Comparison of Mono and Bipolar Electrocoagulation in Laparoscopic Ovariohysterectomy in Dogs

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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 burnt tissue compare to that of monopolar electrocauter.

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

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Introduction

Laparoscopic ovariohysterectomy is widely accepted and reported to be an appropriate alternative to traditional technique, with confirmed advantages. It is also reported that by performing laparoscopic ovariohysterectomy visualization of ovaries are improved and the risk of ovarian remnant syndrome would be decreased. However hemorrhage, which sometimes can be life-threatening is still remains the most common complication of ovariohysterectomy. 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. 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. 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. Monopolar and bipolar electrocauteries are very commonly used in laparoscopic surgeries. 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. 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. However bipolar electrocauter has the advantage of decreasing released smoke and burnt tissue as compare to that of monopolar electrocauter.

There are reports of laparoscopic removal of ovaries and/or uterus by using different electrocoagulation techniques in human hospitals. 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 into 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.

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 from 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. 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.

<table>
<thead>
<tr>
<th>Group</th>
<th>Surgical time (min)</th>
<th>Estimated blood loss (ml)</th>
<th>Degree of tissue burning</th>
<th>Degree of released smoke</th>
</tr>
</thead>
<tbody>
<tr>
<td>Open</td>
<td>37.5±5.56a</td>
<td>2.7±1.18a</td>
<td>2.5±0.29a</td>
<td>3.5±0.29a</td>
</tr>
<tr>
<td>Laparoscopy</td>
<td>37.0±3.24a</td>
<td>1.5±0.50a</td>
<td>1.2±0.25b</td>
<td>1.2±0.25b</td>
</tr>
</tbody>
</table>

*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. 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. 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 cautery 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. 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. 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.\textsuperscript{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.\textsuperscript{25} He reported that high-voltage wave pattern which is used in monopolar electrocauter produces more heat in tissues that results in the production of more smoke during surgeries. Monopolar electrocauter proved to be least effective method of hemostasis because it leaves serious histologic changes, but better effects have been reported for bipolar electrocauter in this regard.\textsuperscript{10} A high percentage of monopolar and bipolar electrocoagulations are reported to be ineffective, that needs re-application.\textsuperscript{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.\textsuperscript{26,27}

It is concluded that the bipolar electrocauter was superior to monopolar electrocoagulator 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


چکیده:
مقایسه هموستاز تک قطعی و دو قطعی در برداشت رحم و تخمدان به روش لاپاروسکوپی در سگ.

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هدف: مقایسه اجرایی هموستاز تک قطعی و دو قطعی در جراحی برداشت رحم و تخمدان به روش لاپاروسکوپی در سگ.

طرح: مطالعه تجربی انتخابی

روش کار: کلیه سگ‌ها تحت پوشش معمولی در دو گروه مساوی برای جراحی لاپاروسکوپی برداشت رحم و تخمدان با استفاده از الکتروکوپک تک قطعی و دو قطعی در حال واقعیت به پشت و زاویه 30 درجه نسبت به خط افقی سر در سطح یا پیونه تراکمی در بدن قرار داشت. در هر دو گروه ترکار 10 میلیمتری برای گذراندن در ناحیه ناف کار گذاشته شد. سپس دو پورت دیگر 5 میلیمتری در سانیتیری قنالی و خلق دو فاصله ناف کار گذاشته شدند. پس از شناسایی تخمدان‌ها، لیگامنت معلق و پایه عروقی تخمدان‌ها، لیگامنت یافتن رحم و بدن رحم در محل بالاتر از سرپوشکس در هر دو گروه قطع شدند، با این تفاوت که در گروه A از الکتروکوپک تک قطعی و در گروه B از الکتروکوپک دو قطعی 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 عوارض جراحی و پس از آن در سگها دیده نشد. در این مطالعه فاکتورهای مختلف شامل مدت زمان جراحی، میزان خونریزی، انتشار دود و میزان سوختگی برسی شدند و کلیه جراحی‌ها توسط دستگاه ضبط ویدئویی مورد نتیج، ثبت قرار گرفتند.

نتایج: از میان فاکتورهای مورد مطالعه بین مدت زمان جراحی و میزان خونریزی نتایج معنی‌داری مشاهده نکردند (P>0.05). اما میزان سوختگی و میزان انتشار دود در محیط بطنی به طور معنی‌داری (P<0.05) در گروه دو قطعی کمتر از گروه تک قطعی بود.

نتجه‌گیری: در مجموع می‌توان گفت که تکنیک جراحی لاپاروسکوپی با استفاده از الکتروکوپک دو قطعی روشهای عمومی تر در جراحی برداشت رحم و تخمدان در سگ بوده و با مشکلات حین عمل کمتری همراه می‌باشد.

کلید واژگان: الکتروکوپک، تک قطعی، دو قطعی، برداشت رحم و تخمدان، لاپاروسکوپی، سگ.