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Study of renal arterial segmentation in mammals by corrosion cast

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ABSTRACT

In mammals, kidneys are supplied by the right and the left renal artery and originate from the related side of the abdominal aorta. Renal arteries give rise to the dorsal and ventral branches and they were divided into the interlobar, arcuate, and interlobular arteries. The aim of present study was to compare and correlate the arterial segmentation of kidney in different mammals.
In the present study 15 Kidneys (5 human kidney, 5 goat kidney and 5 buffalo) were taken. The comparison of the segmentation of renal artery in human and goat and buffalo were studied by using buteryte acetate as casting material. Kidney of goat having same segmental patterns as human kidney whereas in buffalo kidney is lobulated. Knowledge of the distribution of major branches of the renal artery is important in diagnosis and treatment of renal disease for surgeons. Variations in renal vascular anatomy have been important in increasing frequency of experimental renal transplantation.

INTRODUCTION

Renal circulations contain a great deal of discord, not only with reference to the existence and course of minute vessels, but also with respect to the main vascular pathway. Classically blood to the Kidneys passes from the aorta through the renal artery (end arteries), interlobar, arcuate and interlobular arteries and then to glomeruly by means of afferent arterioles. Efferent arterioles from glomeruli go to the apices of their renal pyramids.

A comparison of kidneys of humans and herbivorous animals like pig, goat, sheep and buffalo reveals definite similarities and differences in segmentation and branching pattern of renal artery, most of the kidneys supplies by one main artery.The vascular pattern of human kidney was first studied by Brodel [1] 1901 using celloidin as injecting material. Grave[2] described the common arterial pattern of human kidneys and its application to segmental dissection by injection of plastic material into the postmortem specimen.

The intra renal arterial pattern is constant, irrespective of the variable origin of the segmental artery. Segmental arteries are most commonly branches of main renal artery but may also have a precocious from the main artery, the arota or some other vessel. Segmental arteries arising from sources other than the main renal artery are often falsely called “abberent” or “accessory”. They are in fact, developmental deviation from the so called normal branching pattern. Knowledge of segmental arrangement of organ helps the surgeon to resect only the diseased portion. This help in minimal sacrifice of the organ.

A characterization of the pattern of branching of the renal artery and of the segmentation of the kidney is the essential to a number of experimental procedures, especially when it is proposed to compare findings in different species.

The present study is carried out to access the segmentation of renal artery in mammals by preparing renal cast. The primary object of the work is to demonstrate if possible the basic vascular architecture of the kidneys of the various domestic animals.

MATERIAL AND METHOD

15 Kidneys (5 human kidney, 5 goat kidney and 5 buffalo) were taken for the present work. The human kidneys were obtained from the mortuary of S P Medical College, Bikaner, Rajasthan. The buffalo and goat' kidneys were obtained from local slaughter house. All specimens were collected within 24 hours after death.

The kidney was first washed thoroughly in running water.

Then external surface was cleared by blunt dissection. Intrarenal washing was also done to remove blood in vessels as advocated by Tompsett[3]. Water was injected through renal artery, it used to come out through vein along with some clots, and washing was continued till clear fluid came out of vein. The specimen was then injected in the fresh state. Buteryte acetate was used as a casting material.

Injection of casting material

10-20 ml leurlock syringes were used for the injection of Buteryte acetate as casting material. Cannule of various calibare were prepared from needles of 14-24 sizes. The cannula was introduced in the main vessels and secured in position by thread ligation. The syringe containing the cast material of desired colour was connected to the cannula. Solution was injected under a constant manual pressure. The quantity of solution required for complete filling of the vessels varied with the size of the organ and strength of solution. The cannula was withdrawn and the vessels ligated firmly to prevent leakage of material. The artery was injected by red coloured solution.

Fixation

The injected kidney was kept in 5% formalin solution in glass jar for 3-5 days (at room temperature) to fix the vascular tree.

Maceration of the kidney substance

The kidney after removal from the formalin was washed in running water, decapsulated and immersed in concentrated hydrochloric acid for 72 hours. Immersion of the kidney in acid for a longer period was avoided as it rendered the cast most fragile.

The macerated kidney was left under slow stream of water to wash away the macerated tissue. The cast from shrunken due to air was prevented by immersing the cast in 2% varnish in turpentine. The casts thus obtained were labeled and studied.

OBSERVATION

Human kidney

In human kidney single renal artery was supplied in all cases. The artery divided in the hilum of the kidney in anterior and posterior division from theses divisions 5 segmental arteries (Apical, upper, middle, lower and posterior) arise and supply different segment of kidney. The upper and middle segment were present only on anterior side, posterior segment on posterior side while apical and lower were seen on both side.

Apical segment artery- the apical segmental artery was present in all cases but its origin was variable, therefore it was divided into different type

Type I- arising from trunk of anterior division

Type II- arising from junction of anterior and posterior division

Type III arising from main stem of renal artery

Type IV- arising from posterior division

Type V- double apical artery, one arising from each anterior and posterior division

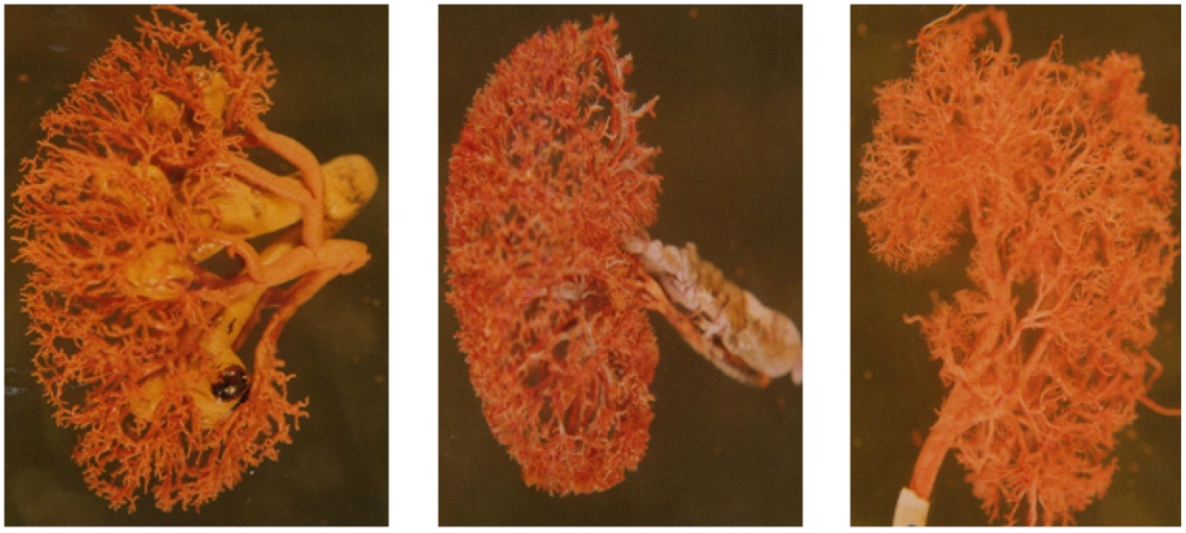
Upper segment artery- it was arising from anterior division of renal artery. In one case it was seen to arise from posterior division

Middle segment artery- it was arising from anterior division of renal artery. In most of the cases it arises from lower segmental artery, in some in common with upper segmental artery, while in few it was arising separately.

Lower segment artery- it always arise from anterior division. Sometimes it arose in common with middle segmental artery.

Posterior segment artery- it was the continuation of posterior division of renal artery. The origin of branches from posterior division was variable in different kidneys.

Each segmental artery was seen to supply its own independent area and there stood no significant anastomosis between segmental arteries. This was proved by ligating one of the segmental arteries prior to the injection. The so called avascular zone (Brodel's line) along the posterior-lateral border of the kidney was not complete. It was present only in middle portion (between upper and middle segment anteriorly and posterior



A. Human B. Goat C. Buffalo

Fig.1. Renal segmenatation of Human, Goat and Buffalo kidney

segment posteriorly), while it was absent in apical and lower pole region.Out of 5 human kidney only one case we observed the apical segmental artery was absent and this region was supplied by upper segmental artery.

Goat kidney

In Goat kidney single renal artery was supplied in all cases. The artery divided into two divisions ventral and dorsal division. Each division sent 4 segmental arteries (cephalic, middle 1,middle 2 and caudal) and supply segments of the respective surfaces of kidney. In some kidneys number was reduced by one or two segments in which common polar artery existed to supply the full thickness of kidney at either of the poles. Ventral cephalic segment artery- first branch of ventral division, supplied ventral cephalic segment. In some cases an additional cephalic artery was also seen coming from either dorsal or ventral division.

Ventral middle 1 segment artery- it was arising from ventral division of renal artery supplying its own segment. At time this artery was arise either in common with ventral cephalic or ventral middle 2 segmental artery, but in that cases common stem soon separate out.

Ventral middle 2 segment artery- it was third branch arising from ventral division of renal artery supplying its own segment.

Ventral caudal segment artery- it was continuation of ventral division.

Dorsal cephalic segment artery- first branch of dorsal division, supplied dorsal cephalic segment. Quite frequently an additional cephalic artery was also seen.

Dorsal middle 1 segment artery- it was arising from dorsal division used to divide into 2-3 branches inside the substance. Often it was seen to arise in common with dorsal cephalic or dorsal middle 2 segmental artery, in that cases common stem used to sub-divide again to form generalized pattern.

Dorsal middle 2 segment artery- it was third branch arising from dorsal division of renal artery supplying its own segment.

Dorsal caudal segment artery- it was continuation of dorsal division.

Sometimes dorsal division of renal artery was small and failed to supply either of poles of kidney in such case the remaining portion was supplied by a branch of ventral division and vice-versa.

No significant anastomosis was seen between the segmental arteries. A marked avascular line (Brodel's line) was seen along the lateral border of the kidney.

Out of 5 casts, 4 kidney cast had normal segmental patterns. In one cast shown cephalic segmental artery arose from the junction of ventral and dorsal division.

Buffalo kidney

In kidney of buffalo were superficially lobulated. There were about 20 lobes in each kidney. Single renal artery was seen entering the hilum of each kidney in all cases except one renal artery was found to divide into ventral and dorsal division. In one case, 2 separate arteries were seen entering the renal hilum. From these divisions 5 segmental arteries were arise (cephalic, ventral, dorsal middle1, dorsal middle2 and caudal).

Ventral division- the main division of artery gives a cephalic segmental artery and then continues as ventral segmental artery.

Dorsal division was giving three branches dorsal middle1, dorsal middle2 and caudal segmental artery.

Cephalic segment artery- it was branch of ventral division. In one case an additional cephalic segmental artery was seen arising from dorsal division.

Ventral segment artery- after giving a cephalic segmental artery the main division of artery continues as ventral segmental artery.

Dorsal middle1 segment artery- it was the first branch given by dorsal division in hilum of kidney.

Dorsal middle2 segment artery- it given by dorsal division following the middle 1 segmental artery.

Caudal segment artery- it was the continuation of dorsal division.

Out of 5 casts, 4 kidney cast had normal segmental patterns. In one cast found small dorsal segmental artery.

DISCUSSION

The present study worked on cast of renal segmentation of human, goat and buffalo kidneys. This study was compared with the studies carried out by other workers.

Delia [4] et al worked on Arterial segmentation of renal parenchyma with single and multiple renal arteries of 200 human renal corrosion casts. They observed in both single and multiple renal artery casts showed 5 renal segmentations in most of casts as per anatomical terminology. Similar finding was observed in the present study.

In present study, the renal arteries were divided into dorsal and ventral branches in goat similar finding were observed in the study of Aslan[5] et al. In another study on corrosion cast of 10 kidneys of sheep were investigated by Aksoy[6] et al. They found that the renal arteries divided into the dorsal and ventral branches. No anastomoses were seen between the renal arteries and their branches.

In mammals kidneys are supplied by the right and left renal arteries and both originate from the abdominal aorta. [7,8]. The knowledge of the renal arteries is essential in the process of partial or segmental resection[9,10]. This has focused the researchers on to the segmentation of the renal arteries on various species. The present worked on to the segmentation of the renal arteries in different mammals which helpful in surgical procedures of segmental resections as well as safe surgeries in renal transplantation.

CONCLUSION

Human kidney has constant segmental arrangement and distribution of renal artery within the kidney. On the basis of renal arterial distribution renal parenchyma divided into five segments apical, upper, middle, lower and posterior. The renal arterial segments do not change and many variations were observed in their course. Kidney of goat having same segmental patterns as human kidney whereas in buffalo kidney is lobulated and supplied by multiple segmental arteries.The necessity of knowing the variation in the vascular segmental patterns of kidney is to prevent the avoidable loss of the normal healthy renal tissue in nephrectomy. The renal segmentation useful in clinical aspects and its knowledge provides short procedures to remove diseased segments as well as renal calculi in the surgical complications

REFERENCE

1. Brodel M. The intrinsic blood vessels of the kidney and their significance in nephrectomy. Bull. John Hopkins Hospital.1901; 12:10-13.
2. Graves FT. the anatomy of intra renal arteries and its application of segmental resection of kidney. Brit j of surg.1954; 42:132-139.
3. Tompsett DH. Improved corrosion cast technique. Ann of Royal Coll of Surgeons.1959; 24:110-123.
4. Delia EZ. Arterial segmentation of renal parenchyma with single and multiple renal arteries. A comparative study on corrosion casts. FASEB J april2009; 23.
5. Aslan K, Nazli M. A comparative macro-anatomic investigation on the intrarenal segmentation of the renal artery in Goats and Morkaraman Sheep. Indian Vet J.2001; 78: 139-143.
6. Aksoy G, Kurtal I, Ozcan S, Aslan K, Ozudogru Z. Intrarenal arteries and their patterns in the Tuj sheep. *Vet. Med. Czech.2004; 49(2): 5760.*
7. Hadziselimovic H., Cus M. Blood vessels and excretory apparatus of the kidney in some wild animals. Acta Anatomica.1975; 91:7182.
8. Dursun N. Veterinary Anatomy II. 1st ed. Medisan Publishing, Ankara.1994; 134 pp.
9. Graves FT. Anatomical Studies for Renal and Intrarenal Surgery.1986 IOP Publishing Lt., Techno House, Redeliffe Way, England, Bristol BS1 6NX.
10. Motwani K, Harneja N K. A comparative anatomy of renal arterial segments in common mammals and man. Indian J.Vet. Surg.1982; *3*: 2731.