

# Laparoscopic and hand-assisted cystorrhaphy strengthened with omental pedicle in dogs: Radiographic and ultrasonographic study

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## Abstract

This study was designed to evaluate the using of two laparoscopic techniques for repairing an experimental cystotomy of urinary bladder reinforced with omental pedicle in dogs. Eighteen local breed male dogs were randomly allocated into two equal groups: first group an experimental cystotomy (about 2 cm) was induced laparoscopically at the ventral surface of the urinary bladder, repaired with titanium clips and reinforced with the omental pedicle. In the second group: similar technique was followed; however, the induced was repaired with hand-assisted extracorporeal laparoscopic method. In both groups, several diagnostic parameters were followed including clinical / laparoscopic exploration, radiology, and ultrasonography. Results obtained in the first group shown the titanium clips 4-6 clips freely applicated and whole time consuming for performing operation was  $45 \pm 2.1$  minutes. Clinically, the experimental animals didn't show any abnormal changes in their behavioral activities. Radiographic examination revealed distention of the urinary bladder accompanied by the presence of distances between the titanium clips; however, ultrasonography didn't show any leakage or thickness at the site of operation. Laparoscopic examination demonstrated mild adhesion between urinary bladder and adjacent organ. In the second group, the operation required  $36 \pm 1.1$  minutes to be completed. Postoperatively, no signs of pain were observed, however, animals demonstrated post-operative transient hematuria, lasts for 24 hours, accompanied with severe adhesion between the bladder and abdominal wall. Radiographically, regular distention of the bladder was revealed, while ultrasonographic examination showed hyperechoic dots and thickening of the bladder wall. We concluded that the hand-assisted laparoscopic cystorrhaphy strengthened by omentum is a practical, time saving and mini-invasive surgical technique.

**Keywords:** Urinary bladder ruptures, Laparoscopy, Titanium, Omentum, Dog

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## إصلاح المثانة البولية بالجراحة المنظارية والجراحة المساعدة خارج الجسم وباستخدام سويقة الثرب في الكلاب: دراسة شعاعية وتصوير بالأموح فوق الصوتية

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### الخلاصة

صممت الدراسة لتقييم استخدام تقنيتين في الجراحة المنظارية لإصلاح شق المثانة البولية بعد تدعيمها بسويقة الثرب في الكلاب. تضمنت التجربة ثمانية عشر كلبا محليا ومن الذكور والتي قسمت عشوائيا إلى مجموعتين متساويتين. المجموعة الأولى يتم فيها إحداث شق تجريبي على السطح البطني للمثانة بواقع ٢ سم وباستخدام الجراحة المنظارية ويتم إصلاحه بـكليبسات التيتانيوم وتدعيمه بسويقة من الثرب. تم إجراء نفس التقنية في المجموعة الثانية لكن أصلح شق المثانة باستخدام تقنية العقد خارج الجسم. تم اعتماد معايير مختلفة للتشخيص تضمنت الفحص السريري والاستكشاف بالمنظارية والأشعة السينية وفحص بالموجات فوق الصوتية. بينت النتائج للمجموعة الأولى استخدام ٤-٦ كليبسات التيتانيوم لغلغ شق المثانة وان الوقت المستغرق لإتمام العملية كان  $45 \pm 2.1$  دقيقة. سريريا لم يطرأ على الحيوانات أي تغييرات في نشاطها. بينت نتائج فحص الأشعة انتفاخ المثانة وتباعده بين كليبسات التيتانيوم وكذلك بينت نتائج فحص السونار

عدم وجود تسريب للبول او تنخن في مكان إجراء العملية. أظهرت نتائج الفحص المنظاري وجود التصاقات بسيطة بين المثانة والأعضاء المجاورة في المجموعة الثانية، استغرق إتمام العملية  $36 \pm 1,1$  ولم يسجل ظهور علامات الألم باستثناء وجود بيلة دموية عابرة انتهت بعد ٢٤ ساعة، وجود التصاق شديد بين جدار المثانة والبطن. واطهر بالأشعة السينية انتفاخ منتظم للمثانة، بينما أظهر الفحص بالموجات فوق الصوتية نقاط مفرطة الصلابة وسمك جدار المثانة. نستنتج من هذه الدراسة ان استخدام الجراحة المنظارية لغلق المثانة بمساعدة اليد وباستخدام الثرب طريقه جراحية تطبيقه امينه قليلة الاذى .

## Introduction

Bladder rupture is a condition where the urinary bladder tears and releases urine into the abdominal cavity (1). Rupture may occur due to trauma, urinary obstruction, tumors, severe bladder disease, and during catheterization (2). A recent research pointed that traumatic urinary injuries are very important in small animals especially in dogs and cats which are considered to be popular affections and diagnosed by the using various methods, especially the positive contrast cystography (3). Cystorrhaphy is a surgical procedure, which is indicated for many purposes such as the reconstruction of the ruptured urinary bladder, removal of cystic/ urethral calculi, identification and biopsy of mass lesions, or treat urinary tract infection (4).

One of the most applicable indication of laparoscopy in veterinary medicine is the diagnosis of urinary bladder rupture (5,6). Laparoscopy plays role in urology. Besides this, the hand-assisted technique has facilitated to adoption of laparoscopy (7). For instance, it has been used successfully in dogs to remove calculi from the bladder, where the bladder was exteriorized from one port and mini-laparotomy (8), and for closure the cystotomy incision (9). The revascularizing properties of the greater omentum used as a vascular pedicle for the prefabrication of skin, to accelerate bone healing (10), and gastric repairing (11). Laparoscopic harvesting of the omentum was carried out for the first time by Saltz in 1993 in order to repair soft tissue defects in the knee in human (12). One of the most common applications of the omentum in veterinary medicine is placement of the omentum over sutured surgical sites in hollow organs such as the intestine or bladder. The omentum adheres to the incision site, which benefits from the omentum's pro-healing effects. Furthermore, omental adhesions prevent leakage of luminal contents through small gaps in the incision (12). The present study evaluated the beneficial effects of laparoscopic harvesting omentum to reinforce the experimentally defective urinary bladder, which was repaired with two different laparoscopic technique in dogs.

## Materials and methods

Eighteen healthy male local stray dogs were included in the present study, aged 12-24 months and their weights were between 12-20 kg. Animals were randomly allocated

into two groups; for anesthesia, a mixture of Ketamine (Rotexmedica, Germany) / Xylazine (Interchemie, Holland), 15mg and 5mg /kg BWt respectively (13) was given intramuscularly. In group one three ports were selected to introduce the laparoscopic instruments (KARL STORZ Endoscopy America, Inc, Germany) (Figure 1). The experiment approved by Collage of Veterinary Medicine University of Mosul. Pneumoperitoneum was successfully done with CO<sub>2</sub> which was smoothly deliver into abdominal cavity at the pressure between 8-12mm / Hg in about 8 L / min gas flow (14). The position of animals was at dorsal position and telescope introduced cranial to the umbilicus. The surgical protocol included evacuation of the urinary bladder by Foley catheter, and then a two-centimeter injury was made at the ventral surface of urinary bladder using laparoscopic scissors. The experimental injury was repaired by 4-6 titanium clips, and then the operation site was strengthened with the omental pedicle. In the second group, the dogs underwent the same manner of treatment except only two ports were used (Figure 2) and the bladder fixed to the abdominal wall, mini laparotomies were performed with aid of laparoscopic tools, to establish the experimental injury accessible for suturing, the adipose tissue and omentum were withdrawn and fixed directly to the site of operation for enfolding (Figure 3). The injury was sutured with Viracyl 3.0 (Ethicon) suture material. Post-operatively, all cases were subjected to clinical inspection and a routine laparoscopic revision of the organs was applied to determine both the position of the urinary bladder and the presence / absence of any leakage. In addition, radiological and ultrasonography (Real Time Ultrasound scanner, Zhou Kaixin Electronic Instrument, China) examinations were undertaken at different times 14, 28, 35 days after the operation.



Figure 1: Ports of introducing instrument in first group.



Figure 2: Ports of introducing instrument in second group.



Figure 3: Adipose tissue and omentum were withdrawn and fixed directly to the site of operation for enfolding.

## Results

Protocol of ketamine/ xylazine was sufficient to produce general anesthesia for laparoscopic and hand assisted cystorrhaphy in dogs. All animals were recovered from anesthesia without apnea or hypothermia. In the first group, the operation required a minimum of  $45 \pm 2.1$  min to be achieved with no adverse effects of the laparoscopic tools on the animal activity, except signs of pain and hematuria. These two signs were subsided and animals reacted and appeared healthy within two days postoperatively. During operation, mild complications were exhibited such as minor bleeding, which may obscure vision, and mild leakage of urine. Thirty-five days postoperatively, there was adhesion between urinary bladder and viscera (Figure 4). The radiographic examination revealed a regular shaped and distended urinary bladder, free from leakage with the presence of titanium clips at different distances (Figure 5, 6). Similarly, on ultrasonographic examination, the wall of the urinary bladder appeared normal with no leakage; however, at the 14<sup>th</sup> and 35<sup>th</sup> days after the operation, moderate hyperechoic

dots were noticed at the craniodorsal aspects of the urinary bladder (Figure 7, 8).

In the second group, the overall time required to achieve the operation was  $36 \pm 1.1$  min, where no hematuria or signs of severe pain was revealed during of maturation. laparoscopic examination showed severe adhesion between the urinary bladder and omentum with abdominal wall at the site of exteriorizing omentum and urinary bladder, there was no leakage during different periods of laparoscopic examination (Figure 9). Radiographically, there was normal anatomical shape of urinary bladder (Figure 10). Ultrasonographic examination of the second group showed no leakage, however, thickness of the urinary bladder wall with hyperechoic dots were revealed after 14 and 30 days (Figure 11, 12).

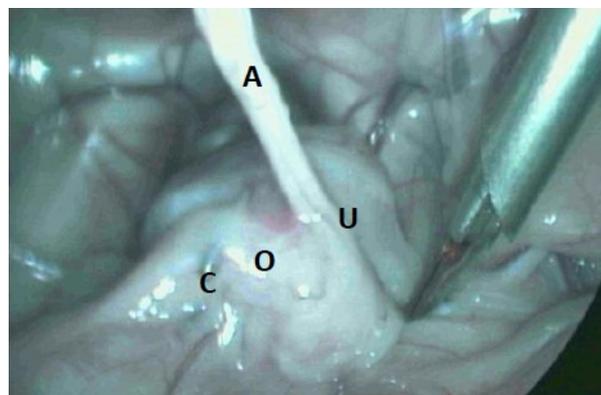


Figure 4: First group Treated dog 35 days post operatively (A) adhesion (C) titanium clips fix (O) omentum with urinary bladder (U).



Figure 5: Radiographic image with ventromedial view by positive contrast X rays, at 14 days, shown the distended urinary bladder (U), titanium clips (C) fixed with different distances.



Figure 6: Radiographic image with lateral view by positive contrast X rays, at 28 days, shown the distended urinary bladder (U), titanium clips (C) fixed with different distances.

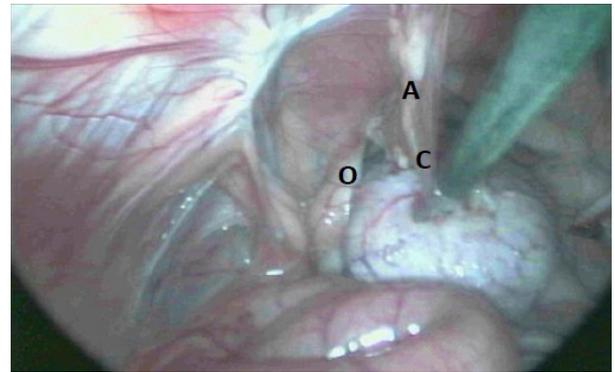


Figure 9: Second group treated dog 28 days post operatively (A) adhesion (C) fix (O) omentum with distended urinary bladder (a) adhesion at the site of omentum harvesting.



Figure 7: longitudinal plan of repaired bladder in first group 14 days postoperatively showing moderate hyperechoic dots indicating of craniodorsal wall of the urinary bladder, normal oval shape with no leakage.



Figure 10: Radiographic image with lateral view by positive contrast X rays, at 14 days, shown the distended urinary bladder (U) in the second group.



Figure 8: Longitudinal plan of repaired bladder in first group 35 days post operatively showing moderate hyperechoic dots (D) indicating of craniodorsal wall of the urinary bladder, normal shape with no leakage.

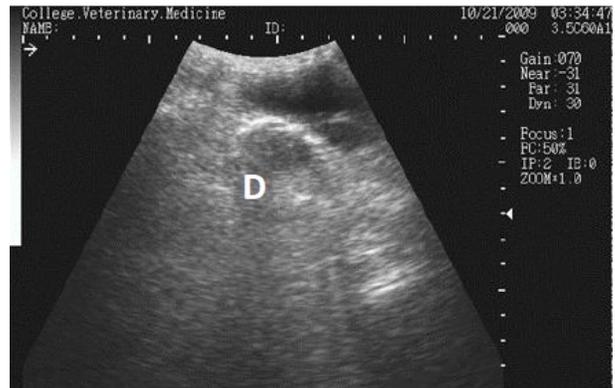


Figure 11: Longitudinal plan of repaired bladder for the second group after 14 days showing mild hyperechoic dots (D) indicating of craniodorsal wall of the urinary bladder, with irregular shape.

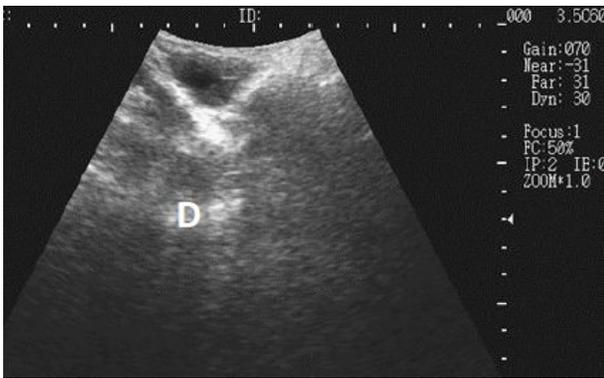


Figure 12: Longitudinal plan of repaired bladder in second group after one month showing hyperechoic dots (D) indicating of craniodorsal wall of the urinary bladder.

## Discussion

At the first two days after the operation, animals expressed signs of pain, which might be a subsequence of the inflammatory process during maturation phase similar observation was recorded in dogs (9). Laparoscopic cystorrhaphy is considered as a perfect feasible and safest method for repairing experimental defect in dog (1). By comparison with the traditional open procedure, laparoscopic cystorrhaphy is associated with less intraoperative and postoperative complications. In dogs, a previous work used the titanium clips to closure the laparoscopic cystotomy incision results in a high efficacy and required less time to be achieved by Abass *et al* and Shakeri *et al* (1,17). In addition, omentum plays an essential role in hemostasis, accelerating wound healing by neovascularize devitalized structures, and providing lymphatic drainage (15,16). It has affirmed that the omentovesicopexy is a simple and efficient technique for the treatment of neurogenic dysfunctions of the urinary bladder. In this technique, the greater omentum helps in the reinnervation and revascularization of the bladder (18). In contrast to the successful using of omentum, another study utilized a human amniotic membrane, however, impairment of the urinary function has been recorded (19).

In this study the omentum was used successfully. Similar to previous studies, the present work represented that the laparoscopic surgery caused a lower incidence rate of adhesions than laparotomy (20,21). Both absorbable and non-absorbable clips were successfully used and recommended for the laparoscopic surgery of bladder because are easy to be manipulated, applied and prevent hemorrhage (22,23). In the first group, the radiographic images showed no leakage, the bladder appeared distended and there were distances between the titanium clips, these observations coincide with a previous work done by Boure

*et al* (23). The positive contrast cystography was more efficient in detecting mucosal surface irregularity, bladder displacement and intraluminal structures (24). In the first group, the radiographic images showed no leakage, the bladder appeared distended and there were distances between the titanium clips, these observations coincide with a previous work done by Waseem also by Boure *et al* (9,23). Results of the ultrasonographic examination agree with another work done by Gallatti and Masao (24) where neither thickness in the wall of urinary bladder nor leakages were noticed. Thus, this work recommends the usefulness of ultrasonography to determine the bladder wall thickening and leakage. A previous work declared that a high urine density in the urinary bladder is positively relating with the sonographic imaging of the bladder (25). However, it has determined that rupture of the bladder wall is difficult to be diagnosed sonographically, where only free abdominal fluid and thickening of the bladder wall might be recognized. A protocol of sonography, catheterization of the bladder accompanied by the injection of the saline solution might be useful for diagnosis rupture (26). Nevertheless, diagnosis of the ruptured urinary bladder still one of the challenges of ultrasonography (27).

## Conclusion

We concluded that the hand-assisted laparoscopic cystorrhaphy strengthened by omentum is a practical, time saving and mini-invasive surgical technique. The using of titanium is effective for preventing both leakages and adhesion, but it is expensive.

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