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

Comparison of Mono and Bipolar Electrocoagulation in Laparoscopic Ovariohysterectomy in Dogs

Samane Berenjian[1], DVM
Jalal Bakhtiari[1*], DVM,
Ali Reza Khalaj[2], PhD
Amir Niasari Naslaji[1], DVM, PhD

[1]Department of Clinical Sciences, Faculty of Veterinary Medicine, University of Tehran, Tehran, Iran.
[2] Faculty of Medicnine, Shahed University, Tehran, Iran.

Abstract

Objective- To evaluate the clinical safety and superiority of monopolar and bipolar electrocauter in laparoscopic ovariohysterectomy in dogs.
Design-Elective experimental study
Animals- Twenty four mixed breed healthy adult female dogs.
Procedures-The dogs divided into two equal groups. Laparoscopic ovariohysterectomy performed using either monopolar (n=12) or bipolar (n=12) electrocoagulation. Under general anesthesia, dorsal recumbency and reverse trendelenburg position a 10 mm portal for camera insertion at the umbilicus. Two other 5 mm portals were placed 5 cm cranial and caudal to umbilicus in both groups. Monopolar electrocauter were used for coagulation and cutting but bipolar electrocauter were used for coagulation only. Following identification of ovaries, suspensory ligament, ovarian vessels, broad ligament and uterine vessels and body were coagulated and cut. The pedicles were checked for any signs of hemorrhage. Ovaries, broad ligament and uterus were removed from the abdomen through umbilical portals.
Results-There were no significant differences between surgical time and the amount of hemorrhage in both groups. Significant differences observed in degrees of the released smoke and tissue burning between groups.
Conclusion- As a whole we concluded that the bipolar electrocauter was superior to monopolar electrocoagulator in laparoscopic ovariohysterectomy and has the advantages of decreasing released smoke and burnt tissue compare to that of monopolar electrocauter.
Key Words- monopolar, bipolar, electrocoagulation, ovariohysterectomy, laparoscopy, dog

[*] **Corresponding author:**
Jalal Bakhtiari, DVM, PhD
Faculty of Veterinary Medicine, University of Tehran, Tehran, Iran
E-mail address: bakhtiar@ut.ac.ir

Introduction

Laparoscopic ovariohysterectomy is widely accepted and reported to be an appropriate alternative to traditional technique, with confirmed advantages.[1,2,3,4,5,6] It is also reported that by performing laparoscopic ovariohysterectomy visualization of ovaries are improved and the risk of ovarian remnant syndrome would be decreased[7]. However hemorrhage, which sometimes can be life-threatening is still remains the most common complication of ovariohysterectomy.[8] Use of careful technique while breaking the suspensory ligament, handling and manipulating the ovarian pedicle and uterine, and placing ligatures is important in preventing hemorrhage.[9] Performing surgeries with fewer hemorrhages are now concerned in newly introduced laparoscopic techniques and it is provided us with several new coagulation tools like Ligasure, bipolar and monopolar electrocauter, Ultracision and ultrasonic coagulating shears that are widely used to ensure haemostasis in both laparoscopic and open surgeries.[10] There is no ideal technique existed for entire procedures. Within these techniques electrocoagulation is more applicable when the tissue has a small cross sectional with plenty of vessels like ovarian pedicle.[11] Monopolar and bipolar electrocauters are very commonly used in laparoscopic surgeries.[12] The high voltage causes to cut and burn tissue during monopolar diathermy. However the low voltage causes only to hemostasis in bipolar system. Monopolar electrocoagulator involves current flow from the hand piece which represents active electrode through the patient's body to the return dispersive electrode which is neutral pad before returning to the electrosurgical generator. During bipolar diathermy the forceps are coupled and current passes from one tip of the hand piece which represents active electrode to the contralateral tip that is neutral electrode.[13,14] Different advantages and disadvantages have been taken into account for both techniques. The use of monopolar electrocauter has been discouraged because of concerns about alternative site burns or unintended burns. In turn it works as scissors when resection is needed.[12,15] However bipolar electrocauter has the advantage of decreasing released smoke and burnt tissue as compare to that of monopolar electrocauter.[16,17]

There are reports of laparoscopic removal of ovaries and/or uterus by using different electrocoagulation techniques in human hospitals.[19,20] There is no report existed in veterinary literature regarding comparison of monopolar and bipolar electrocautery and since these two devices are frequently available in clinics providing laparoscopic surgeries, this study designed to evaluate the superiority of the electrocauteries.

Materials and Methods

Among the healthy dogs that were referred to Small Animal Teaching Hospital, University of Tehran for elective neutering, twenty four adult female mixed breed dog weighting 14-17 kg were selected for this study. A pilot study was conducted prior to performing surgery on referral cases to evaluate the potentiate problems that we may encounter during the surgery. The dogs were divided into two groups randomly and food was restricted for 8 hours prior to surgery. The dogs received acepromazine (0.1 mg/kg, i.m.; Nuerotrank® Alfasan) and buprenorphine (10 µg/kg, i.v.; Buprenex®) for premedication and the combination of ketamine (5.5 mg/kg; i.v.; Ketalar®, Alfasan) and diazepam (0.27 mg/kg; Valium®, Caspian, i.v.) for induction of anesthesia. A single prophylactic dose of cefazolin (20 mg/kg; i.v.; Ancef®; Loghman) was injected at the time of inducing anesthesia. The anesthesia was maintained by inhalation of isoflurane (1.6%, Nicholas Piramal) in Oxygen through anesthetic machine. The urinary catheter was placed in urethra to evacuate bladder and the area from

xiphoid to pubis was prepared under aseptic conditions. The dogs were placed in dorsal recumbency and trendelenburg position (head down) to make the cranial displacement of the visceral abdominal contents. Also 30 degree tilting in either right or left lateral recumbency was done to perform electrocoagulation of left or right ovarian pedicles respectively. A 10 mm skin incision was made at the umbilicus and the sub-cutis was reflected until revealing the linea alba. It was cut precisely and insertion of the trocar in to the abdomen performed under direct vision. The primary 10 mm cannula inserted, while ventral abdominal wall was pulled up to avoid trauma to visceral organs. The surgical time was started at this point. Next pneumoperitoneum was established by carbon dioxide and using an automatic high flow insufflator (Wolf, Germany) connected to the laparoscopic cannula until a pressure of 12 mm Hg achieved. A 10 mm diameter 0 degree rigid telescope (Wolf, Germany) connected to a light source and inserted into the peritoneal cavity. Two other 5 mm portals were placed through 5 mm midline skin incision 5 cm caudal and cranial to umbilicus. The 5 mm grasping forceps was inserted from the cranial portal to grasp ovaries. Next either the 5 mm monopolar or bipolar electrocauter forceps was introduced into the abdomen in mono and B respectively (Fig 1 & 2). Following identification of the ovaries, the suspensory ligament, ovarian pedicles and broad ligament of each side were coagulated and transected. Then the patient returned to dorsal recumbency with head tilted down and the grasping forceps was used to grasp cervix from the caudal portal. The uterine body and its associated vessels were coagulated by the electrocautery forceps. The laparoscopic scissors were used for transaction of the pedicles in bipolar. The pedicles were checked for any signs of hemorrhage. Finally the ovaries, uterus and broad ligament were removed from the abdomen through the camera portal. All sites were sutured in a routine manner.

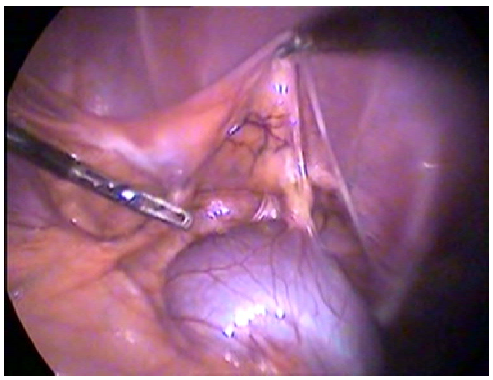

Figure 1. Monopolar electrocauter is being used to coagulate and resect the ovarian pedicle in group A

Figure 2. The use of bipolar electrocauter to coagulate ovarian pedicle in group B.

All surgeries were video-recorded. Mean surgical time, released smoke, hemorrhage and degree of burning of tissues were estimated during surgery. Grades of the released smoke were estimated and scoring was performed from 1 to 4 prior to surgeries as follows: Grade 1: lack of smoke during electrocoagulation; Grade 2: little production of smoke around the pedicle following cauterization; Grade 3: Moderate production of the smoke that obscures the surgeon's visualization. However there was no need to remove the camera from the abdomen to facilitate evacuation of the smoke; Grade 4: Severe production of the smoke leading to the removal and cleaning the camera. This, in turn, interrupts the surgery until the smoke evacuated from the abdomen.Tissue burning was graded form 1 to 3. Grade 1: Only the

tissues grasped between jaws of the electrocauter hand piece was coagulated. Grade 2: As wide as the tip of the electrocauter hand piece around the grasped tissue was coagulated. Grade 3: Severe burning of tissues occurred not only around the grasped tissues but also in other surrounding tissues adjacent to it.
Data were analyzed using Kruskal-Wallis test in SAS.[21] Data were presented as Mean ± SEM. ***P*** value less than 0.05 was considered significant.

Results

All animals recovered from anesthesia and the surgeries were successful without any complication. Mean surgical time was 37.5±5.56 minutes in mono and 37.0±3.24 minutes in bipolar without significant difference (P >0.05; Table 1). Although mean estimated blood loss was higher in mono (2.7±1.18 ml) compared to bipolar (1.5±0.50 ml), but it was statistically insignificant (P>0.05). Mean grade of the released smoke was 3.5±0.29 in mono and 1.2±0.25 in bipolar (P<0.05). Also mean grade of tissue burning was significantly different in mono (2.5±0.29) compared to bipolar (1.2±0.25; P<0.05; Table 1).

Table 1. Comparing measured parameters (Mean ± SEM) between open and laparoscopic surgeries following ovariohysterectomy in dogs.

Group	Surgical time (min)	Estimated blood loss (ml)	Degree of tissue burning	Degree of released smoke
Open	37.5±5.56[a]	2.7±1.18[a]	2.5±0.29[a]	3.5±0.29[a]
Laparoscopy	37.0±3.24[a]	1.5±0.50[a]	1.2±0.25[b]	1.2±0.25[b]

[ab] Values within rows with different superscripts differ (P<0.05).

Discussion

The most frequent complication during ovariohysterectomy is hemorrhage that can be easily prevented by the application of the appropriate device for sealing vessels and tissue pedicles that ensures haemostasis.[9] To have efficient and safe mode of hemostasis variety of devices are introduced in laparoscopic surgeries. But electrical hemostatic techniques are more preferred among others and generally the most usual devices are monopolar and bipolar electrocauter in clinics. Mean surgical time for laparoscopic ovariohysterectomy in earlier published studies ranged from 20 to 36 minutes which is in consistent with the other reports.[21,22] The lack of significant difference in mean surgical time in both groups indicated that the both techniques of sealing vessels are acceptable and the use of scissors for transecting tissue in bipolar electrosurgery does not elongate the surgical time if used appropriately. The use of cauter forceps and scissors during bipolar diathermy resulted in possible increase of the surgical time due to increase the number of surgical movements that may slow the procedure theoretically which is not in agreement with the results of the present study.[17,23] Bipolar electrocauter has been reported to be more feasible including less tissue effect in comparison with other sources of electrosurgical devices in previous reports when tissue damage was considered.[18,2] Similar results obtained in our study. Desiccation using the coagulation current resulted in carbonized tissue contribute to the cellular debris released into the air. As smoke is produced inside the abdomen, it is absorbed through the peritoneal membrane. This leads to increase the range of methemoglobin and carboxymethemoglobin in patient's blood circulation. The smoke is harmful to operation room personnel as well as the

patient. Released smoke will obstruct surgeon's visualization that may elongate the surgical time.[25] Mean released smoke was significantly lower in bipolar, which is the advantage of this technique that is in agreement with Ulmer's et al findings.[25] He reported that high-voltage wave pattern which is used in monolpolar electrocauter produces more heat in tissues that results in the production of more smoke during surgeries. Monopolar electrocauter proved to least effective method of hemostasis because it leaves serious histologic changes, but better effects have been reported for bipolar electrocauter in this regard.[10] A high percentage of monopolar and bipolar electrocoagulations are reported to be ineffective, that needs re-application.[27] The similar problem was encountered in this study. However the newly introduced hemostatic devices like Ligasure and Ultracision have been reported to be more efficient with less histologic damages.[26,27]

It is concluded that the bipolar electrocauter was superior to monopolar electrocogulator in laparoscopic ovariohysterectomy and has the advantages of decreasing released smoke as well as burnt tissue when compare to that of monopolar electrocauter. Evaluation of efficacy and safety of the new coagulating tools in laparoscopic surgeries are recommended.

Acknowledgements

The group of authors would like to sincerely appreciate Dr Azin Tavakoli for assistance during this study, Research Council of the Faculty of Veterinary Medicine University of Tehran, Center of Excellence for Veterinary Research on Iranian Indigenous Animals and Minimally Invasive Surgery Research Center, Rasool Akram Hospital for approval and providing financial assistance.

References

1. Hancock RB, Lanz OI, Waldron DR, et al. Comparison of postoperative pain after ovariohysterectomy by harmonic scalpel-assisted laparoscopy compared to median celiotomy and ligation in dogs. *Vet Surg* 2005;34**:**273–282
2. Austin B, Lanz, O, Hamilton, SM, et al. Laparoscopic ovariohysterectomy in nine dogs. *JAAHA* 2003;39:391-396
3. Freeman LJ. Introduction to Veterinary Laparoscopy. In: Freeman LJ eds. Veterinary endosurgery. 1 st ed. Missouri: Mosby Co, 1999;61-65
4. Collins BS. A spaying dilemma: Laparoscopic ovariectomy as an alternative to a traditional ovariohysterectomy. Senior Seminar paper Cornell University College of Veterinary Medicine 2008, April 23rd.
5. Davidson EB, Moll HD, Payton ME. Comparison of laparoscopic ovariohysterectomy and ovariohysterectomy in dogs. *Vet Surg* 2004;33:62-69
6. Bakhtiari J, Mokaram S, Khalaj AR, et al. Clinical evaluation of effective laparoscopic ovariohusterectomy in dogs. *IJVR* 2006;63(3):141-147
7. Stone EA, Ovary and uterus. In: D. Slatter, Editor, Textbook of small animal surgery, Elsevier Science, USA. 2003,1487–1496.
8. Miller DM, Ovarian remnant syndrome in dogs and cats: 46 cases (1988–1992), *J Vet Diagn Invest***,** 1995, 572–574.
9. Howe LM. Prepubertal gonadectoym in dogs and cats-Part I. Compendium Continuing Education in Small animal Practice. 1999 21:197-201

10. Dimantis T, Kontos M, Arvelakis, et al. Comparison of monopolar electrocoagulation, bipolar, electrocoagulation, Ultracision and Ligsure. *Surg Today* 2006;36:908-913

11. Sangster TP. An overview of laparoscopic dissection modalities. Available at: http://www.laparoscopyhospital.com/dissection.htm. Accessed Feb 15, 2011.
12. Hulka JF, Thweatt D, Ulberg LC. Contained cautery: Studies toward safer laparoscopic sterilization techniques. *Fertil Steril* 1973;24:912-920

13. Baldwin CJ, Cowell RL, Kostolich M, et al. Hemostasis: Physiology, diagnosis and treatment of bleeding disorders in surgical patients, in Slatter D (ed): Text book of small animal medicine. Philadelphia, PA, Saunders, 1993;29-51
14. Toombs JP, Bauer MS, Basic operative techniques. In Slatter D (ed): Text book of small animal surgery. Philadelphia, PA, Saunders, 2003;168-178
15. Van Goethem BE, Rosenveldt KW, Kirpensteijn J. Monopolar versus bipolar electrocoagulation in canine laparoscopic ovariectomy. *Vet Surg* 2003;32:464-470
16. Baggish MS, Tucker RD. Tissue actions of bipolar scissors compared with monopolar devices. *Fertil Steril* 1995; 63:422-426
17. Edelman DS, Unger SW. Bipolar versus monopolar cautery scissors for laparoscopic cholecystectomy: a randomized prospective study. *Surg Laparosc Endosc* 1995;5: 459-462
18. Ko R, Tan AH, Chew BH, et al. Comparison of the thermal and histopathological effects of bipolar and monopolar electrosurgical resection of the prostate in a canine model. *BJU Int*. 2010; 105:1314-1317
19. Lee CL, Hung KG, Wang CJ, et al. Laparoscopic radical hysterectomy using pulsed bipolar system: Comparison with conventional bipolar electrosurgery. *Gyneco onco* 2007;105:620-4
20. Gyr T, Ghezzi F, Arslanagic S, et al. Minimal invasive laparoscopic hysterectomy with ultrasonic scalpel. The *Ame J Surg* 2001;181:516-519.
21. SAS/STAT user's guide, version 6.12. Cary, NC: SAS Institute Inc.; 2006
22. Mayhew PD, Brown DM. Comparison of three techniques for ovarian pedicle hemostasis during laparoscopic-assisted ovariohysterectomy. *Vet Surg* 2007;36:541-547.
23. Magne ML, Tams TR. Laparoscopy: instrumentation and technique, In Tams TR (ed): Small Animal Endoscopy. St Louis, MO, Mosby, 1999,397-408
24. Tulikangas PK, Smith T, Falcone T, et al. Gross and histologic characterisrics of laparoscopic injuries with four different energy sources. *Fert Steril* 2001; 75:806-810

25. Nicola JH, Nicola EM, Vieira R, et al. Speed of particles ejected from animal skin by C[O.sub.2] laser pulses, measured by laser Doppler velocimetry. *Phys Med Biol* 2002;47:847-856.
26. Kwok A, Nevell D, Ferrier A, et al. Comparison of tissue injury between coagulating shears and electrosurgical scissors in the sheep model. *J Am Assoc Gynecol Laparosc* 2001;8:378-384
27. Heniford BT, Matthews BD, Sing RF, et al. Initial results with an electrothermal bipolar vessel sealer. *Surg Endosc* 2001;15:799-801

چکیده:

مقایسه هموستاز تک قطبی و دو قطبی در برداشت رحم و تخمدان به روش لاپاروسکوپی در سگ

سمانه برنجیان[1]، جلال بختیاری[*1]، علیرضا خلج[2] ، امیر نیاسری نسلجی[1]

[1] گروه علوم درمانگاهی، دانشکده دامپزشکی، دانشگاه تهران، تهران،ایران،
[2] دانشکده پزشکی، دانشگاه شاهد، تهران، ایران.

هدف- مقایسه ارجحیت هموستاز تک قطبی و دو قطبی در جراحی برداشت رحم و تخمدان به روش لاپاروسکوپی در سگ.
طرح: مطالعه تجربی انتخابی
حیوانات- بیست و چهار قلاده سگ ماده بالغ از نژاد مخلوط
روش کار- کلیه سگها تحت بیهوشی عمومی در دو گروه مساوی برای جراحی لاپاروسکوپیک برداشت رحم و تخمدان با استفاده از الکتروکوتر تک قطبی و دو قطبی در حالت خوابیده به پشت و زاویه ۳۰ درجه نسبت به خط افق به طوریکه سر در سطح پایین تری نسبت به بدن قرار داشت آماده شدند. در هر دو گروه تروکار ۱۰ میلیمتری برای عبور دوربین در ناحیه ناف کار گذاشته شد. سپس دو پورت دیگر ۵ میلیمتری در ۵ سانتیمتری قدامی و خلفی ناف کار گذاشته شدند. پس از شناسایی تخمدانها، لیگامنت معلقه و پایه عروقی تخمدانها، لیگامنت پهن رحم و بدنه رحم در محل بالاتر از سرویکس در هر دو گروه قطع شدند، با این تفاوت که در گروه A از الکتروکوتر تک قطبی و در گروه B از الکتروکوتر دو قطبی استفاده شد. در نهایت پس از اطمینان از هموستاز کامل، رحم و تخمدانها از محل پورت ناف خارج شدند. کلیه جراحی ها با موفقیت انجام شد و هیچگونه عوارضی حین جراحی و پس از آن در سگها دیده نشد. در این مطالعه فاکتورهای مختلفی شامل مدت زمان جراحی ، میزان خونریزی ، انتشار دود و میزان سوختگی بررسی شدند و کلیه جراحی ها توسط دستگاه ضبط ویدیویی مورد ثبت قرار گرفتند.
نتایج- از میان فاکتورهای مورد مطالعه بین مدت زمان جراحی و میزان خونریزی تفاوت معنی داری مشاهده نگردید ($P>0/05$). اما میزان سوختگی و میزان انتشار دود در محوطه بطنی به طور معنی داری ($P<0/05$) در گروه دو قطبی کمتر از گروه تک قطبی بود.
نتیجه گیری- در مجموع می توان گفت که تکنیک جراحی لاپاروسکوپی با استفاده از الکتروکوتر دو قطبی روشی مطمئن تر در جراحی برداشت رحم و تخمدان در سگ بوده و با مشکلات حین عمل کمتری همراه می باشد.
کلید واژگان- الکتروکوآگولاسیون، تک قطبی، دو قطبی، برداشت رحم و تخمدان ، لاپاروسکوپی، سگ.