Iranian Veterinary Surgery Association

Iranian Journal of Veterinary Surgery

Journal homepage: www.ivsajournals.com

Original Article

Cystosonographic and Cystographic Evaluations of Urinary Bladder Defects Managed with Composite Colo-Peritoneal Grafts in Dogs

Sa'idu Tanko Muhammad[1]*, Cheh Augustine Awasum[2], Bisalla Mohammed[3], Adamu Zoaka Hassan[2], Mohammed Abdurrahman[2], Andrew Ababa James[4], Maruf Lawal[2], Daniel Onimisi Avazi[4], Mu'azu Nuhu Bappah[2], Joseph Olusegun Ayo[5], Mohammed Hadi Sulaiman[6], Kwem Bakau Kadima[1]

[1] Veterinary Teaching Hospital, Ahmadu Bello University, Zaria, Nigeria. [2] Department of Veterinary Surgery and Radiology, Ahmadu Bello University, Zaria, Nigeria. [3] Department of Veterinary Pathology, Ahmadu Bello University, Zaria, Nigeria. [4] Department of Veterinary Medicine, Surgery and Radiology, University of Jos, Nigeria. [5] Department of Veterinary Physiology, Ahmadu Bello University, Zaria, Nigeria. [6] Department of Veterinary Anatomy, Ahmadu Bello University, Zaria, Nigeria.

ARTICLE INFO

Article History:

Received 9 February 2021
Revised 10 September 2021
Accepted 13 September 2021
Online 13 September 2021

Keywords:

Urinary bladder
Colo-peritoneo-cystoplasty
Cystosonography
Cystography
Dogs

ABSTRACT

Radiographic and ultrasonographic evaluations of the urinary bladder architecture following autologous composite colo-peritoneal pedicle graft, as alternative tissue for urinary bladder reconstruction, in the surgical repair of experimental urinary bladder defects were carried out in two dogs. Predetermined 2 × 4 cm dimension of urinary bladder defect was created on the dorsum of the urinary bladder, and was patched with harvested 3 × 5 cm composite colo-peritoneal pedicle flap. All operations were aseptically and humanely conducted. The gross anatomical evaluation of the urinary bladder architecture was performed by ultrasonography and contrast radiography of the repaired urinary bladder. Post-surgical cystosonographic assessments on day 8 showed thickened urinary bladder wall at the point of the graft, which decreased markedly on day 21. Cystographic evaluation revealed gradual transition of the urinary bladder architecture at the point of graft with clear delineation and minimal blurring at week 2 post-operation, which gradually disappeared at weeks 10 and 14. The cystosonographic and cystographic evaluations demonstrated evidence of advanced healing and well-preserved urinary bladder architecture with no evidence of leaks. The imaging modalities are adequately diagnostic to assess urinary bladder repairs following its management with composite colo-peritoneal graft in dogs.

Introduction

The morphological integrity of most internal body organs or systems of an individual are best evaluated with appropriate imaging modality.[1] Ultrasonography is a painless, non-invasive, and cheap procedure that provides valuable information concerning morphology and luminal contents of urinary bladder.[2,3] The

* Correspondence to: Sa'idu Tanko Muhammad, Veterinary Teaching Hospital, Ahmadu Bello University, Zaria, Nigeria, E-mail: tmsaidu@abu.edu.ng; samutanko@gmail.com

www.ivsajournals.com© Iranian Journal of Veterinary Surgery, 2021
https://doi.org/10.30500/IVSA.2021.272528.1249

difficulties associated with accurate ultrasonographic evaluation may be due to body conformation, overlying bowel and ultrasonographer's skills.[4] The thickness of normal urinary bladder wall should be less than 2 mm in healthy dogs, with larger dogs having a slightly thicker wall than smaller dogs.[5] Currently, high frequency transducers typically show three distinct bladder wall layers.[6] The ultrasonographic appearance of a well-distended normal urinary bladder is an anechoic structure, which is usually ovoid to oblong in shape.[7] Congenital disorders of the urinary bladder diagnosed cystosonographically include patent urachus and bladder (urachal) diverticulum, appearing as thin-walled convex out-pouching of the bladder wall at the apex level.[8] In cases of chronic cystitis, the wall appears thick and irregular.[7] In acute case of the cystitis, it appears cystosonographically as diffused, thickened urinary bladder wall in the cranio-ventral portion of the bladder, and the urine is echogenic due to the presence of inflammatory products and/or haemorrhage.[9] In case of traumatic cystitis, the sonographic appearance of the wall is usually thickened and irregular; while the bladder containing blood clots, observed as mildly hyperechoic, with non-shadowing, mobile material in haemorrhagic cystitis.[10]

Cystography (contrast radiography) has been utilised for decades in the evaluation of the morphological integrity of the urinary system.[11] The contrast radiographic study is performed mostly to aid in evaluating the morphological integrity of the urinary bladder following trauma or history of related congenital anomalies, which cannot be defined by survey radiography.[12] The employment of retrograde cystographic procedure is adequate in regional urinary bladder geometry, such as size, shape, location, extent of affliction (leakage or tear), surface character, number or organ opacity.[11,13,14] Carbon dioxide and nitrous oxide are the negative contrast substances used in contrast cystography, which is good in demonstrating the location and shape of the bladder.[15] From the literature, the best surgical procedures currently in practice for urinary bladder repair are enterocystoplasties, which bring greater relief of the post-operative complications often associated with urinary bladder reconstruction.[16] Colocystoplasty is a "salvage" enterocystoplastic procedure, because it returns life to nearly normal level, with low morbidity and mortality.[17] The aim of the present study was to employ ultrasonography and cystography in the evaluation of the morphologic integrity of reconstructed urinary bladder following its reconstruction with autologous composite colo-peritoneal pedicle grafts (colo-peritoneo-cystoplasty) in Nigerian indigenous dogs.

Materials and Methods

Ethical Approval

Ethical clearance was sought and obtained in accordance with the statutory regulations guiding animal care and use as approved by Ahmadu Bello University Committee on Animal Use and Care (ABUCAUC), with an approval number ABUCAUC/2016/010.

Experimental Animals

Two (female 3/4-year-old and male 1.5-year-old) Nigerian indigenous dogs (NIDs), weighing 15 and 18 kg, respectively were acquired, as donations from the neighbouring university community, and acclimatised in the kennels of Veterinary Teaching Hospital, Ahmadu Bello University, Zaria, Nigeria for two weeks prior to the commencement of the operation.

Pre-operatively, each dog was ascertained to be, apparently, healthy and fit for the surgical procedure, through physical and laboratory evaluations. The procedure was carried out under general anaesthesia. The dogs were aseptically prepared and the asepsis was maintained throughout the surgical procedures.

Anesthesia

The surgeries were performed under general anesthesia achieved through a cannulated cephalic venopuncture. Premedication was performed intravenously using 0.05 mg/kg of atropine sulphate (Amopin, Yanzhou Xier Kangtai Pharma. Co., Ltd, China) and chlorpromazine hydrochloride (Clomazin, Maxheal Pharmaceuticals, Karnal, India) at a dose of 4 mg/kg. Thiopentone sodium (Rotex Medica Trittau, Germany) at a dose of 15 mg/kg (IV) was used for induction of anesthesia. The dogs were intubated with size 7.5 endotracheal tubes post-induction, and Halothane (Nicholas Pharmal India Limited, India) at 2% concentration was employed for the maintenance of anesthesia. Aseptic conditions were adhered to strictly throughout the procedures.[18]

Surgical Procedure

The abdominal cavity was accessed via caudal mid-ventral 15-cm abdominal incision, extending from the

umbilicus to the pelvic brim,[18] to expose the parietal peritoneum, urinary bladder and colon. The pre-determined (5 × 3 cm) seromuscular layer of the colon was incised length-wise and transversely from the ante-mesenteric border, bluntly detached from the *lamina propria* (*tunica adventitia*) and preserved with its vascular supply. The seromuscular edges from the remaining bowel were then apposed and sutured, ''intussuscepting'' de-seromuscularised mucosa to maintain the bowel continuity. The desired graft (donor tissue) of the parietal peritoneum caudal to the umbilicus was exposed, measured (5 × 3 cm) and harvested. The harvested free peritoneal graft was immediately transplanted onto the harvested seromuscular colonic pedicle flap on the same dog (Figure 1), and sutured using size 4-0 Ethicon-Vicryl (Polyglactin 910, Johnson-Johnson Jult, Belgium) to form a 5 × 3 cm composite colo-peritoneal pedicle flap (Figure 2). From its dorsum, a 4 × 2-cm dimension urinary bladder tissue was excised (Figure 3); thereby creating full thickness bladder defect on each dog, which was subsequently reconstructed (Figure 4) with the already formed 5 × 3 cm autologous composite colo-peritoneal flaps, using the size 4-0 Vicryl.[19] The urinary bladder was laterally catheterised trans-abdominally by cystostomy, using indwelling Foley catheter (10 Fr) to aid urine evacuation, rest the urinary bladder and infusion of solution(s) into the bladder during imaging.

Figure 1. Pre-harvested peritoneal flap being transplanted on to the muscular surface of the harvested seromuscular colonic pedicle flap form composite colo-peritoneal pedicle graft.

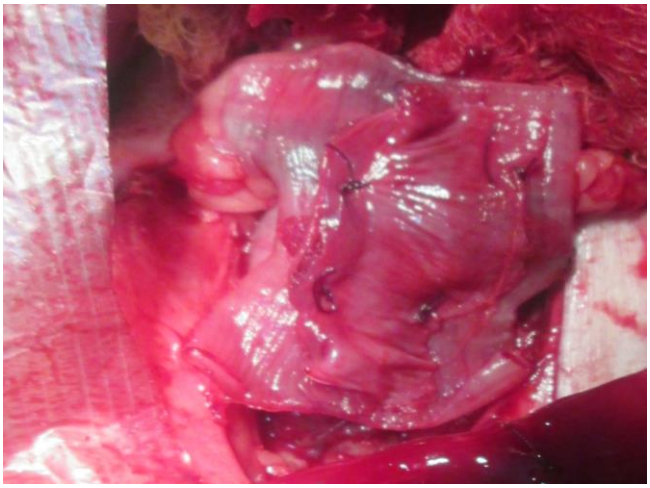

Figure 2. A formed composite colo-peritoneal pedicle flap in preparation for grafting.

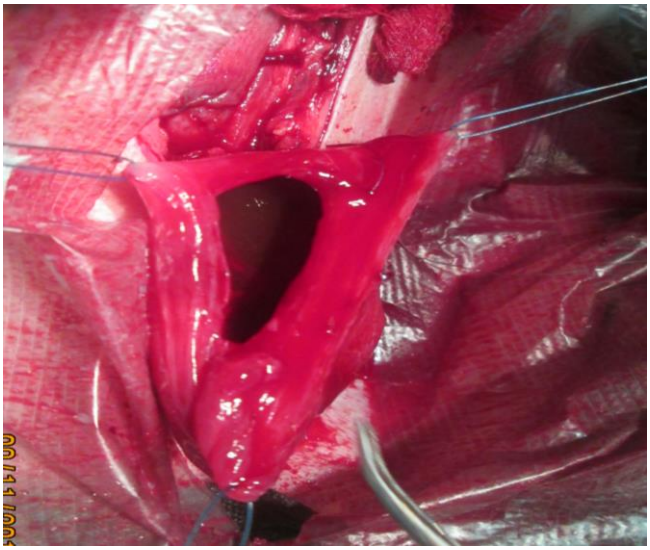

Figure 3. Partial cystectomy: Rectangular (4 × 2 cm) urinary bladder defect in preparation for reconstruction (Colo-peritoneo-cystoplasty).

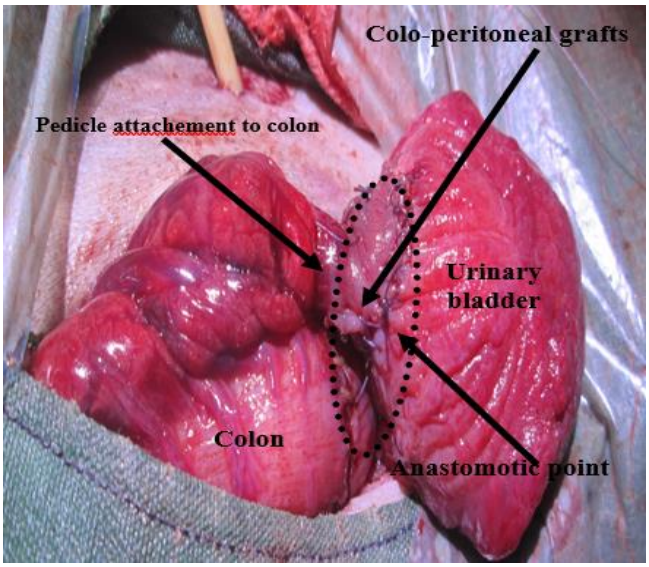

Figure 4. Reconstructed of 2 × 4 cm urinary bladder defect with 3 cm x 5 cm composite colo-peritoneal pedicle graft in a dog, seen engorged with inflated Foley catheter (10FR) intra-cystic and anastomotic point of the composite colo-peritoneo-cystoplasty.

Post-Surgical Care

Elizabethan collar was applied on each dog to prevent them from interfering with the wound sites. Both dogs were administered metronidazole (Trimetro IV, J B Chemicals and Pharmaceuticals Ltd., India) at the dose rate of 25 mg/kg and 5% dextrose-0.9% saline (DANA Pharmaceuticals Ltd., Nigeria) infusions intravenously 12-hourly for 5 days. Thereafter, the dogs were maintained on gruel diet (a low viscous mixture of water, ground millet, guinea corn, sugar and fried fish) for 7 days post-surgery. Pentazocine injection (2 mg/kg) was administered intramuscularly for 5 days. The catheter was removed two weeks post-operation for the patient to store and void urine naturally. The dogs were monitored for a period of 14 weeks until when they were, apparently, fully recovered.

Ultrasonographic Procedure

For cystosonography, urine produced and stored in the bladder before being voided was utilised to distend the bladder prior to the ultrasonographic examination. Where the bladder was empty or contained little quantity of urine, normal saline solution was used to distend the urinary bladder through the catheter. The bladder was imaged from the caudal ventral abdominal wall (adopting a para-preputial approach in the male dog) following the application of aquasonic gel. A high-frequency (6-7.5 MHz) transducer/probe, from an ultrasound scanner (Sonostar C5, Sonostar Technologies Co., Guangzhou, Guangdong, China), was placed just cranial to the pubic brim, moving cranially until the bladder was identified. The bladder of each dog was imaged twice at weeks 1 and 3 post-surgery, in both sagittal and transverse planes (Figure 5).

Cystographic Procedure

Cystography (contrast radiography) was performed at the 2nd, 10th and 14th weeks post-surgery, as described by Stephanie[12] and Park and Wrigley.[13] Food was withheld for 24 hours and cleansing enema was performed three hours before commencement of the contrast cystography. Sterile lubricant (K-Y Lubricating jelly, Johnson-Johnson Jult, Belgium) and 2% lidocaine hydrochloride solution (Labcalin, Laborate Phamaceutical, India) were then placed on a sterile gloved-hand. The sterile 10 Fr Foley catheter (improvised with scalp vein tube, in the male) was lubricated with the K-Y jelly on the gloved hand. The 2%-lidocaine hydrochloride solution was allowed to fill the lumen of the catheter, and the tip of the catheter was inserted into the urethra and gradually advanced to the urinary bladder. Survey radiography was initially undertaken, which was followed immediately by infusion of contrast medium (Urografin 76%, Berlimed S.A. Spain, reconstituted to 20% solution) at 5 ml/kg into the urinary bladder through the catheter (Figure 6). Lateral and ventro-dorsal radiographic views of the abdomino-pelvic region at 70 kV and 6 mA using mobile X-ray machine (MDX-100 model by Recorders and Medicare System Ltd., Chandigarh, India) were obtained.[17] Thereafter, the two (lateral and ventro-dorsal) radiographs were developed and viewed for interpretation.

Results

Cystosonographic assessments performed on day 8 post-surgery showed anechogenic appearance of the bladder content, with thickened bladder wall at the point of patch (dorsum), compared to the ventrum (Figure 7). Similarly, the dorsal bladder wall (point of patch) presented a marked decrease in thickness (relative to the ventrum) at day 21 post-surgery (Figure 8). The contrast cystographic evaluation of the reconstructed urinary bladder (with composite colo-peritoneal tissue) at different periods of the study revealed high opacification only within the urinary bladder in both the ventro-dorsal and lateral views,

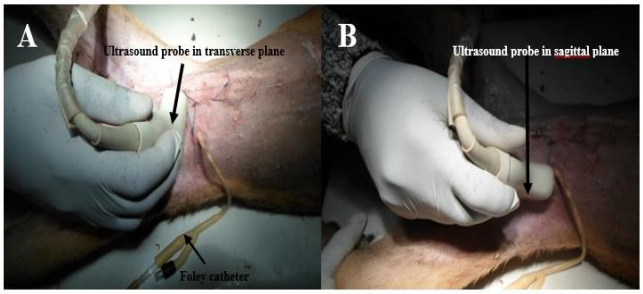

Figure 5. Trans-abdominal ultrasonographic scanning of the urinary bladder in transverse (A) and sagittal (B) planes.

Figure 6. Infusion of Urograffin solution (5 ml/kg) via 10Fr Foley catheter into urinary bladder of a bitch (A) and a dog (B) for evaluation of the bladder conformation post-colo-peritoneo-cystoplasty by urography.

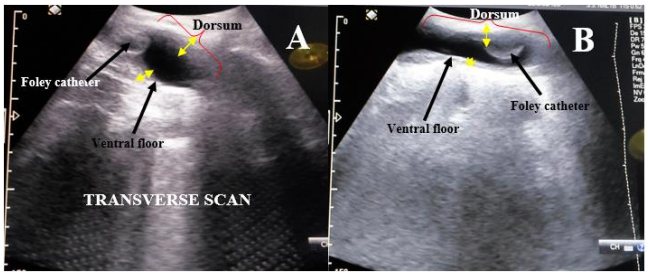

Figure 7. Sonographic appearance of the urinary bladder at week 1 post-surgery showing anechogenic appearance of the bladder content in male (A) and female (B) dogs. Note the thickened bladder wall at the dorsum (point of composite colo-peritoneal patch) relative to the ventral (native) wall of the bladder in both figures.

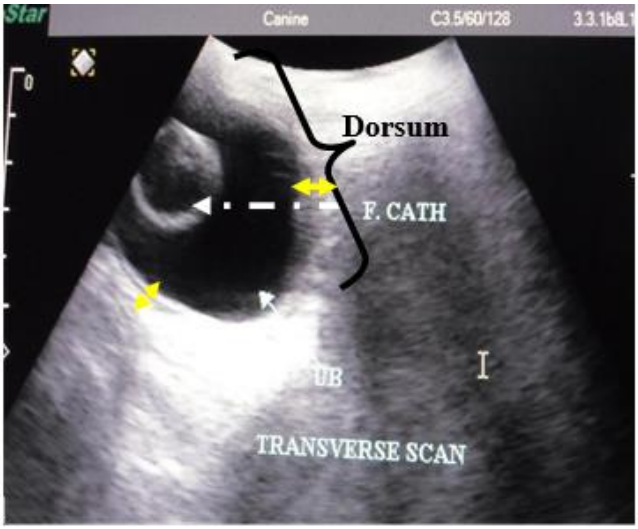

Figure 8. Sonograph of the urinary bladder (UB) showing marked decrease in the thickness of the dorsal bladder wall (composite colo-peritoneal tissue) at day 21 post-surgery.
Key: F. CATH= Foley catheter.

indicating distinctive urinary bladder silhouettes. There was gradual transition of the urinary bladder architecture at the point of patch. Subsequently, clear delineation and minimal blurring at week 2 post-surgery were observed (Figure 9), which gradually disappeared following subsequent evaluations at weeks 10 and 14 post-operatively (Figures 10 and 11, respectively).

Discussion

Early cystosonographic appearance of the urinary bladder with thickened bladder wall at the point of patch is one of the most common findings due to the inflammatory process, occurring at the patched point following surgery. This finding is similar to the report on acute bladder cystitis and benign lesions of the urinary bladder.[6,10] The evaluation was also essential following enterocystoplasty for evidence of anastomotic leaks, suggested by Sidhu.[6] The authors

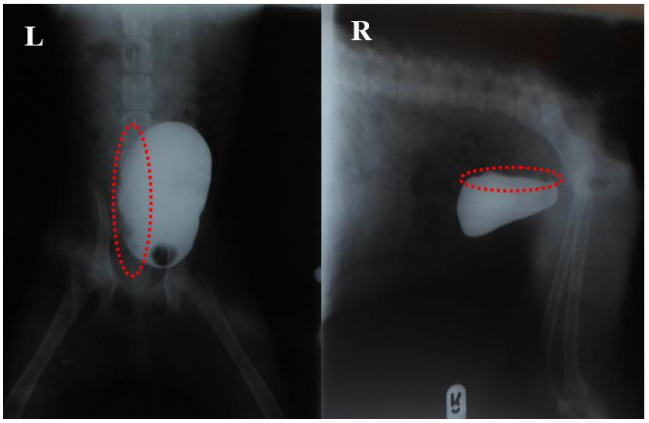

Figure 9. Ventro-dorsal (L) and lateral (R) cystographs two weeks post-colo-peritoneo-cystoplasty. Note the clear delineation of the urinary bladder architecture and irregularity at the point of patch (circled).

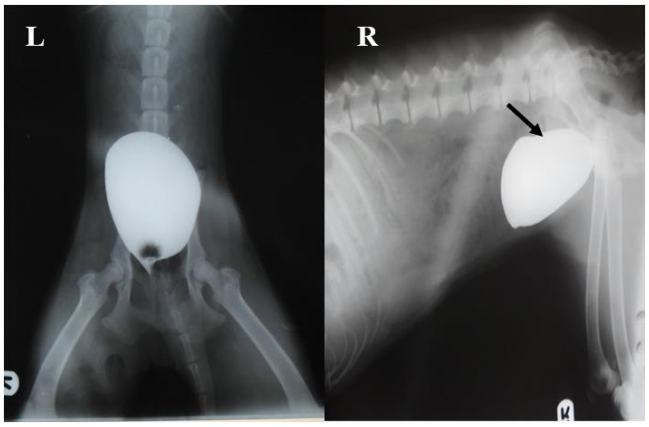

Figure 10. Ventro-dorsal (L) and lateral (R) contrast cystographs of the reconstructed urinary bladder 10 weeks post-cystoplasty. Note the clear delineation of the urinary bladder architecture and slight dent at the point of patch (arrow).

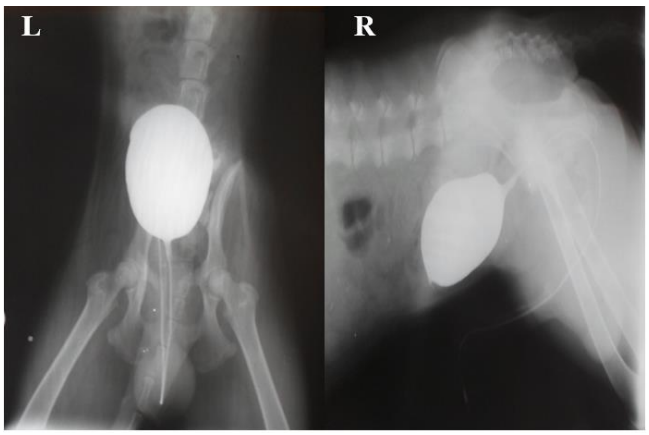

Figure 11. Ventro-dorsal (L) and lateral (R) contrast cystographs of the reconstructed urinary bladder 14 weeks post-colo-peritoneo-cystoplasty. Note the clear delineation of the urinary bladder architecture and uniform regularity in dogs post-surgically.

reported that sonographic evaluation of the urinary bladder post-bladder augmentation and replacement

procedures often reveals unexpected findings, resulting from incorporation of bowel into the urinary bladder wall. This observation was the basis for the latter evaluation performed in the present study at the 3rd week of evaluation. Thus, following the surgery, colo-peritoneo-cystoplasty, it was observed to present marked decrease in the thickness of the dorsal bladder wall, evidenced by reduced post-surgical inflammatory response. The cystogram revealed an intact and distended urinary bladder at day 21 post-surgery with irregularity at the point of patch. The subsequent slight dent observed at the point of patch (10th week post-operatively), final uniformity and regular smooth topography (14th week post-surgically) indicated near perfectly, preserved urinary bladder, devoid of leaks and abnormality. There was also evidence of adaptation between the neocystic (composite colo-peritoneal portion) and the transitional epithelium of the urinary bladder. These observations are in agreement with those of Probst [20] and Muhammad,[17] who reported uniform and smooth urinary bladder topography in dogs following colo-cystoplasty. The cystograms were also similar to the findings of Muhammad[16] and Muhammad,[17] who utilised contrast cystography (20% solution of Urografin) to evaluate the urinary bladder following ileocystoplasty and colocystoplasty in dogs, respectively. The cystosonographs of the urinary bladder with thickened bladder wall at the point of graft (early), later decreased in thickness as an evidence of advanced healing, demonstrated that the cystosonographic evaluation is adequate in assessing colo-peritoneo-cystoplasty. Similarly, the cystographs revealed distended and well-preserved urinary bladder architecture with no evidence of leaks, indicative of advanced healing and adaptation between composite colo-peritoneal portion and the urinary bladder.

It was concluded from this study that cystosonography and cystography are appropriate imaging modalities to be employed in the evaluation of morphological integrity of urinary bladder in dogs, as were demonstrated following composite colo-peritoneal graft being anatomically suitable in surgical correction of urinary bladder defects for enterocystoplasty in dogs.

Acknowledgments

This study did not receive any grant/funding. The authors would like to thank staff members of the Veterinary Teaching Hospital and Faculty of Veterinary Medicine, Ahmadu Bello University, Zaria, Nigeria for their contributions towards the success of this study. Specifically, we wish to express special gratitude to Professors S. U. Abdullahi and B. M. Jahun for their kind assistance at the various stages of this study.

Conflict of Interest

The authors declare no conflict of interest.

References

1. Gómez RG, Ceballos L, Coburn M, Corriere JN, Dixon CM. Consensus on geitourinary trauma; Consensus statement on bladder injuries. *British Journal of Urology,* 2004;94:27-32.
2. Essman SC. Contrast cystography. *Clinical Technics in Small Animal Practice*. 2005;20(1):46-51.
3. Hume C, Seiler G, Porat-Mosenco Y, Caceres A, Shofer F, Sorenmo K. Cystosonographic measurements of canine bladder tumours. *Veterinary and Comparative Oncology*, 2010;8:122-126.
4. Muhammad ST, Awasum CA, Hassan AZ, Usman B, Jahun BM. Traumatic urinary bladder injuries in small animals. *Journal of Veterinary Medicine and Animal Health*, 2015;7(1):27-32.
5. Geisse AL, Lowry JE, Schaeffer DJ, Smith CW. Sonographic evaluation of urinary bladder wall thickness in normal dogs. *Veterinary Radiology & Ultrasound*, 1997;38(2):132–137.
6. Sidhu R, Bhatt S, Dogra VS. Ultrasonography of the urinary bladder. *Journal of Clinical Ultrasound*, 2010;5:457-474.
7. Sutherland-Smith J. Bladder and urethra. In: Penninck DG, d'Anjou MA, Ames TA, eds. *Atlas of Small Animal Ultrasonography*. Blackwell Publishing, 2008;365–384.
8. Confer AW, Panciera RJ. The urinary system. In: McGavin MD, Carlton WW, Zachary JF, eds. *Thomson's Special Veterinary Pathology*. 3rd ed. St. Louis, MO: Mosby, 2001;235–277.
9. L´eveill´e R. Ultrasonography of urinary bladder disorders. *Veterinary Clinic of North America Small Animal Practice,* 1998;28(4):799–821.
10. Takiguchi M, Inaba M. Diagnostic ultrasound of polypoid cystitis in dogs. *Journal of Veterinary Medical Sciences*, 2005;67(1):57-61.
11. Pechman RD. The Urethra. In: Thrall DE, St. Louis MO, eds. *Textbook of Veterinary Diagnostic Radiology*. WB Saunders, Philadelphia, US, 2007;725-728.
12. Stephanie CE. Contrast cystography. *Clinical Techniques in Small Animal Practice*, 2005;20(1):46-51.
13. Park RD, Wrigley RH. The urinary bladder. In: Thrall DE, St. Louis MO, eds. *Textbook of Veterinary Diagnostic Radiology*. WB Saunders, Philadelphia, US, 2007;708–724.
14. Feeney DA, Anderson KL. Radiographic Imaging in Urinary Tract Disease. In: Bartges J, Polzin DJ eds.

Textbook of Nephrology and Urology of Small Animals. Blackwell Publishing Ltd, USA, 2011;97-127.

15. Sura P. Lower Urinary Tract Trauma. In: Bartges J, Polzin DJ eds. *Textbook of Nephrology and Urology of Small Animals*. Blackwell Publishing Ltd, USA, 2011;828-834.
16. Muhammad ST, Hassan AZ, Awasum CA, Mohammed B. Radiographic evaluation of "graft take" following ileocystoplasty of extensive urinary bladder defects in dogs. *Journal of Veterinary Advances*, 2014;4(7):623-630
17. Muhammad ST, Awasum CA, Mohammed B, Hassan AZ. Cystographic evaluation post-colocystoplasty in two Nigerian indigenous dogs. *Nigerian Veterinary Journal*, 2016;37(2):82-87.
18. Muhammad ST. Evaluation of the Use of Colonic and Ileal Grafts in the Repair of Extensive Urinary Bladder Defects in Dogs. MSc Dissertation, Ahmadu Bello University Zaria, Nigeria. 2013;48113.
19. Muhammad ST, Awasum CA, Mohammed B, Hassan AZ. Evaluation of Autologous Composite Colo-peritoneal Grafts in the repair of Experimental Urinary Bladder Defects in Dogs. *Archives of International Surgery,* 2020;9(4):104-111.
20. Probst M, Piechota HJ, Dahiya R, Tanagho EA. Homologous bladder augmentation in dog with the bladder acellular matrix graft. *British Journal of Urology International*, 2000;85(3):362-371.