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The Role of Radiography in Detection of Unilateral Obstructed Kidney in Dog

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Abstract: The present study was carried out on twenty five apparently healthy adult mongrel dogs. The animals were 12 males and 13 females. Their age ranged from 9 months to 4 years and their weight from 9-31 kg. The animals were divided into five groups; each of five dogs. The groups were treated in the following manner according to the time of ligation of the left ureter into: 2, 7, 14 and 21 days for groups 1, 2, 3 and 4, respectively in addition to the control group. The kidneys were evaluated radiographically according to the renal opacification, perisestance of opacification and renal dimensions in relation to L2. It was found that the renal opacification was the poorest in the animals in group 4. The perisestance of opacification increased with the increase the time of ligation.

Key words: Ureter, ligation, radiography, hydronephrosis, dogs, Egypt

INTRODUCTION

Acute obstructive uropathy is a world-wide major cause of renal impairment that leads to end-stage renal failure if left untreated (Harris *et al*., 1993). Urinary obstruction, together with infectious processes continues to be the most frequent consequences of diseases that affect the urinary tract, potentially causing renal parenchymal damage of an irreversible nature (Tucci *et al*., 1997).

Acquired hydronephrosis results from partial or complete obstruction of the urinary outflow tract, usually obstruction of a ureter. The obstruction may be caused by impingement on a ureter by an abdominal mass, ureteral calculi, stricture of a ureter, neoplasia of the bladder in the area of the trigone or accidental ligation of a ureter during surgery. Urine continues to be formed in the presence of an obstruction. This results in dilatation of the outflow tract and the increased pressure eventually causes atrophy of the renal parenchyma. Ultimately, the kidney becomes a large fluid-filled sac and urine formation ceases. There may be no clinical signs if sufficient kidney function is maintained by the opposite kidney and if there is no infection (Kealy and McAllister, 2000).

Survey radiography provides information regarding renal size, location, number and radiographic density. However, survey radiographs may not provide adequate morphologic information when the patient is emaciated or has retroperitoneal fluid (Carlise, 1977; Rivers and Johnston, 1986; Burk and Ackerman, 1996; Feeney, 2002). Excretory Urography (EU) is a radiographic contrast-enhanced procedure used to enhance visualization of the renal parenchyma and to provide visualization of the structures not normally identified on survey radiographs i.e., pelvic recesses, renal pelvis and ureters (Carlise, 1977; Rivers and Johnston, 1986; Burk and Ackerman, 1996; Feeney, 2002). Intravenous Urography (IVU) is a standard investigation for detecting ureteral obstruction (Begun *et al*., 1997). In addition to the higher specifity in detecting ureteral obstruction, IVU were also demonstrating the cause of obstruction and help in planning of further treatment (Cheung *et al*., 2002). Although, excretory urography is not a quantitative measurement of renal function, it may be used to assess the relative function of the kidneys and may be lossely interpreted to assess the pathophysiologic mechanisms of renal failure (Feeney *et al*., 1981).

MATERIALS AND METHODS

The present study was carried out on twenty five apparently healthy adult mongrel dogs. The animals were 12 males and 13 females. Their age ranged from 9 months to 4 years and their weight from 9-31 kg. The animals were divided into five groups (five dogs each). Animal experiments were conducted according to the guidelines

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for animal experiments in Assiut University-Egypt. The animals were anaesthetized by intravenous injection of thiopental sodium after diazepam tranquilization and then, subjected to ventral abdominal celiotomy. Unilateral left sided ureteral ligation near the uretrovesicular junction was performed in the animals of group 1, 2, 3 and 4. The animals in control group were subjected only for visceral manipulation. The kidneys were evaluated radiographically according to the renal opacification, perisestance of opacification and renal dimensions in relation to L2. The plain radiography of both kidneys was done by the left lateral and ventrodorsal projections by fixed X-ray apparatus using exposure factors ranged from 40-55 kV and 25-35 mA-S with FFD about 60-75 cm. The animals were prepared as in survey radiography.

The animals were adequately hydrated by intravenous injection of 500 mL normal saline before the excretory urography. The bladder was emptied to induce diuresis. Sodium diatrizoate (Urographin 76%, SCHERING) was injected intravenously via a butterfly canula in the cephalic vein. It was used in a dose rate 850 mg kg^{-1} B.W. in normal kidneys but this dose was doubled in case of ligated ureters. A compression band was applied on the animal body just cranial to the pubic bone before the injection of the contrast medium. The radiographs were taken directly after injection and at 5, 10, 15, 30, 45, 60, 75, 90 and 120 min after injection of the contrast medium.

RESULTS AND DISCUSSION

The kidneys could not be seen on the plain radiograph. The right kidney (unligated one) in all groups was displayed on the radiograph after the intravenous injection of contrast material within normal shape, size and density.

The left kidney (ligated kidney) in all groups appeared on the nephrogram within the normal size according to the dimensions related to the length of L2. The opacification of the left kidney varied according to the duration of ligation. The renal parenchyma was well detected early on the nephrogram in groups 1 and 2 (Fig. 1-4) but persisted for long time. The opacifiaction of the left kidney in groups 3 and 4 delayed and was poor on the radiograph (Fig. 5-8).

The renal collecting system (Renal divericulae and renal pelvis) appeared dialted and distorded on the pyelogram in groups 1-3 (Fig. 1-6) unlike in group 4 in which the collecting system was not obvious (Fig. 7 and 8).

The left ureter increased in diameter gradually according to the duration of ligation. A radiopaque oval shaped structure appeared at uretrovesical junction in

Fig. 1: VD view of dog with left ureteral ligation for 48 h during injection of contrast media for IVU. Nephrogram phase appeared normal

Fig. 2: VD view of dog with left ureteral ligation for 48 h, 1.5 h after injection of contrast media for IVU. Dialated renal diverticulae of LK on the pyelogram

about 20% of animals (Fig. 9). Unilateral complete or partial hydronephrosis may remain silent for long periods since, the unaffected kidney can maintain adequate renal function.

Sometimes its existence first becomes apparent in the course of intravenous pyelography. It is regrettable that this disease tends to remain asymptomatic, recognition of urinary obstruction is important because obstruction increase the susceptibility to infection and to stone formation and unrelieved obstruction always leads to permenant renal atrophy. The excretory urography

Fig. 3: VD view of dog after 7 days ureteral ligation, 5 min after injection of contrast media (IVU) showing enlarged renal diverticulae of LK

Fig. 4: VD view of dog after 7 days ureteral ligation 45 min after injection of contrast media for (IVU) showing enlarged renal diverticulae and RP of LK and dialted LU

revealed the delay opacification in renal parenchyma of the obstructed kidney with small areas of radiolucency. The persistence of opacification was detected radiographically. There was a severe dilatation of the renal diverticulae. The obstructed kidney appeared smooth, regular and large sized than the contralateral kidney. So, the excretory urography gives quantitative evaluation of renal function and detect the changes of renal dimension provided compared with the contralateral kidney. These results may be taken to exclude the survey radiography for detection of renal changes and consider the excretory urography for only quantitative evaluation of the renal

Fig. 5: VD view of dog after 14 days ureteral ligation 15 min after injection of contrast media for (IVU) showing enlarged renal diverticulae and RP of LK and dilated LU

Fig. 6: VD view of dog after 14 days ureteral ligation 30 min after injection of contrast media for (IVU) showing enlarged renal diverticulae and RP of LK and severely dilated LU

function. The present conclusions could be supported by the reports of Gonenci *et al.* (2003). The excretory urography showed the so delay of renal opacification, very poor opacification, persistenace of renal opacification and the marked dilatation of renal collecting system. The results could be supported by Burk and

Fig. 7: VD view of dog after 21 days ureteral ligation 60 min after injection of contrast media for (IVU) showing enlarged RP of LK and dilated LU

Fig. 8: Lateral view of dog after 21 days ureteral ligation 120 min after injection of contrast media for (IVU) showing enlarged poor opacified LK

Feeney (2003) who stated that poor initial density on the radiograph that did not decrease may occur with glomerular disease or severe interstitial or tubular disease.

The normal canine kidney was approximately 2.5-3.5 times the length of the body of the second lumbar vertebra as seen on the ventrodorsal view (Kealy and McAllister, 2000; Coulson and Lewis, 2002).

The researchers did not agree with this way for determination of renal length relative to L2 due to the left obstructed kidneys were detected enlarged sonographically and grossly nevertheless were still in the range of 2.5-3.5 L2 length on the radiograph i.e., L2 in dogs of group 4 which had ligated ureter for 21 days was

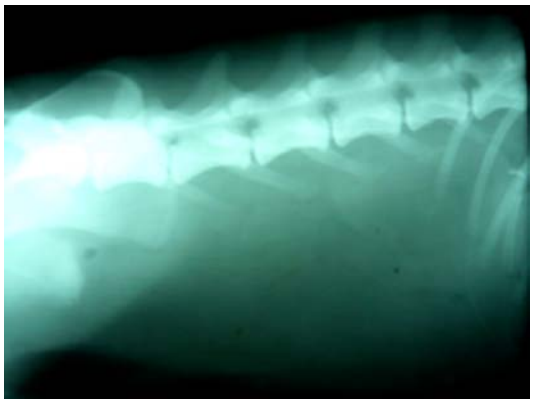

Fig. 9: Lateral view of dog after 7 days ureteral ligation 60 min after injection of contrast media for (IVU) showing enlarged dialated LU with Diverticulum (D) at the bladder

2.75 cm while enlarged LK 8.5 cm. So, the determination of renal dimensions on the radiograpgh should be returned to the normal (sound) kidney or preoperative renal dimension in unilateral affected kidney or the normal kidney in the same sized (weight) and breed of animal in case of bilateral lesioned kidneys.

CONCLUSION

The unilateral ureteral obstruction may occur without any observable clinical signs leading to irreversible renal changes within 17-21 days. While the plain radiography alone cannot detect any renal changes, the Intravenous Urography (IVU) is a standard investigation for detecting ureteral obstruction. However, it exposes the patient to the risks of ionizing radiation, contrast-related nephrotoxicity and anaphylaxis. IVU is not suitable for patients with renal impairment. Contrast excretion from the kidneys is often time consuming especially for patients with chronic ureteral obstruction and renal function impairment.

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