IJVS 2014; 9(2); Serial No:21

IRANIAN JOURNAL OF VETERINARY SURGERY (IJVS)
WWW.IVSA.IR

Comparison of Laparoscopic Versus Conventional Open Partial Nephrectomy in Dogs

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Abstract

Objective- Laparoscopic partial nephrectomy (LPN) has been proven to be a safe and effective technique in human. This study was conducted to evaluate the feasibility and safety of utilizing laparoscopic partial nephrectomy in dogs and to compare this technique with open routine partial nephrectomy for the first time in Iran.
Design- Experimental study.
Animals- Sixteen large mixed-breed female dogs, weighting 22±5 kg, 1-2 years age.
Procedures- All dogs were anesthetized and positioned for surgery on left kidney. Partial nephrectomy (PN) was performed through five portals in left flank in laparoscopic group and through midline incision in open group. After renal artery was recognized and clamped, the caudal pole of kidney was resected. Then the exposed renal parenchyma was sutured. Operative time, ischemia time, incision length, clinical findings, hematological parameters, blood urea nitrogen, serum creatinine and intra and post-operative complications were recorded for one month.
Results- Surgeries were performed successfully in both groups and visualization was excellent in laparoscopic group. Mean operative time was insignificantly longer in laparoscopic group. Mean ischemia time was evaluated more in laparoscopic group but total length of incisional scar was obviously longer in open cases. There was mild infection in one portal site of first group. Other parameters were assessed normal and there was no significant complication in both groups.
Conclusion and Clinical Relevance- This experience demonstrated that LPN is a safe and feasible procedure in dogs with acceptable outcomes and advantages comparing with open PN.
Key Words- Dog, Partial nephrectomy, Laparoscopy, Open surgery.

Introduction

Renal failure is a sequence to trauma and a vast number of diseases and tumors, which ultimately arouses the need for partial or complete removal of the damaged kidney in order to save the animal's life.[1,2] Partial nephrectomy (PN) is the golden standard technique to treat traumatized kidneys or small focal renal lesions, particularly if optimal preservation of renal function is necessary due to bilateral renal dysfunction. However, in most cases total nephrectomy is easier and carries less risk of postoperative hemorrhage, but it is not ethical for animals to undergo radical surgery just because the surgeon involved, does not have adequate experience with PN. Accordingly, animals should be involved in the true treatment decision for open or laparoscopic, total or partial nephrectomy.

The first partial nephrectomy was performed in removing a perirenal fibrolipoma in a man by Wells in 1884.[3] Later, partial nephrectomy using laparoscopy became a safe alternative to open surgery in human.[4] The first laparoscopic partial nephrectomy (LPN) in animal was reported in pig in 1993 by McDougall.[5] In 1996 kairemo reported that two-thirds of the kidney volume can be removed without danger in pigs.[6] The purpose of this study was to evaluate the feasibility and safety of utilizing laparoscopic partial nephrectomy in dogs and to compare this technique with open

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conventional partial nephrectomy for the first time in Iran.

Materials and methods

Present study was approved by the Animal Ethics Committee of the Faculty of the Veterinary Medicine, University of Tehran, Tehran, Iran. The experiment was conducted at Small Animal Veterinary Teaching Hospital, Faculty of the Veterinary Medicine, University of Tehran. Sixteen large mixed-breed female dogs, weighting 22±5 kg, 1-2 years age, were selected for the experiment and were divided into two equal groups. Prior to the surgery, ultrasound examination of kidney was performed. CBC and biochemical parameters contain BUN and creatinine were assessed to ascertain animal health and normal kidney function, in particular. Food was restricted for 8 hours prior to surgery and cefazolin (20 mg/kg) was administrated IV as a preoperative prophylaxis antibiotic before inducing anesthesia. Dogs were sedated with acepromazine (0.05 mg/kg) and ketamine (10 mg/kg) IM and general anesthesia was induced by combination of ketamine HCL (5 mg/kg) and diazepam (0.2 mg/kg) IV and maintained by inhalation of isoflurane in oxygen (1.5%) through anesthetic machine.

In the first group laparoscopic procedure was performed. Dogs were placed in right lateral recumbency. The first trocar was inserted via 10mm incision left lateral to the umbilicus. Then pneumoperitoneum was established by connecting the trocar to the high flow insufflators using carbon dioxide. The 10 mm 0 degree rigid camera connected to a light source inserted into the abdomen. The second, third and fourth 5mm trocars were placed in proximal and left lateral side to the first portal, then a 10mm trocar were placed distal to camera portal in order to insert the instruments such as graspers, needle holder, electrocauter, scissor and clamp (Fig1). After the portals were placed, the left kidney's hilus was identified and renal artery was exposed by dissecting the peri hilus fat and attachments (Fig 2). Then the renal artery was clamped with vascular hemoclamp. The lower pole of kidney parenchyma was resected by scissor (Fig3). Then the exposed parenchyma was repaired by continuous suture pattern using hem-o-lok clips for making tension after each bite in order to prevent parenchymal hemorrhage (Fig 4). Then, the artery clamp was released slowly and kidney was inspected for bleeding. The resected portion (15%) of kidney was removed out in a bag through 10mm portal. At the end, trocar incisions were sutured in routine manner.

In the second group, open partial nephrectomy through a midline incision was performed. The renal artery was clamped by placement of a vascular forceps. After resecting the caudal pole of left kidney, the exposed parenchyma was sutured in a continuous pattern. Then the renal artery forceps was released and the resected section (15%) was removed from the abdomen. At the end, the abdominal incision was closed in a routine three layers manner. Antibiotic therapy was continued until day 5 in this group.

Mean operative, ischemia time, incision length and intra-operative complications were recorded in all dogs. In addition, complete blood count (CBC) and clinical parameters including heart rate, respiratory rate and body temperature were measured before surgery and on days 1 and 30 after surgery. Furthermore, blood urea nitrogen (BUN) and serum creatinine were measured before and 30 days after surgery. Any Clinical complications were monitored every day.

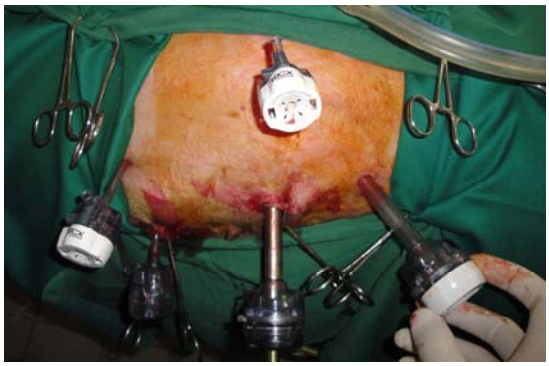

Figure 1- Portals insertion

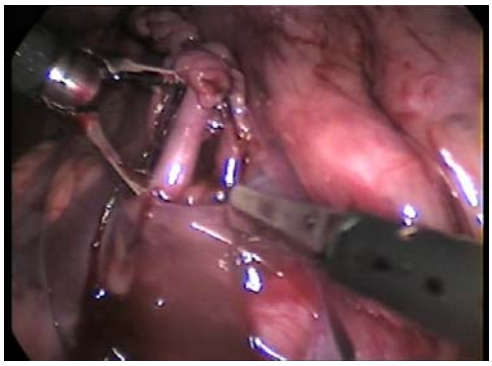

Figure 2- Renal artery dissection

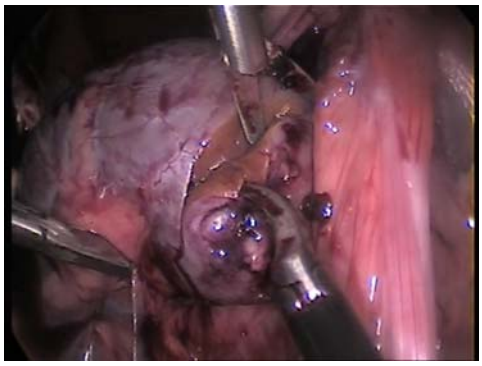

Figure 3- Resection of kidney's lower pole

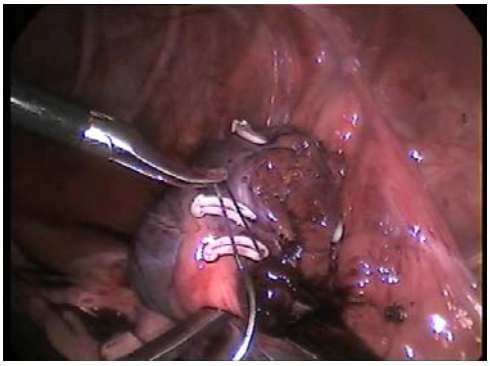

Figure 4- Repairing the exposed renal parenchyma

Results

Surgery was performed successfully and all dogs recovered without serious complications. No intra-operative complication occurred in any groups. Visualization of the kidneys during laparoscopic surgery was excellent and it was considered better than open surgery. There was no need to convert any of laparoscopic surgeries to open ones. No hemorrhage or urinary leakage was observed after operation and none of the cases required re-operation. There was no post-operative complication in any cases except in one dog in laparoscopic group which showed mild infection in one portal site and was treated by antibiotic therapy.

Mean operative time in first group was 45.62 ± 2.12minutes and in second group was 41.87 ± 1.15 ($p > 0.05$). Mean kidney ischemia time was 16.12 ± 0.54and 10.25 ± 0.36 minutes in laparoscopic and open surgery groups respectively ($p < 0.05$). Total length of incisional scar was 41.12 ± 0.71mm in laparoscopic group and 106.25 ± 5.72mm in open surgery group ($p < 0.05$). All clinical findings include heart rate, respiratory rate and body temperature were within normal ranges in both groups on days 1 and 30 after surgery. In spite of slight increase in BUN and creatinine values on day 30 compared to day 0, but they were within normal ranges in both groups. All Hematological parameters were normal except WBC which had slight elevation in three dogs in first group and in five dogs in second group one day after surgery. Two dogs of open surgery group showed increase in neutrophils one day after surgery. However, all the parameters were evaluated normal on day 30 after operation.

Discussion

In recent years, laparoscopic surgeries in veterinary medicine has been gaining wider acceptance and their usage in various procedures is expanding rapidly. According to this fact, assessment of advantages, disadvantages and possible complications of each procedure seems to be essential and require more research. The purpose of this study was to evaluate the feasibility and safety of laparoscopic partial nephrectomy in dog in comparison to routine open partial nephrectomy.

Laparoscopic partial nephrectomy (LPN) was first reported in 1993 by Winfield and colleagues in human.[4]In 2007, Gill compared this technique with open PN n 1800 patients and recommended laparoscopic procedure with the advantage of less operative time, decreased operative blood loss and shorter hospital stay.[7] In another study in 2007, Gill reported the oncological and renal functional outcomes 5 years after laparoscopic partial nephrectomy which were excellent compared to those of open nephron sparing surgery.[8]

The first laparoscopic partial nephrectomy in animals was reported in 1993 by McDougall in pig as an animal model. He introduced LPN as a feasible, repeatable procedure in pig.[5]

Performing partial nephrectomy through laparoscopic technique permitted an improved visualization and identification of abdominal organs tremendously as compare to open technique. This advantages is due to image amplification and improved illumination in video-surgery.[9]According to Stifelman, laparoscope is introduced to provide magnified visualization of operative field.[10]

In present study, there were no mortality and urologic complications such as hemorrhage and leakage related to all performed PN surgeries. In 2008, Tuna reported that prolonged warm ischemia and increased intraoperative blood loss increase the likelihood of postoperative complications which is consistent with our results.[11]

Operating time and ischemia time were within acceptable limits in both groups. Mean operating time was longer in laparoscopic group but there was no statistically significant difference between two groups. Significant lesser operative time in our experiment compared to human reports (ex: 144min, 200min) was probably related to excessive fat around human's kidney[12,13]. Several animals studies[14,15] and clinical reports[16,17] demonstrating kidney tolerance to warm ischemia (WI) time beyond 30 minutes. Mean ischemia time in open group was recorded less compared to laparoscopic group, although both were less than 30 minutes The study by Ward is commonly cited by opinion leaders to state a maximum 30-minute tolerance of the kidney to warm ischemia. These authors showed in dogs that warm ischemic intervals of up to 30 minutes can be sustained with eventual full recovery of renal function.[18] Although early observations in dog models showed that there may be substantial variation in kidney tolerance up to two or three hours of ischemia.[19] There is no doubt that the extent of renal damage after transitory arterial occlusion exclusively depends on the duration of the ischemic insult.[20,21,22]

Total length of incisional scar in laparoscopic group was significantly shorter than open partial nephrectomy group which led to less tissue injury and trauma in

addition to less manipulation. Obviously this is why less pain is one of the advantages associated with laparoscopic surgeries.[23]

Laparoscopic surgeries are associated with minimal port site complications (3%) include infection, bleeding and hernia. Infection (1.8%) related to increased number of ports followed by portal site bleeding (0.7%) is the most frequent complication.[24] These results are comparable to many other studies. Den Hoed et al. reported infection incidence 5.3% [25] , Shindholimath et al. 6.3% [26] , and Colizza et al. <2% [27]. Neudecker et al. had shown that port site complications were increased with more number of ports.[28] In our study, wound infection occurred only in one case at the site of third port which estimated high compared to our open PN group and also other scientists reports. According to Barclay analysis, laparoscopic surgery is linked to a 50% reduction in hospital-acquired infection rates vs. open surgery.[29] This is in contrast with our experiment result and the probable reason for infection occurrence in one of the laparoscopic sites was negligent in postoperative nursing.

All clinical parameters include heart rate, respiratory rate and temperature in addition to homological factors were within normal and favorable ranges which were similar to Latif's report after partial nephrectomy in dogs.[1] However, in present experiment leukocytosis in both groups and neutrophilia in open surgery group one day after surgery were attributed to surgical stress and existence of nitrogeneous metabolites in blood after PN surgery. These results are in accordance with the findings of Latif (2007) and Frederick and James (1974).[1,30]

The values of BUN and creatinine were assessed normal in all cases. In a study which was conducted in 2007 on five dogs, Latif reported high values of BUN and serum creatinine one month after removing 25% of the left kidney by open surgery, which became normal at the end of the second month. He justified such outcomes as a result of functional and structural hypertrophy of the partially resected kidney. Similar results have also been reported in the past by Lhotta in 1991.[1,31] However, they were in contrast with our study since BUN and serum creatinine were within normal ranges up to the end of our experiment on day 30in open group. Similar normal results were reported by de Souza in pigs, two weeks after LPN [32]which was much the same as our Laparoscopic group.

Conclusion

Keeping in view of all findings, this study clearly demonstrated the safety and efficacy of LPN with acceptable outcomes after short-term follow-up as compare to that of the open conventional partial nephrectomy in dogs. The technique seems to be feasible and safe when is performed by highly skilled surgeons since sufficient learning curve is a critical factor in laparoscopic surgeries. Despite technical difficulties, there are lots of potential benefits associated with LPN over open conventional PN in dogs as humans which is yet to be studied.

References

1. Latif SMW, Khan MA, Mahmood AK, et al. Effect of partial and complete nephrectomy on various blood parameters in dogs. *J Anim Pl Sci* 2007; 17:1-2.
2. Benjamin MM, Outline of Veterinary Clinical Pathology. 3rd Ed., Iowa State Univ. Press, Iowa, USA 1983;175-178.
3. Wells S, Successful removal of two solid circumrenal tumors. *BMJ* 1984; 1: 758.
4. Winfield HN, Donovan JF, Godet AS, et al. Laparoscopic partial nephrectomy: initial case report for benign disease. *J Endourol* 1993; 7:521-526.
5. McDougall EM, Clayman RV, Chandhoke PS, et al. Laparoscopic partial nephrectomy in the pig model. *J Urol* 1993; 149(6):1633-6.
6. Kairemo, KJA, Taari K, Salo JO, et al. Renal function remains after unilateral total and contra-lateral partial nephrectomy: an experimental study in pigs using ^{99m}Tc-DTPA. *Urological Res* 1996; 24(3):161-166.
7. Gill IS, et al. Comparison of 1,800 laparoscopic and open partial nephrectomies for single renal tumors. *J Urol* 2007; 178(1):41-6.
8. Lane BR, Gill IS. 5-Year outcomes of laparoscopic partial nephrectomy. *J Urol* 2007; 177(1):70-74.
9. Remedios AM, Fergunson J, Minimally invasive surgery: Laparoscopy and thoracoscopy in small animals. *Comp Cont Educ Pract Vet* 1996; 18:1191-1199.
10. Michael DS, Ernest S, Steven JSh, Hand-Assisted Laparoscopy in Urology. *Rev Urol* 2001 Spring; 3(2): 63-71.
11. Turna B, Frota R, Kamoi K, et al. Risk Factor Analysis of Postoperative Complications in Laparoscopic Partial Nephrectomy. *J Urol* 2008; 179(4): 1289–1295
12. Schiff JD, Palese M, Vaughan ED Jr, et al. Laparoscopic vs. open partial nephrectomy in consecutive patients: the Cornell experience. *BJU Int* 2005; 96(6):811-4.
13. Robinson BC, Snow BW, Cartwright PC, et al. Comparison of laparoscopic versus open partial nephrectomy in a pediatric series. *J Urol* 2003; 169(2):638-40.
14. Baldwin DD, Maynes LJ, Berger KA, et al. Laparoscopic warm renal ischemia in the solitary porcine kidney model. *J Urol* 2004; 64(3):592-597.
15. Leary FJ, Utz DC, Wakim KG, Effects of continuous and intermittent renal ischemia on renal function. *Surg Gynecol Obstet* 1963 116:311-317.

16. Bhayani SB, Rha KH, Pinto PA, et al. Laparoscopic partial nephrectomy: effect of warm ischemia on serum creatinine. *J Urol* 2004;172(4) part 1:1264-1266.
17. Yossepowitch O, Eggener SE, Serio A, et al. Temporary renal ischemia during nephron sparing surgery is associated with short-term but not long-term impairment in renal function. *J Urol* 2006; 176(4): 1339-1343.
18. Ward JP, Determination of the optimum temperature for regional renal hypothermia during temporary renal ischaemia. *BJUI* 1975; 47(1):17-24.
19. Handley C, Heider C, Morris GC, et al. Renal failure-I: the effect of complete renal artery occlusion for variable periods of time as compared to exposure to sub-filtration arterial pressures below 30 mm Hg for similar periods. *Ann Surg* 1957; 145(1):41-58.
20. Chiu C, Sievert KD, Dahms S, et al. Intraoperative reperfusion blood flow predicts post warm ischemic kidney transplant survival and efficacy of preservation maneuvers. *Transpl P* 1999; 31(1-2): 1049-1050.
21. Brasile L, Stubenitsky BM, Booster MH, et al. Hypothermia-a limiting factor in using warm is chemically damaged kidneys. *AJT* 2001; 1(4):316-320.
22. Lyrdal F. The effect of surgical trauma, ischaemia and ureteral occlusion on renal blood flow and function. An experimental study in the rabbit. *Scand J Urol Nephrol* 1975; 1-15.
23. Perla E, Amir S, Boaz S, et al. Laparoscopic Surgery May Be Associated With Severe Pain and High Analgesia Requirements in the Immediate Postoperative Period. *Ann Surg* 2006; 243(1): 41–46.
24. Karthik S, Augustine AJ, Shibumon MM, et al. Analysis of laparoscopic port site complications: A descriptive study. *J Minim Access Surg* 2013; 9(2):59-64
25. Den Hoed PT, Boelhouwer RU, Veen HF, et al. Infections and bacteriological data after laparoscopic and open gallbladder surgery. *J Hosp Infect* 1998; 39:27-37.
26. Shindholimath VV, Seenu V, Parshad R, et al. Factors influencing wound infection following laparoscopic cholecystectomy. *Trop Gastroenterol* 2003; 24:90-2.
27. Colizza S, Rossi S, Picardi B, et al. Surgical infections after laparoscopic cholecystectomy: Ceftriaxone vs ceftazidime antibioticprophylaxis. A prospective study. *Chir Ital* 2004; 56:397-402.
28. Neudecker J, Sauerland S, Neugebauer E, et al. The European association for endoscopic surgery clinical practice guideline on the pneumoperitoneum for laparoscopic surgery. *Surg Endosc* 2002; 16:1121-43.
29. Barclay L, Laparoscopic Surgery May Reduce Hospital-Acquired Infection Rates. *Surg Endosc* April 2008.
30. Frederick WO, James EP, Textbook of Large Animal Surgery. Williams & Wilkins Company, Baltimore, USA. 1974;584.
31. Lhotta K, Eberle H, Konig P, et al. Renal function after tumor enucleation in a solitary kidney. *AJKD* 1991; 17(3): 266-270.
32. De Souza DB, Abílio EJ, Costa WS, et al. Kidney healing after laparoscopic partial nephrectomy without collecting system closure in pigs. *J Urol* 2011 Feb; 77(2):508.e5-9.

نشریه جراحی دامپزشکی ایران
سال ۲۰۱۴، جلد ۹ (شماره ۲)، شماره پیاپی ۲۱

چکیده

ارزیابی مقایسه‌ای تکنیک جراحی پارشیال نفرکتومی به روش باز و لاپاروسکوپیک در سگ

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هدف- عمل جراحی پارشیال نفرکتومی از طریق لاپاروسکوپی در انسان به عنوان یک تکنیک مطمئن پذیرفته شده است. این مطالعه با هدف ارزیابی عمل پارشیال نفرکتومی به روش لاپاروسکوپیک و مقایسه آن با روش باز می‌باشد.

طرح- مطالعه تجربی

حیوانات-۱۶ قلاده سگ ماده نژاد بزرگ مخلوط با میانگین وزن ۵±۲۲ و سن ۲-۱ سال

روش کار-تمامی سگها پس از بیهوشی جهت انجام جراحی بر روی کلیه چپ، خوابانیده شدند. عمل پارشیال نفرکتومی از طریق ۵ پورت در ناحیه پهلوی چپ در گروه لاپاروسکوپی و از رهیافت خط وسط در گروه باز انجام گرفت. پس از کلمپ شریان کلیوی، ناحیه پل تحتانی کلیه برداشته شد. سپس سطح مقطع کلیه توسط بخیه سرتاسری بسته شد. طول جراحی، مدت زمان ایسکمی، طول برش، یافته‌های بالینی، پارامترهای خونی، نیتروژن اوره خون، کراتینین سرم و تمامی عوارض به مدت یک ماه مورد ارزیابی قرار گرفتند.

نتایج- جراحی‌ها در هر دو گروه با موفقیت انجام گرفت و دید موضع در گروه لاپاروسکوپی بسیار مناسب ارزیابی گردید. میانگین طول مدت جراحی به صورت غیرمعنی‌دار در گروه لاپاروسکوپی بیشتر بود. میانگین مدت ایسکمی در گروه لاپاروسکوپی بیشتر، اما طول برش در گروه باز طولانی‌تر ارزیابی شد. عفونت خفیف در محل یکی از پورت‌های گروه اول مشاهده گردید. سایر پارامترها طبیعی ارزیابی شد و هیچ عارضه‌ای در گروه‌ها مشاهده نگردید.

نتیجه‌گیری و کاربرد بالینی- این مطالعه نشان داد که جراحی پارشیال نفرکتومی لاپاروسکوپیک روشی مطمئن است که درمقایسه با جراحی باز دارای مزایای قابل توجهی می‌باشد.

کلمات کلیدی- سگ، پارشیال نفرکتومی، لاپاروسکوپی، جراحی باز.