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Anatomical Study of Corrosion Cast Kidney in the Swamp Buffalo

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ABSTRACT

Ten kidneys with renal arteries and ureters of swamp buffaloes (*Bubalus bubalis*) were collected from slaughter house. Arteries and ureters were injected with Technovit 7001 resin containing red pigment and yellow pigment, respectively. Place the specimens in cold water in a natural shape, and then corroded with 50% potassium hydroxide on next day. After one week, renal tissues were taken out in running water until thoroughly clean. Right and left renal arteries bifurcated into two main branches, cranial and caudal branches. The caudal branch gave off 1-2 middle branches. The two main branches and middle branch, then gave off interlobar branches to supply renal tissue. The cranial branch supplied the medial and lateral part of cranial pole, while caudal branch, the largest and longest, curved around lateral side of secondary branch ureter, then pass downward laterally to caudal pole and supplied both medial and lateral part of caudal pole. Middle branch supplied middle part of kidney and lateral border of cranial pole. Middle branch of left kidney was small due to the pointed cranial end. Ureter divided into two primary branches of ureter directed toward the poles of kidney and then subdivided to form the secondary branches of ureter which carrying calices, the funnel shaped structures. Number of renal calices were 27-53 and 23-49 in right kidney and left kidney, respectively. Small size calices were found in kidneys with high number calices. Serveral straight thread-like structures were found on the surface of some calices. These structures were no branches in SEM study, and represented collecting ducts. The pattern of primary, secondary branches of ureter and calices cast were correlated with the shape of kidney. This study is a basic background for understanding the pattern and distribution of renal arteries and renal calices of swamp buffaloes.

Key words : swamp buffalo, kidney, corrosion cast, renal arteries, renal calices

INTRODUCTION

Since buffaloes are good feed converter and necessary for working in the paddy field. Recently, the anatomical researches on various organs of buffaloes were carried out; *eg.* the course and distribution of trigeminal nerve (Rao and Tewari, 1971), the arrangement of caudal arteries and veins (Binev *et al* ., 1984), the distribution and structure of lymphoid tissue in the alimentary tract (Vyas and Mudholkar, 1972), the topography, morphology and histology of esophagus (Yap and Maala, 1973). The kidney of buffaloes were only reported that their renal glomeruli are smaller than those of the ox and horse (Ommer and Mariappa, 1970). The vascular pattern of renal artery has reported in

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the water buffalo (Ghosh and Datta, 1989), but the vascular pattern of renal artery with renal calices are not yet studies. Therefore, this study was performed in the swamp buffalo.

This study concerned with the three dimensional corrosion cast of anatomical pattern and distribution of renal arteries and renal calices in buffalo's kidney. The illustration will be the basic background for understanding the pattern of renal arteries and renal calices and also be useful to those with specialized interest in anatomy of swamp buffalo's kidney.

MATERIALS AND METHODS

Ten kidneys with renal arteries and ureters of adult swamp buffaloes were collected from slaughterhouse. The sex and age of animals were not considered. The kidneys were flushed out the debries and blood clots from the vessels by using normal saline solution. Technovit 7001, methylmetacrylate resin was used for preparing corrosion cast of renal arteries and ureters. Mixed 100 parts of resin with 1 part of hardener I (Benzoyl peroxide). Then added red pigment for artery cast and yellow pigment for ureter cast. One part of hardener II (Dimethyl-p-toluidine) was added just before injection. The renal arteries and ureters were cannulated with plastic tubes and injected mixture of resin into renal arteries and ureters. Plastic tube was clamped with hemostatic clamp. Place the specimens in a cold water in a natrual shape and started corroding specemens in 50% potassium hydroxide on next day. Specimens were turned several times until all surface were corroded. After one week, renal tissue were soft and partly dissolved, then rinse specimens under gentle jet of tap water until thoroughly clean. Small branches of renal arteries were pruned out to demonstrate the segmental branches and interlobar branches which bifurcated from renal arteries. The straight thread-like structures at the surface of calices were coated with gold and observed by scanning electron microscope (JOEL 35 CF). The correlation of three dimensional pattern of renal arteries, ureters and calices corrosion casts were studied.

RESULTS AND DISCUSSION

The kidneys of swamp buffalo were divided externally into several lobes of unequal size. Right kidney was flattened dorsolaterally and oval shape. Left kidney had a rounded caudal end and a point cranial end as kidney of the ox (Figure 1). Right and left renal arteries after passing through the hilus, bifurcated into two main segmental branches, cranial and caudal branches (Figure 2, 3). Except one kidney, renal artery was double arising separately close to each other. One branch represent cranial branch, the other represent caudal branch. Caudal branch then gave off 1-2 middle branches. The two main branches and middle branch gave off many interlobar branches which were vary in number to supply renal tissue. Cranial branch curved around medial side of secondary branch of ureter and gave off interlobar branches to supply medial and lateral part of cranial pole. While caudal branch, the largest and longest amoung the three branches curved around lateral side of secondary branch of ureter and pass downward laterally toward caudal pole to supply medial and lateral part of caudal pole. Middle branch curved around lateral side of secondary branch of ureter and supplied middle part of kidney and lateral side of cranial pole (Figure 2,3). The difference of renal artery distribution between right and left kidney were found in middle branch which was shorter and smaller in left renal artery due to the area of renal tissue supplied of a point cranial pole in left kidney. The distribution of interlobar arteries of right kidney was in radiate manner related to the broad oval shape of right kidney. Ureter after passing through the hilus with

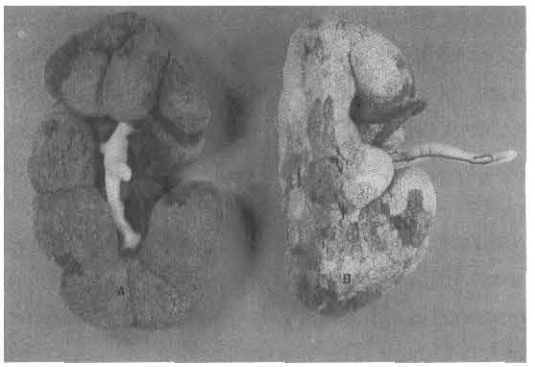

Figure 1 Cast of right and left kidneys.
A. Right kidney
B. Left kidney

renal artery, it divided into two primary branches of ureters which pass directly to both poles of kidney and subdivided to form secondary branches of ureter which carrying calyx, a funnel shaped structure. Number of renal calices were 27-53 and 23-49 in right kidney and left kidney, respectively (Figure 2, 3, 4, 5). These number of calices different from the kidney of the ox which were reported 18-22 renal papillae per kidney (Schummer *et al.*, 1979) and 18-20 calices per kidney (Liumsiricharoen *et al* .,1995). The size of calices were small in a high number of calices. Small size

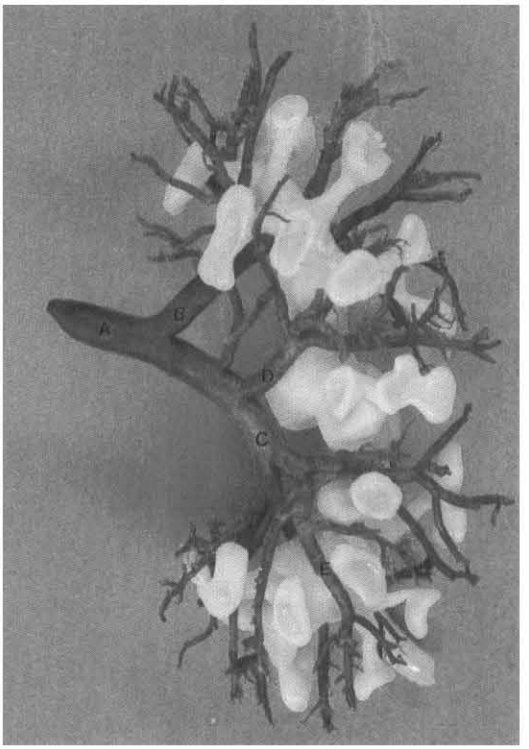

Figure 2 Cast of right kidney (dorsal view) showing vascular pattern and ureter.
A. Renal artery
B. Cranial branch
C. Caudal branch
D. Middle branch
E. Interlobar branch

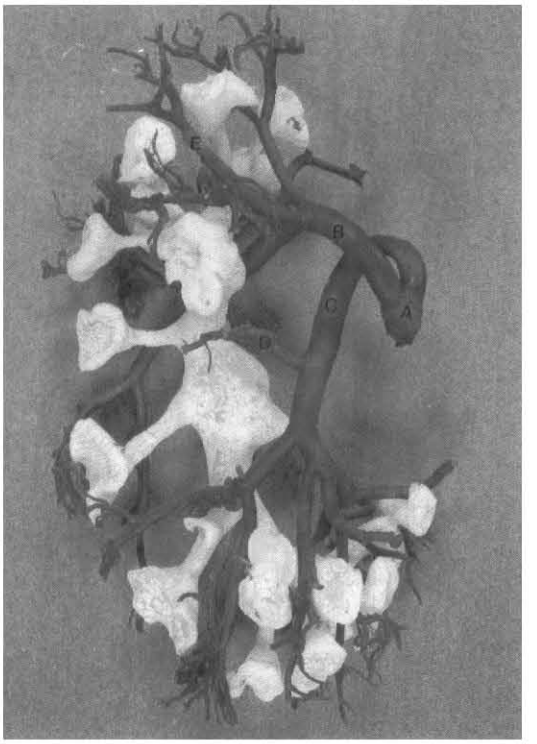

Figure 3 Cast of left kidney (dorsal view) showing vascular pattern and ureter.
A. Renal artery
B. Cranial branch
C. Caudal branch
D. Middle branch
E. Interlobar branch

calyx represent one original papilla from kidney unit while the larger size calyx had resulted from the fusion of many papillae as found in some kidneys of the ox. The scanning electron micrograph of renal calyx showed a lot of straight thread-like structures, repesent collecting ducts. The collecting ducts united and opened into papillary duct, (Figure 6) the collecting ducts showed no branch. (Figure 7) the pattern of primary and secondary branches ureter cast of right kidney was in radiate manner related to the interlobar branches while those of left kidney was elongate and narrow toward the cranial pole due to the external shape of kidneys (Figure 2, 3, 4, 5). These observation is not accordance with the findings of Ghosh and Datla (1989) who reported the distribution different of right and left renal arteries in water buffalo which were three first order branches or segmental branches in right kidney and five first order branches in left kidney. The worker studied only the renal

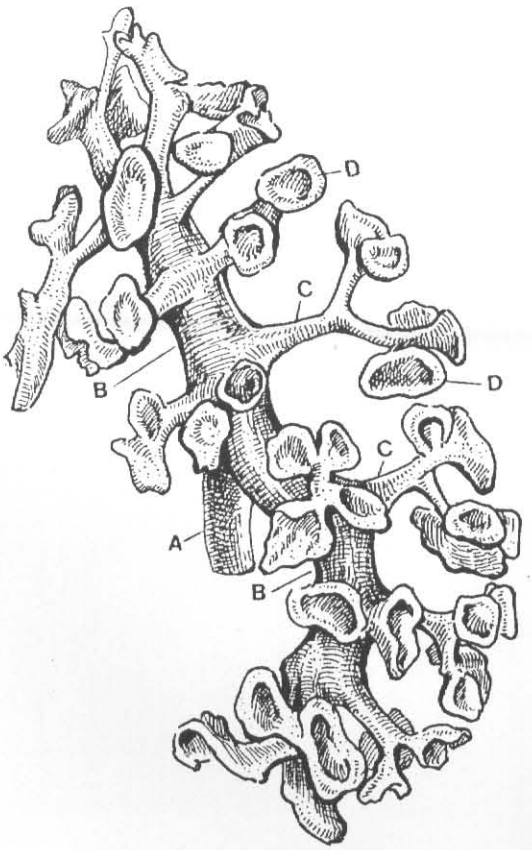

Figure 4 Cast of right ureter and calices.
A. Ureter
B. Primary branch of ureter
C. Secondary branch of ureter
D. Renal calyx

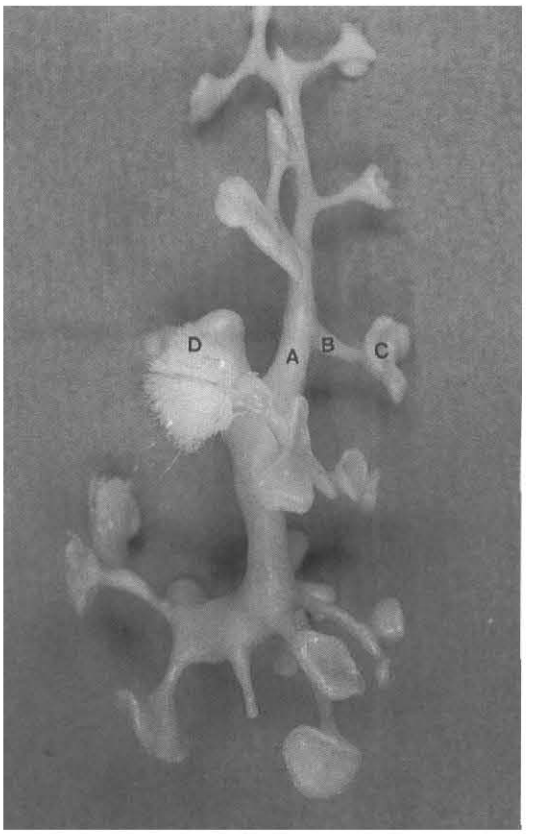

Figure 5 Cast of left ureter and calices showing collecting duct.
A. Primary branch of ureter
B. Secondary branch of ureter
C. Renal calyx
D. Collecting duct

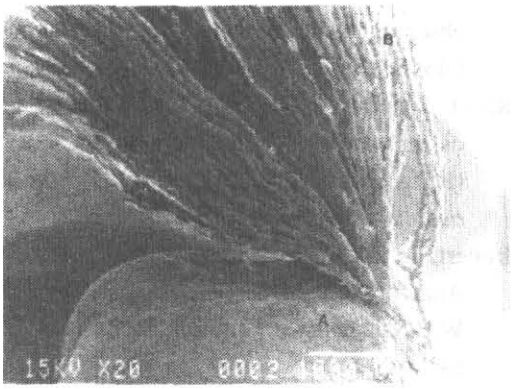

Figure 6 Scanning electron micrograph of renal calyx.
A. Renal calyx
B. Collecting duct
C. Papillary duct

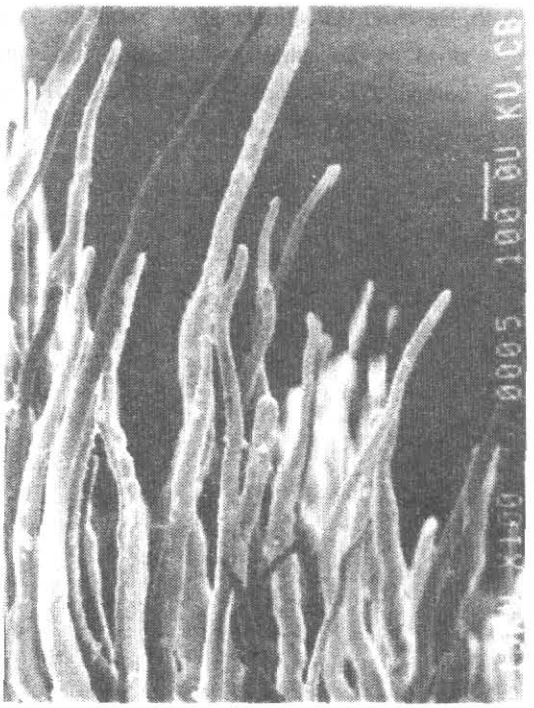

Figure 7 *Scanning electron micrograph of papillary duct.*

vasculature with out studied the direction and relation of renal arteries with secondary branch of ureter in the same kidney. From previous studied, there were no particulary distribution different between right and left renal arteries in many kinds of animals. The course and branching pattern of right and left renal arteries were similar in dog and both renal artery of ox were divided into several branches within the hilus (Robert, 1975), each *renal artery in man, usually divided into three* branches, two infront and one behind the renal pelvis (Last, 1978). These observation of renal arteries destribution different were found in *middle* branch and interlober branch which is in agreement *with Ghosh and Datla, (1989) who reported that* great variation in the number of interlobar branches *due to the multilobulated and various size of lobe of* the kidney.

CONCLUSION

The pattern and distribution of right and left renal arteries of swamp buffaloes were bifucated into two main branches, cranial and caudal branches. Each branch supplied each pole of the kidney. Caudal branch gave off 1-2 middle branches to supply middle part and some part of cranail pole. The main branches were unequal size and giving to variable number of interlobar branches. Ureter was divided into two primary branches of ureter and subdivided to form secondary branches of ureter, *which carrying a number of calices, funnel shaped* structures. Several straight thread-like structures on the surface of calices represented collecting ducts, showing no branch in SEM study. The *collecting duct united and opened into papillary* duct.

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