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دراسات تشريحية على الأوعية الدموية الكلوية في الحمار

فؤاد عثمان ، صفوت رجب

أجريت هذه الدراسة على خمسة وثلاثين كلية لحمير بالغة من كلا الجنسين • تمت دراسة توزيع الأوعية الدموية وعلاقتها بعضها البعض داخل الكلية وذلك بواسطة القوالب المتآكلة والتشريح والاشعة •

قد أوضحت الدراسة أن شريان الكلية اليمنى ينقسم الى فرع زيلي ، فرع ظهري وفرع بطني على حين أن شريان الكلية اليسرى ينقسم الى فرع أمامي ، فرع ظهري وفرع بطني كل فرع من هذه الفروع يكون مسئولا عن تغذية قطعة خاصة من الكلية وبناءا على هذا يمكن تقسيم الكلية اليمنى الى قطعة زيلية ، قطعة ظهرية ، وقطعة بطنية بينما تنقسم الكلية اليسرى الى قطعة أمامية ، قطعة ظهرية ، وقطعة بطنية • في الكلية اليمنى يتمثل الجزء الزيلي بالقطب الخلفي للكلية والجزء البطني يحتل الجزء البطني الأوسط من هذا العضو • أما الجزء الظهري فيشمل بقية الكلية • يحتل الجزء الأمامي في الكلية اليسرى الثلث الأمامى من النصف البطني للكلية أما الثلثين الاخريين لهذا النصف يكونان القطعة البطنية • أما القطعة الظهرية فتحتل كل النصف الظهري للكلية •

كما أوضحت الدراسة عدم تواجد الأوردة المحفظية في كلية الحمار على حين أن الأوردة النجمية تتواجد فقط خلف نقير الكلية •

هذا وقد تبين من الدراسة أن الأوردة الكلوية تحذو حذو الشرايين داخل الكلية ولكنها تتشابك بحرية مع بعضها •

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ANATOMICAL STUDIES ON THE RENAL BLOOD VESSELS OF DONKEY
(Equus asinus)
(With 17 Figures)

By
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SUMMARY

A total of thirty five kidneys from adult donkeys of both sexes were provided for this study. Distribution of the renal vessels and their mutual relations were studied by corrosion casts, dissection and angiographs. The study revealed that the right renal artery divides into caudal, dorsal and ventral arteries of second order. while th left renal artery into cranial, dorsal and ventral arteries of second order. Each of these arteries supplies its own independant segment. Concequently, the right kidney can be divided into caudal, dorsal and ventral segments, while the left kidney into cranial, dorsal and ventral segments. In the right kidney, the caudal segment comprises the caudal pole, while the ventral segment forms the mid - ventral part of the organ. The remaining part of the kidney belongs to the dersal segment. In the left kidney, the cranial segment occupies only the cranial third of the ventral half, while its remaining caudal two thirds form the ventral segment. The dorsal segment comprises the complete dorsal half of the left kidney. The study provided also that the capsular veins are not present in donkey, while the stellate veins are present and situated caudal to the hilus. The renal veins inside the kidney follow the arterial pattern, however, they anastomose freely with each other. Therefore, they do not have segmental organization like the arteries.

INTRODUCTION

Accurate anatomical studies on the renal vasculature are important not only for better understanding of renal function but also for surgical interference as well as for comparative purposes. The arterial renal system has been studied by GRAHAME (1944) in the two - humped camel; ARNAUTOVIC (1959); MIERZWA (1975) and SHIVELY (1978) in dog; SABER (1976) and MOUSSA (1980) in the one - humped camel; MIERZWA (1976) in cat, EL-AYAT, MOUSSA and OSMAN (1981) in buffalo; WOZNIAK, KIERAZ and WAWRZYNIAK (1972) and ABDALLA, ASSAD and AHMED (1981) in man. Moreover, the macroscopic arangement of the renal vessels are described by MOORE (1928) in man; CHRISTENSEN (1952) in dog; WELLER (1964) in horse; HOLLE (1964) in small ruminants; WILL (1966) in ox and ZIMMERMANN (1972) in cat.

However, the only available literature on the renal artery of donkey was the brief account given by SELIM (1981). Moreover, no literature about the macroscopic arrangement of renal veins in this animal was available. The present work is an attempt to study the arrangement of blood vessels in side the kidney w .h particular attention to their mutual relations.

MATERIAL and METHODS

A total of thirty five kidneys from adult donkeys of both sexes were provided for this work. The renal veins have been opened in four kidneys to check the presence of valves. The remaining specimens were divided into three groups. The first group comprises 15 kidneys and used to prepare casts by injecting coloured vinilyte either into the renal artery and ureter (five specimens), or the renal vein and ureter (five specimens) or the artery, vein and ureter (five specimens). The soft tissues were corroded by concentrated hydrochloric acid. The technique of TOMPSETT and WAKELY (1956) was adopted. The second group comprises eight kidneys and used for dissection after latex injection and fixation in 10% formalin solution. The dissection is done by removal of the soft tissue in part and following the branches inside the kidney by the aid of magnifying lens. The third group comprises eight specimens and provided for radiography after Micropaque injection either into the artery (four specimens) or into the vein (four specimens). The nomenclature adopted according to the Nomina Anatomica Veterinaria (1975) and the available literature (ZIMMERMANN, 1972) for the names which are not recorded in the Nomina Anatomica Veterinaria.

RESULTS

Arterial system:

The right renal artery, about 3-5 cm in length, arises from the lateral aspect of the abdominal aorta opposite to the last intercostal space. Just before entering the renal hilus, it gives off a caudal branch and then divides into dorsal and ventral branches of second order. The left renal artery is detached from the aorta 1-3 cm more caudal than the right one. It divides close to the hilus into three branches of second order, cranial, dorsal and ventral. Each of these branches supplies its own independant segment. Concequently, the right kidney can be divided into caudal, dorsal and ventral segments, while the left kidney into cranial, dorsal and ventral segments.

Arteria renalis II caudalis:

This artery is present only in the right kidney (Figs. 1/4, 2/2, 3/3, 5/1). It extends about 1-2 cm towards the caudal pole, where it gives off 4-6 interlobar arteries to supply the corresponding part of the kidney. In 10 specimens, this artery is detached directly from the aorta (Fig. 5/1).

Arteria renalis II cranialis:

The cranial artery of second order (Figs. 6/5, 7/3, 8/1, 10/2, 11/2) is found only in the left kidney. It gives off 2-3 interolbar arteries to supply the cranial third of the ventral half of the kidney.

Arteria renalis II ventralis:

It is found in both sides. In the right kidndy (Figs. 1/6, 2/4, 3/4, 5/3), the artery proceeds laterad to supply the mid - ventral part of the kidney through 5-7 interlobar arteries. In four

specimens, the Arteria renalis II ventralis divides into three arteries of third order, each gives off two interlobar arteries. In the left kidney, the Arteria renalis II ventralis (Figs. 6/4, 7/1, 8/2, 9/2, 11/4, 12/3) supplies the caudal two thirds of the ventral half of the organ and with regard to its direction, it can be considered as the direct continuation of the renal artery.

Arteria renalis II dorsalis:

It is found also in both sides. In the right kidney (Figs. 1/5, 2/3, 3/2, 4/3, 5/4), the dorsal artery of second order proceeds in the middle zone towards the lateral border, where it gives off 5-7 interlobar arteries to supply the cranial two thirds of the dorsal half of the kidney. Moreover, shortly beyond its origin, the artery gives off a cranio - ventral branch (Figs. 3/5, 5/5) which supplies the cranial third of the ventral half of the organ through 2-3 interlobar arteries. In the left kidney (Figs. 6/3, 7/2, 8/3, 9/3, 10/3, 11/3, 12/4), the short dorsal artery divides into two unequal arteries of third order which supply the dorsal half of the organ. The larger artery gives off 4-5 interlobar arteries, while the other smaller one detaches 2-3 interlobar arteries. The ureteric artery (Figs. 6/7, 7/5) is detached from the cranial or dorsal arteries of second order or the interlobar arteries to supply the initial part of the ureter and renal pelvis.

Arteriae interlobares renis:

The interlobar arteries (Figs. 3/6, 4/4, 8/4, 9/5, 13/8, 14/9) arise either as collateral or terminal branches from the renal arteries of second or third order. In certain areas, especially in the poles, they arise before the arival of the parent artery to the renal pelvis or its terminal recesses. They arise either singly or in pairs, and may penetrate through the lobe itself or pass between two adjacent lobes. No anastomoses have been observed between the interlobar arteries.

Arteriae arcuatae:

The arcuate arteries (Figs. 3/7, 4/5, 8/5, 9/6, 11/7, 12/7, 13/9, 14/7) are gently curved in their course. They arise from the interlobar arteries and divide one or two times giving other generations. In the vicinity of the renal hilus, these arteries extend in all directions and corse each other before they divide into interlobular arteries.

Arteriae interlobulares:

The interlobular arteries (Figs. 1/7, 2/5, 3/8, 4/6, 6/6, 7/4, 9/7, 13/10, 14/8) can be divided according to their course and node of distribution into superficial and deep groups. The arteries of the superficial group proceds either in straight or curved manner towards the periphral prat of the cortex. The deep group supply the part of the cortex near the cortico-medullary junction. Usually they arise singly from the arcuate arteries.

The afferent arterioles are detached either directly from the arcuate arteries or from the intralobular ones. Each of the latter terminates into 4-5 afferent arterioles. They may arise either singly or in pairs and attain a slightly curved course.

Venous system:

The capsular veins could not be demonstrated in the donkey, while the stellate ones (Fig. 15) are demonstrated caudal to the hilus. They are represented by 3-4 veins lying directly under the Capsula fibrosa extend from the caudal pole towards the hilus. Before reaching the hilus, they unite to form a single vein which convies the blood into the renal vein.

The Venae interlobulares (Figs. 13/10, 14/8) drain the renal cortex and can be differeniated into superficial and deep groups. The former drain the peripheral part of the cortex and

extend towards the cortico - medullary junction. The deep interlobular veins drain the remaing part of the cortex without anastomosing with those of the superficial ones. The interlobular veins terminate either singly or in pairs into the arcuate ones.

The Venae arcuatae (Figs. 13/9, 14/7, 17/5) run in the cortico - medullary junction, parallel to the superficial surface of the kidney and usually terminate at right angles into the interlobar veins. In the hilus region, they are less in number and terminate directly into the renal veins of third order. There are large number of venous anastomoses between the adjacent arcuate veins forming a closely packed venous network which encircles the cortico medullary junction.

The Venae interlobares (Figs. 13/8, 14/9, 16/4, 17/4) vary from 15-20 in number. They extend between the adjacent lobes and usually terminate singly into the renal veins of third or second order. However, in the mid - dorsal and mid - ventral parts of the kidney, each 2-3 interlobar veins terminate together. They accompany the homonymous arteries, but the veins lie usually internal to the arteries. A large number of anastomotic veins have been observed between the interlobar veins. These anastomotic vessels recieve the venules comming from the renal pelvis.

The veins of second order unite together outside the renal hilus to form the renal vein. The right and left renal veins joins the caudal vena cava somewhat caudal to the corresponding arteries. Along its course, the renal vein recieves 1-2 ureteric veins. The latter drain the initial part of the ureter and renal pelvis. Valves are observed along the course and junctions of renal veins of different orders as well as the interlobar veins.

DISCUSSION

The terminology and number of primary branches of the renal arteries seem to be variable not only in different species but also in the same specie. The present work showed that the left renal artery, before reaching the hilus, divides into cranial, dorsal and ventral arteries of second order, while the right one into caudal, dorsal and ventral arteries. However, only dorsal and ventral arteries of second order have been observed by SABER (1976) and MOUSSA (1980) in the one - humped camel; GRAHAME (1944) in the two - humped camel; GRAHAME (1959) in elphant and grey seal; ARNAUTOVIC (1959) and MIERZWA (1975) in the dog; WROBEL (1961) in swines; HOLLE (1964) in small ruminants; ZIMMERMANN (1972) and MIERZWA (1976) in cat and ABDALLA, ASSAD and AHMED (1981) in man. In this connection, WHILLE (1966) and EL-AYAT, MOUSSA and OSMAN (1981) described cranial and caudal branches of second order for the renal artery of ox and buffalo respectively. On the other hand, the renal artery divides into 4-7 branches as mentioned by SHIVELY and STUMP (1975) in guinea pig; 4-6 branches by WELLER (1964) in horse and 4-7 (right side) or 4-6 (left side) as mentioned by SELIM (1981) in the donkey.

Regarding the renal arterial segmentation, the present work divided the left kidney into cranial, dorsal and ventral segments and the right kidney into caudal, dorsal and ventral ones. However, SELIM (1981) in the same animal divides the right kidney into apical, cranial, middle ventral, middle dorsal, caudal and caudal extremity segments. He added that the apical segment is absent in the left kidney. The human kidney is divided into two or three segments by WOZNIAK, KIERSZ and WAWRZYNIAK (1972) and four segments by ABDALLA, ASSAD and AHMED (1981). Moreover, WROBEL (1961) for the kidney of swine, described 2-3 segments,

termed as cranial and caudal or cranial, middle and caudal. The kidney of the ox is divided by WILLE (1966) into 5-6 segments and that of one - humped camel is divided by SABER (1976) into 9-15 segments. This large contraversy between the authors working on different species or even those on the same specie about the names and number of the segments depends upon what branches of the renal artery was considered as segmental.

The interarterial anastomosis between the interlobar arteries mentioned by CHRISTENSEN (1952) in dog and SABER (1976) in one - humped camel could not be observed in the current work. The present work agreed with those offered by MOORE (1928) and ABDALLA, et al. (1981) in man; ARNAUTOVIC (1959) in dog; FOURMAN and MOFFAT (1971) in man, dog, cat and rat and MOFFAT (1975) who revealed that each interlobar artery supplied a difinit part of the kidney and no anastomoses occurs between the arteries of different parts.

As far as the relations between the renal arteries and veins, and the presence of valves up to the interlobar veins is concerned the present work in this respect is in accordance with those of WELLER (1964) in horse; WROBEL (1961) in pig and ZIMMERMANN (1972) in cat. Moreover, despite the fact that the veins inside the kidney are artery satellites, but they do not shaw segmental organization as they anastomose freely with each other. This is in accordance with the findings of WROBEL (1961) in pig; WELLER (1964) in horse; ZIMMERMANN (1972) in cat and MOUSSA (1980) in one - humped camel.

The Venae capsulares described by WELLER (1964) in horse and ZIMMERMANN (1972) in cat are not demonstrated in the donkey. The present result is in accordance with that of HOLLE (1964) in small ruminants.

The stellate veins are present in donkey, but not identical to those described by HOLLE (1964) in small ruminants and WELLER (1964) in horse who stated that the stellate veins are localized in the hilus surrounding area. In the donkey, the present work revealed that they are only limited to that part caudal to the hilus. Therefore it can be considered as a diagnostic feature of the kidney. On the other hand, CHRISTENSEN (1952) in dog and ZIMMERMANN (1972) in cat stated that the stellate veins are distributed all - over the entire surface of the kidney and are always visible.

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LEGENDS OF FIGURES

Fig. (1): Vinilyte cast showing the distribution of the right renal artery and its relation to the renal pelvis, dorsal view. Note that the ureter is shifted towards the coudal pole.

1- Ureter,
2- Recessus terminalis,
3- Arteria renalis cextra,
4- Arteria renalis II caudalis,
5- Arteria renalis II dorsalis,
6- Arteria renalis II ventralis,
7- Arteriae interlobulares

Fig. (2): Vinilyte cast showing the distribution of the right renal artery, dorsal view.

1- Arteria renalis dextra, 2- Arteria renalis II caudalis,
3- Arteria renalis II dorsalis, 4- Arteria renalis II ventralis,
5- Arteriae interlobulares

Fig. (3): Vinilyte cast for the right renal artery showing the distribution of its three branches of second order in the corresponding parts of the kidney. Note that the renal arteries of second order are slightly separated from each other.

A- Dorsal half of the kidney, B- Ventral half of the kidney
1- Arteria renalis dextra, 2- Arteria renalis II dorsalis,
3- Arteria renalis II caudalis, 4- Arteria renalis II ventralis,
5- Arteria renalis III cranio ventralis, 6- Arteriae interlobares,
7- Arteriae arcuatae, 8- Arteriae interlobulares

Fig. (4): Renal arteriography, right side, ventro - dorsal view. Note that the Arteria renalis II caudalis is not injected.

1- Arteria renalis dextra, 2- Arteria renalis II ventralis,
3- Arteria renalis II dorsalis, 4- Arteriae interlobares,
5- Arteriae arcuatae, 6- Arteriae interlobulares

Fig. (5): Right renal artery, injected with latex and followed inside the kidney after removal of the parenchyma of the dorsal half of the organ.

1- Arteria renalis II caudalis (directly detached from the aorta),
2- Arteria renalis dextra, 3- Arteria renalis II ventralis,
4- Arteria renalis II dorsalis, 5- Arteria renalis III cranio-ventralis.

Fig. (6): Vinilyte cast showing the distribution of the left renal artery and its relation to the renal pelvis, ventral view.

1- Ureter, 2- Recessus terminales,
3- Arteria renalis II dorsalis, 4- Arteria renalis II ventralis,
5- Arteria renalis II cranialis, 6- Arteriae interlobulares
7- Arteria ureterica,

Fig. (7): Vinilyte cast showing the distribution of the left renal artery, ventral view.

1- Arteria renalis II ventralis, 2- Arteria renalis II dorsalis,
3- Arteria renalis II cranialis, 4- Arteriae interlobulares,
5- Arteria uretrica

Fig. (8): Vinilyte cast for the left renal artery showing the distribution of its three branches of second order in the corresponding parts of the kidney. The arteries of second order are slightly separated.

A- Dorsal half of the kidney, B- Ventral half of the kidney.
1- Arteria renalis II cranialis, 2- Arteria renalis II ventralis,
3- Arteria renalis II dorsalis, 4- Arteriae interlobares,
5- Arteriae arcuatae, 6- Arteriae interlobulares

Fig. (9): Renal arteriography, left side, dorso - ventral view.

1- Arteria renalis sinistra, 2- Arteria renalis II ventralis,
3- Arteria renalis II dorsalis, 4- Arteria renalis II cranialis,
5- Arteriae interlobares, 6- Arteriae arcuatae,
7- Arteriae interlobulares

Fig. (10): Left renal artery, injected with latex and followed inside the kidney after removal of the parenchyma of the dorsal half of the kidney.

1- Arteria renalis sinistra,
2- Arteria renalis II cranialis,
3- Arteria renalis II dorsalis

Fig. (11): Vinilyte cast showing the distribution of the left renal artery and its relation to the pelvis, dorsal view.

1- Arteria renalis sinistra,
2- Arteria renalis II cranialis,
3- Arteria renalis II dorsalis,
4- Arteria renalis II ventralis,
5- Ureter,
6- Pelvis renalis,
7- Arteriae arcuatae

Fig. (12): Vinilyte cast showing the distribution of the left renal artery, and its relation to the pelvis, ventral view.

1- Arteria renalis sinistra,
2- Arteria renalis II cranialis,
3- Arteria renalis II ventralis,
4- Arteria renalis II dorsalis,
5- Ureter,
6- Pelvis renalis,
7- Arteriae arcuatae

Fig. (13): Vinilyte cast showing the distribution of renal vessels and their relations to the pelvis of the left kidney, ventral view.

1- Ureter,
2- Recessus terminalis,
3- Arteria renalis,
4- Vasa renalis II cranialis,
5- Vasa renalis II ventralis,
6- Vasa renalis II dorsalis,
7- Vena renalis,
8- Vasa interlobares,
9- Vasa arcuatae,
10- Vasa interlobulares

Fig. (14): Vinilyte cast showing the distribution of the renal vessels and their relations toe the pelvis of the left kidney, dorsal view.

1- Arteria renalis,
2- Arteria renalis II cranialis,
3- Arteria renalis II dorsalis,
4- Vena renalis II dorsalis,
5- Vena renalis,
6- Recessus terminales,
7- Vasa arcuatae,
8- Vasa interlobulares,
9- Vasa interlobares

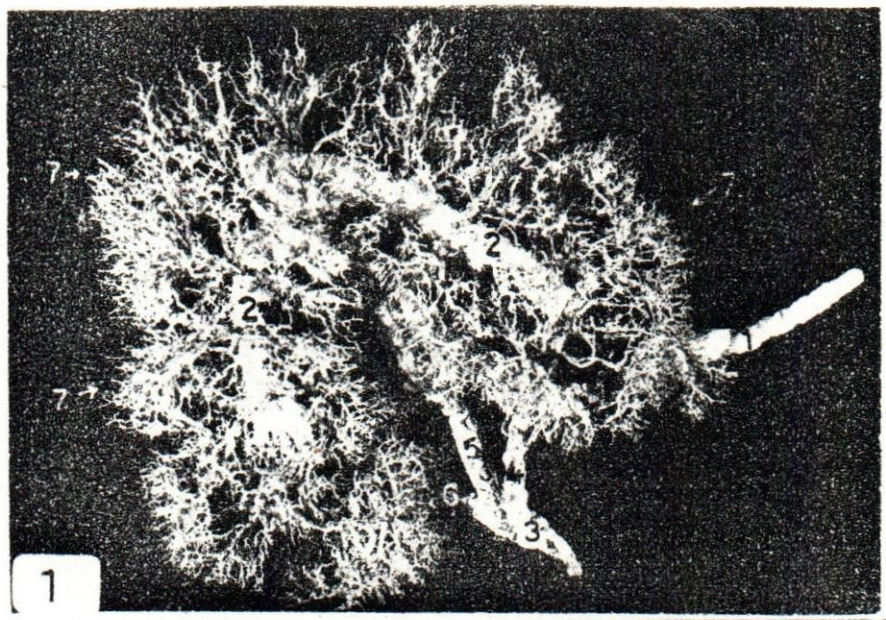
Fig. (15): Left kidney with intact Capsula adiposa, ventral view. Note that the arrow indicate the injected Venulae stellate.

Fig. (16): Left renal vein injected with latex and followed inside the kidney after removal of the parenchyma of the dorsal half of the organ.

1- Vena renalis,
2- Vena renalis II dorsalis,
3- Venae renales III dorsales,
4- Venae interlobares

Fig. (17): Right renal vein injected with latex and followed inside the kidney after removal of the parenchyma of the ventral half of the organ.

1- Vena renalis,
2- Vena renalis II ventralis,
3- Vena renalis II caudalis,
4- Venae interlobares,
5- Venae arcuatae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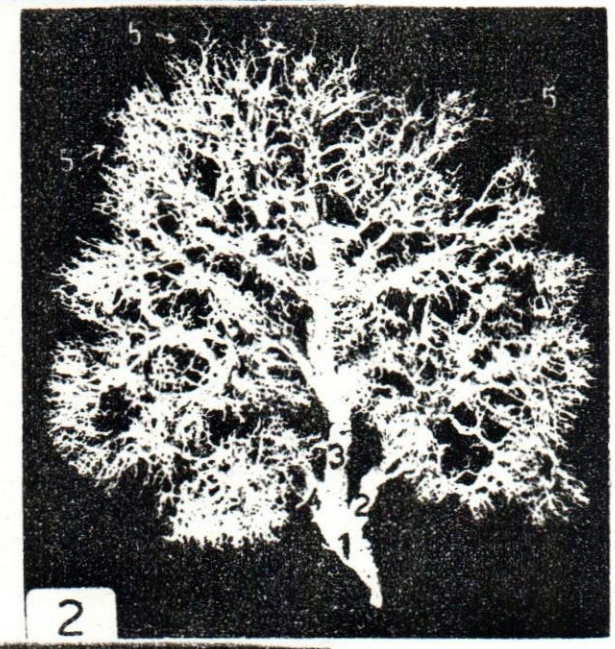
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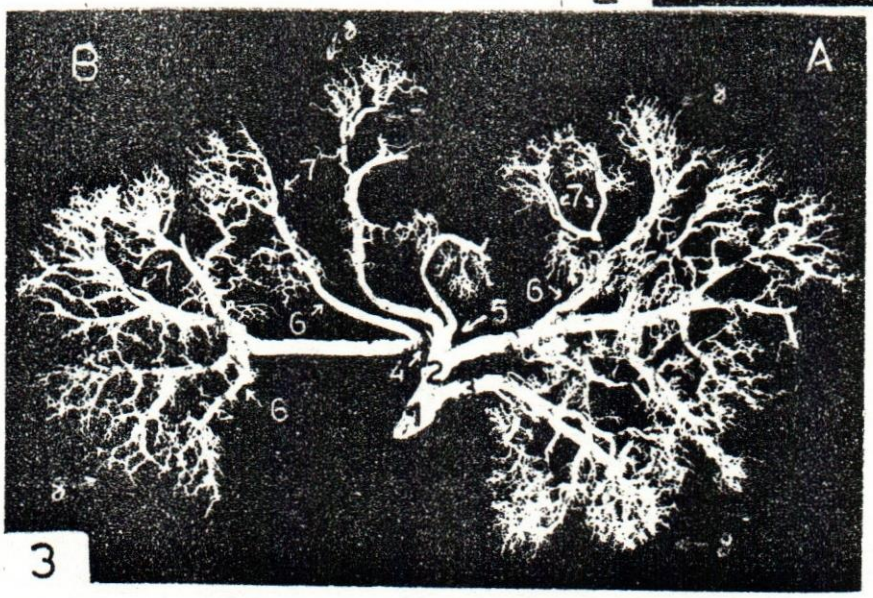
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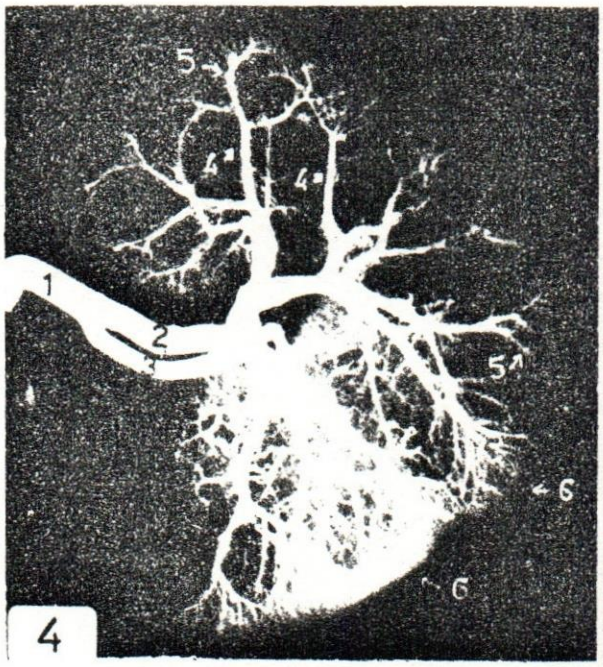

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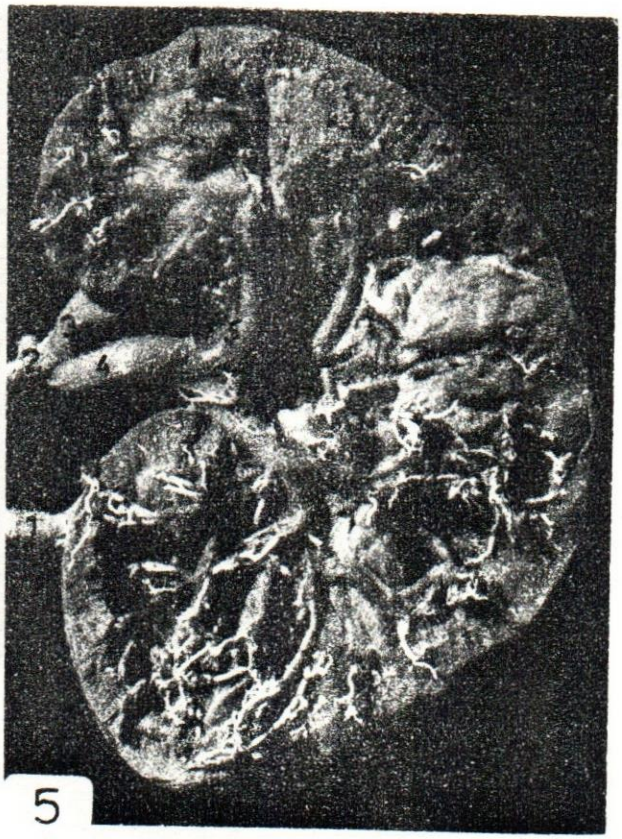

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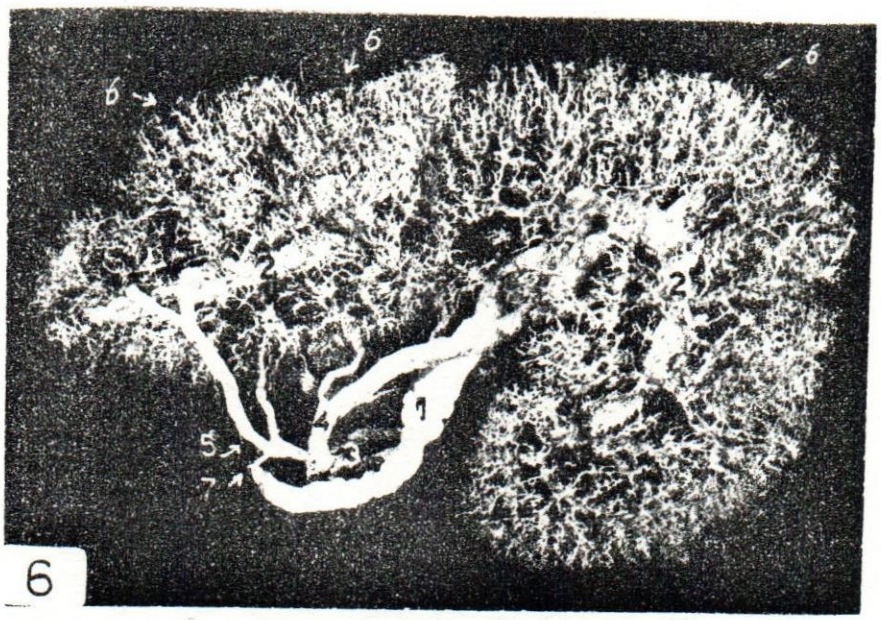

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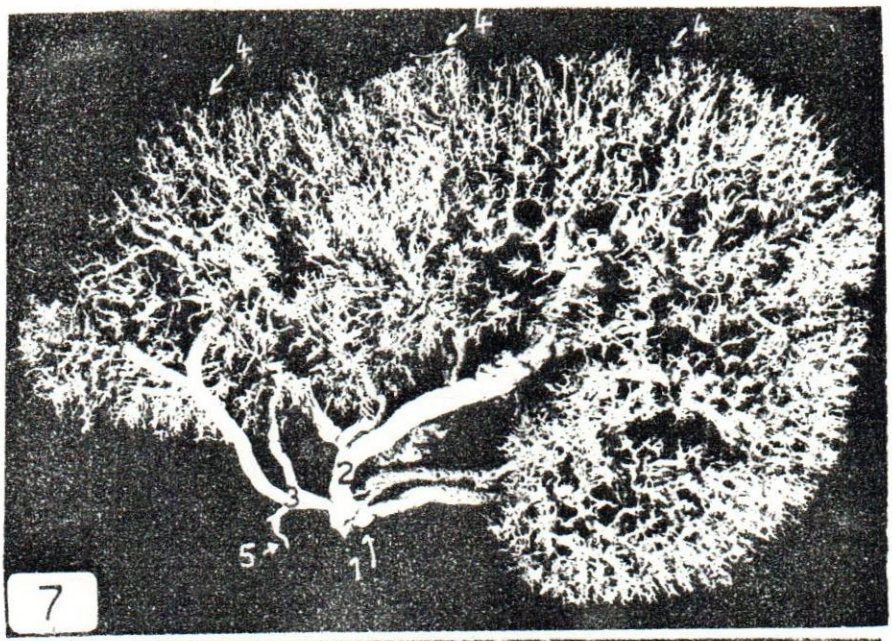
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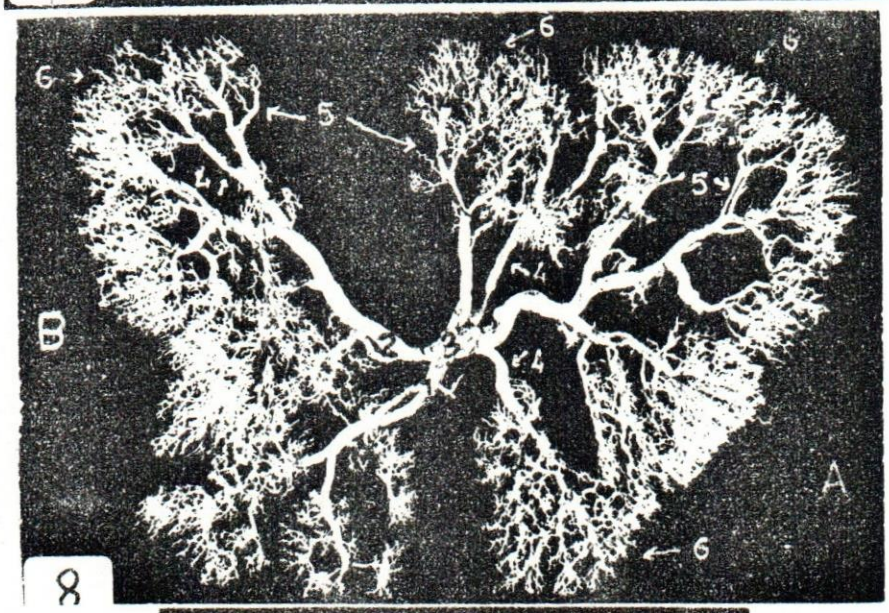
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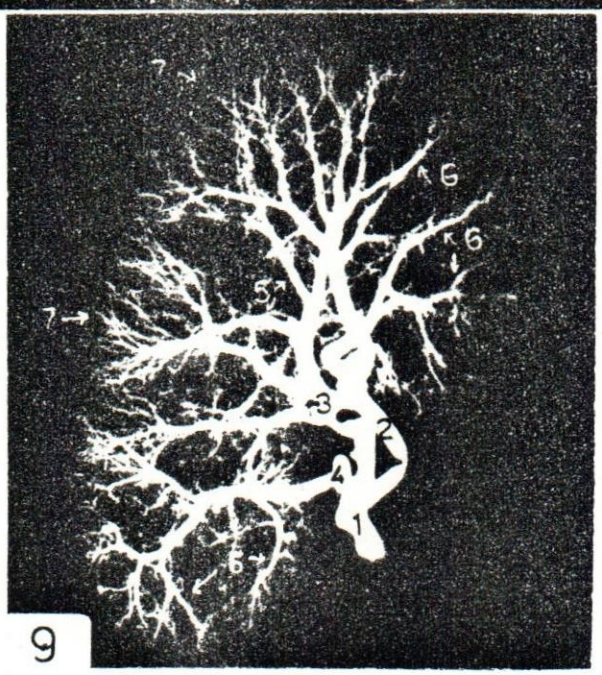
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