1969), Smith (1999), Boyd et Al., (2000), Tipirdamaz et al, (2001), Budras et al, (2007) & Cann (2003)* in the dog and *Edwards (1960), Moore and Dalley (1999), Johnson and Ellis (2005) and Brezezinski et al, (2009)* in human. The present study revealed that, the arterial blood supply of the manus

region in the rabbit was mainly achieved by the median, ulnar and superficial antebrachial arteries, these findings was supported by *Popesko et al., (2003)* in rabbit and *Sisson and Grossman (1969), Smith (1999), Boyd (2000), Tipirdamaz et al, (2001), Budras et al (2007) & Cann (2003)* in the dog. However, *Evans and deLahunta (1996)* in the dog stated that, the median, caudal interosseus and cranial superficial antebrachial arteries were the chief blood supply of the manus.

According to current investigation, the median artery terminated by II, III, and IV palmar common digital arteries; this result was approved by *Popesko et al (2003)* in rabbit and *Boyd (2000)* in the dog. However, *Edwards (1960)*, *Moore and Dalley (1999)*, *Johnson and Ellis (2005)* and *Brezczynski et al (2009)* in human and *Evans and deLahunta (1996)* *Budras et al (2007)* in the dog, stated that, the palmar common digital arteries arose from the superficial palmar arch.

In accordance with *Popesko et al., (2003)* in rabbit and *Sisson and Grossman (1969)*, *Smith (1999)*, *Boyd (2000)* & *Budras et al. (2007)* in the dog and *Massie (1944)*, *Boyd et al (1956)*, *Karlsson and Niechajev (1982)*, *Williams, et al (1999)*, *Patnaik et al (2002)* and *Brezczynski et al (2009)* in human, the palmar common digital arteries were bifurcated into lateral and medial proper palmar digital arteries. It is to add that the later two vessels showed an anastomoses on the middle phalanx similar to that recorded by *Farag (2002)* in the hind paw of the same animal.

Popesko et al (2003) in rabbit, reported that, the palmar common digital arteries communicated with the corresponding dorsal common digital arteries, before they bifurcate, through the II, III and IV interdigital arteries. This was a line with the present study.

In the work, the radial artery was derived from the median artery and gave off; dorsal and palmar carpal

branches. The same results were stated by *Popesko et al (2003)* in rabbit, *Sisson and Grossman (1969)*, *Evans and deLahunta (1996)*, *Boyd et al (2000)*, *Budras et al (2007)* and *Cann (2003)* in the dog. While, *Edwards (1960)*, *Moore and Dalley (1999)* and *Brezczynski et al (2009)* in human, reported that, the radial artery was derived from the brachial artery.

In accordance with *Popesko et al (2003)* in rabbit, *Boyd et al (2000)*, *Budras et al (2007)*, *Cann (2003)*, in the dog, the ulnar artery was originated from the common interosseus artery. However, *Moore and Dalley (1999)*, *Johnson and Ellis (2005)* and *Brezczynski et al (2009)* in human stated that, the ulnar artery was derived from the brachial artery. In this context, *Sisson and Grossman (1969)* in dog asserted that, the ulnar artery was derived from the median artery.

In the present study, the superficial palmar arch was formed by radial and ulnar arteries and palmar branch of caudal interosseus artery, same results were observed by *Popesko et al (2003)* in rabbit, *Massie (1944)*, *Boyd et al (1956)*, *Karlsson, and Niechajev (1982)*, *Jelicic et al (1988)* *Moore and Dalley (1999)*, *Williams, et al (1999)*, *Patnaik et al (2002)*, *Johnson and Ellis (2005)*, *Loukas and Holdman (2005)*, *Brezczynski et al., (2009)* and *Loukas et al (2009)* in human and *Boyd et al (2000)* in the dog. On the other hand, *Evans and deLahunta*

(1996) in the dog stated that the superficial palmar arch was formed by radial, median and caudal interosseus arteries. *Budras et al (2007)* in dog added that the arch was formed by median, radial, ulnar and caudal interosseus arteries.

In accordance with *Popesko et al (2003)* in rabbit, *Massie (1944)*, *Boyd et al (1956)*, *Karlsson and Niechajev (1982)*, *Williams et al (1999)*, *Moore and Dalley (1999)*, *Patnaik et al (2002)*, *Johnson and Ellis (2005)* and *Brezezinski et al (2009)* in human and *Budras et al (2007)* and *Cann (2003)* in the dog, the deep palmar arch was formed by radial and ulnar arteries and palmar branch of caudal interosseus artery. While, *Sisson and Grossman (1969)*, *Evans and deLahunta (1996)* in dog mentioned that the deep palmar arch was formed by radial and common interosseus arteries.

The superficial antebrachial artery was derived from the brachial artery and detached 2nd, 3rd and 4th dorsal common digital arteries. The later branches were bifurcated into lateral and medial proper dorsal digital arteries. This pattern was also asserted by *Popesko et al (2003)* in rabbit and *Budras et al (2007)* in the dog.

The dorsal carpal branch of the radial artery in the specimens under investigation communicated with the united palmar branch of the caudal interosseus and ulnar arteries to form the dorsal carpal rete. It detached I-IV dorsal metacarpal

arteries. These observations were in accordance with *Popesko et al (2003)* in rabbit.

References

- Boyd, J. D.; Clark, W. E.; Hamilton, W. J.; yoffey, J. M.; Zuckerman, S.; Appleton, A. B. (1956):** Textbook of human anatomy In: Cardiovascular system blood vessels. Macmillan and Co. Ltd. New York: 341-346.
- Boyd, J. S.; Paterson, C. and May, A. H. (2000):** Color atlas of clinical anatomy of the dog and cat.
- Brezezinski, M.; Luisetti, T. and London M. J. (2009):** Radial artery canuulation: A comprehensive review of recent anatomic and physiologic investigations. *Anesth. Analg.*; 1763-81.
- Budras, K. D.; MacCarthy, P. H.; Fricke, W. and Richter R. (2007):** Anatomy of the dog 5th ed.. Hannover.
- Cann, C. C. (2003):** Dog anatomy A coloring atlas. Teton newmedia. Libirary of Congress cataloging.
- Edwards, E. A. (1960):** Organization of the small arteries of the hand and digits. *Am. J surg.*; 99:837-46.
- Evans, H. E. and deLahunta, A. (1996):** Miller's guide to the dissection of the dog. 4th ed.
- Farag, F. M. (2002):** the arterial supply of the hind paw in the rabbit. *Beni-suef vet.j.med.vol.xii*, No. (1) july (113-129).
- Jelicic, N.; Gajisin, S. and Zbrodowski, A. (1988):** Arcus

- Palmaris superficialis. *Acta Anat* (Basel); 132:187-90.
- Johnson, D. and Ellis, H. (2005):** Pectoral girdle and upper limb. In: *Standring, S. Gray's anatomy*. New York. Elsevier Churchill livingstone: 799-942.
- Karlsson, S. and Niechajev, A. (1982):** Arterial anatomy of the upper extremity. *Acta Radiologica Diagnosis* 23:115-121.
- Loukas, M.; Holdman, S. (2005):** Anatomic variations of the superficial and deep palmar arches. *Folia Morphol*; 64:78-83.
- Loukas, M.; Tubbs, S.; Louis, J. R. and Apaydin, N. (2009):** Princeps Pollicis artery arising from the superficial palmar arch. *Singapore Med J*; 50(11): e 391.
- Massie, G. (1944):** Surgical anatomy In: the upper limb 4th ed. J. & A Churchill Ltd. London: Pp. 177-8.
- Meredith, A. (2009):** Rabbits, Royal (Dick) School of Veterinary Studies, University of Edinburgh <http://www.aquavet.i12.com/Rabbit.html> (accessed 02.04.09).
- Moore, K. L. and Dalley, A. F. (1999):** Upper limb. Clinically oriented anatomy. 4th ed. Philadelphia: Lippincott Williams and Wilkins: 665-810.
- Nicholson, M. (2001):** British Rabbit Council. www.thebrc.org/index.html
- Nomina Anatomica Veterinaria 5th ed. (2005):** published by Committee on Vet. Anat. Nomenclature of the world association of Vet. Anatomists Vienne.
- Patnaik, V. V. G.; kalsey, G. and Rajan, K. (2002):** Palmar arterial arches- Morphological study. *J Anat. Soc. India* 51(2) 187-193
- Popesko, P.; Rajtova, V. and Horak, J. (2003):** A colour atlas of anatomy of small laboratory animals "Rabbit and Gunia pig". pp: 101-102.
- Schively, M.J. (1979):** Xeroradiographic anatomy of the domesticated rabbit (*Oryctolagus cuniculus*) part I: head, thorax and thoracic limb. *The Southwestern Veterinarian* 32, 219-233.
- Sisson, S. and Grossman, J. D. (1969):** The anatomy of the domestic animals. 4th ed. W. B. Saunders, Philadelphia, London.
- Smith, B. J. (1999):** Canine anatomy. Philadelphia : Lippincott Williams & Wilkins, Pp: 307-310.
- Tompsett, D. H. and C. W. Wakeley (1965):** Anatomical Techniques. 1st Edition. E & Living Stone Ltd. Edinburgh and London.
- Tipirdamaz, S.; Yalcin, H. and Dursun, N. (2001):** Anatomy; Macroanatomic investigations of the blood supply of the thoracic limb of Kangal dogs. Vol. 23, issue 1.
- Williams, P. L.; Bannister, L. H.; Berry, M. M.; Collins, P.; Dyson, M.; Dussek, J. E.; Fergussoin, M. W. J. (1999):** Gray's anatomy In: Cardiovascular system. Gabella, G. Edr. 38th ed. Churchill Livingstone Edinburg, London: 1542-44.

الملخص العربي
دراسات تشريحية عيانية على المدد الشرياني لمنطقة الكف في الأرنب

حمدي رزق- سماح البابلي
قسم التشريخ والأجنه - كلية الطب البيطري- جامعة القاهرة

أجري البحث علي القوائم الصدرية لعشرة من الأرناب البالغة النمو، وقد تم تخدير الحيوانات وحقنها من الشريان السباتي العام بمحلول ملح طبيعي 0.9%، تلي ذلك حقنها بكتلة المطاط السائل الملون بمادة حبر الروترنج.

وقد بينت الدراسة أن:

المدد الشرياني لمنطقة الكف في الأرناب ينقسم إلي مجموعتين: إحداهم راحية والأخرى ظهرية، وتتكون كل من هاتين المجموعتين من مجموعة سطحية وأخرى غائرة. وتشتمل المجموعة الراحية السطحية علي الشرايين الإصبعية الراحية العامة II III IV والتي تنشأ من الشريان الوسطاني، بينما تشتمل المجموعة الراحية الغائرة علي الشرايين المشطية II III IV والتي تنشأ من القوس الراحي الغائر. كما تبين وجود قوس راحي سطحي يقوم بتغذية العضلات بين العظمية. كما تشتمل المجموعة الظهرية السطحية علي الشرايين الإصبعية الظهرية II III IV والتي تنشأ من الشريان السطحي بعد العضدي. أما المجموعة الظهرية الغائرة تشتمل علي الشرايين المشطية الظهرية II III IV والتي تنشأ من الشبكة الرسغية الظهرية.