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Single-port laparoscopic ovariectomy using a pre-tied loop ligature in Santa Ines ewes

Ovariectomia por um portal laparoscópico com aplicação de ligaduras pré-montadas em ovelhas Santa Inês

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ABSTRACT

The aim of the study was to develop and assess the feasibility, postoperative pain and inflammatory response of the single-port laparoscopic ovariectomy in ewes, using a simple pre-tied loop ligature technique. Pre-tied Meltzer's knot was employed for prophylactic hemostasis of the ovarian pedicle. Slipknot was inserted within the abdominal cavity through a 14-gauge needle and tied surrounding the ovarian pedicle. Mean surgical time, manipulation, ligature and resection of each ovary and anesthesia time were 63±20, 20±10 and 91±26 minutes, respectively. No bleeding occurred during the surgeries. Ewes showed low scores pain (0.5±0.5) at all time-points. Postsurgical plasma fibrinogen was within the normal range for sheep specie at all time-points. The ewes showed a significant weight gain in comparison to the basal scaling (one day before the surgery). Single-port laparoscopic ovariectomy using a pre-tied loop ligature is feasible in the ovine specie and provided minimal postoperative distress and quick weight gain.

Key words: *laparoscopy, ovary, ovine, single-site access, slipknot.*

RESUMO

Objetivou-se com este trabalho desenvolver e descrever uma técnica de ovariectomia por videolaparoscopia utilizando um portal laparoscópico e um sistema de ligadura pré-montada, avaliando a sua viabilidade, o desconforto doloroso e o processo inflamatório provocado em ovelhas. O nó de Meltzer pré-montado foi utilizado para hemostasia profilática do pedículo ovariano. O nó corrediço foi inserido na cavidade abdominal através de uma agulha 14G e atado em torno do pedículo ovariano. O tempo médio de cirurgia foi de 63±20min, o de manipulação, ligadura e ressecção para cada ovário foi de 20±10min, e o de anestesia 91±26min. Não houve hemorragia durante as cirurgias. As ovelhas apresentaram escores de dor considerados baixos (0,5±0,5). Todos os valores do fibrinogênio plasmático estiveram dentro do padrão de normalidade, não havendo diferença estatística entre os momentos avaliados. Houve aumento significativo nas médias de peso das fêmeas, quando comparados ao momento controle (um dia anterior ao experimento). A ovariectomia por um portal laparoscópico com aplicação de ligaduras pré-montadas é factível para a espécie ovina, provocando mínimo estresse, desconforto doloroso e rápido ganho de peso nos animais.

Palavras-chave: *laparoscopia, nó deslizante ovário, ovinos, acesso único.*

INTRODUCTION

Gonadectomy is a surgical technique that inflicts positive impacts on ovine breeding. Ovariectomy is not only performed to prevent pregnancy, but also to reduce problems related to the estrous cycle, such as interference on the weight gain (GARBER et al., 1990; BLEUL et al., 2005). Other purposes of ovariectomy in livestock animals include enhancement of the weight gain performance and improvement of the carcass quality

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(SILVA et al., 2006), the preservation of gametes of high performance, animals with great genetic value, to sample specimens for advanced researches on reproductive biotechnologies (PADULA et al., 2002; TEIXEIRA et al., 2011) or to treat ovarian disorders (MOBINI et al., 2004).

Gonadectomy may present some disadvantages, such as increased costs and risk of surgery-related complications (PEINADO et al., 2008), which can lead to low production performance, especially due to postoperative stress and pain. Therefore, the efforts of the surgical management in livestock should always be focused on the reduction of cost-benefit and minimal postoperative stress, as pain can impair weight gain (FITZPATRICK et al., 2006; LUNA, 2008).

One of the most critical steps during the laparoscopic approach for ovariectomy is the achievement of an affective prophylactic hemostasis of the ovarian pedicles. The use of energy surgical sources such as electrosurgical generators, harmonic scalpel and lasers, and automatic stapling/cutting devices increases the costs-benefit of the procedure and may be expensive and difficult to implement (AZIZ et al., 2008).

The pre-tied ligature systems, also known as endoscopic slipknots or "endoloops", are composed of a slipknot and a laparoscopic tool used to guide and tighten the knot, which is known as knot pusher (KATSINELOS et al., 2006). Hemostasis is achieved by pushing and tightening the knot around the ovarian pedicle. One of the main advantages of the use of thread ligature is the absence of thermal injury of adjacent tissue, which is usually caused by electrocoagulation (LIM et al., 2007).

There are several reports of the use of loop ligature for ovariectomy in the equine specie (BOURÉ et al., 1997; RAGLE & SCHNEIDER, 1998; HANSON & GALLUPO, 1999; RODGERSON & HANSON, 2000). In humans, endoloop ligature was carried out in shorter surgical time and caused less postoperative pain then the electrocoagulation for salpingectomy (LIM et al., 2007). However, no reports regarding the use of pre-tied ligature for ovariectomy in the ovine specie was found in the current literature, furthermore this technique could also be performed in other females including women.

The aim of this study was to develop and assess the feasibility, the postoperative pain, and the inflammatory response of a technique for single-port laparoscopic ovariectomy in ewes.

MATERIAL AND METHODS

Seven healthy ewes were assessed. The awere fasted for 36 hours prior to surgical procedure and their body weight was measured on a digital scale. The animals were premedicated using diazepam (0.5mg kg^{-1}, IM), and tramadol (2mg kg^{-1}, IM). Following anesthetic induction using a mixture of propofol (6mg kg^{-1}, IV) and lidocaine chloride (1mg kg^{-1}, IV), the ovines were intubated using a cuffed 8-mm tracheal tube, in order to provide humidified oxygen under assisted ventilation. Anesthesia was maintained with propofol (0.5mg kg^{-1} min^{-1}, IV) and lidocaine-chloride (1mg kg^{-1} min^{-1}, IV) in constant rate infusion (CRI). The ewes were positioned in dorsal recumbence, in Trendelenburg position. Local anesthesia with lidocaine chloride (2ml) was performed on the incision site.

A single-port laparoscopic approach was carried out. A 11-mm trocar was inserted through the abdominal wall in the midline, 20cm cranial to the udder. Following establishment of the port, CO_2 pneumoperitoneum was created until intra-abdominal pressure reached 5-8mmHg, using 5L min^{-1} of flow rate. A 10-mm operating laparoscope, with a 6mm working channel, was introduced into the abdominal cavity through the trocar. A 5-mm, 42-cm long Babcock atraumatic forceps was inserted through the working channel of the laparoscope for manipulation of the ovaries (Figure 1A). A 2-0 nylon pre-tied Meltzer's knot was introduced into the abdomen through a 14-gauge needle, using a thin hollow stainless steel stick as a knot pusher (Figure 1B). The Babcock forceps was passed through the loop of the slipknot (Figure 1C). Afterwards, the ovary was grasped and pulled through the loop and the slipknot was tighten around the ovarian pedicle (Figure 1D). Two ligatures were applied on each ovarian pedicle in the same fashion. The pedicle was then raised by the ligature thread, and the atraumatic forceps was replaced by an endoscopic scissors to resect the ovary. After excision, the hemostasis was checked and the ovary was exteriorized through the 11-mm trocar (Figure 1E). Following removal of both ovaries, the CO_2 pneumoperitonium was completely drained. Skin suture was placed, using the interrupted horizontal mattress pattern with 2-0 nylon. The muscular layer was not sutured. During the early post-operative period, all animals received a single dose of oxytetracycline (20mg kg^{-1}, IM).

The total surgical time (from skin incision to suture), time of the approach to the

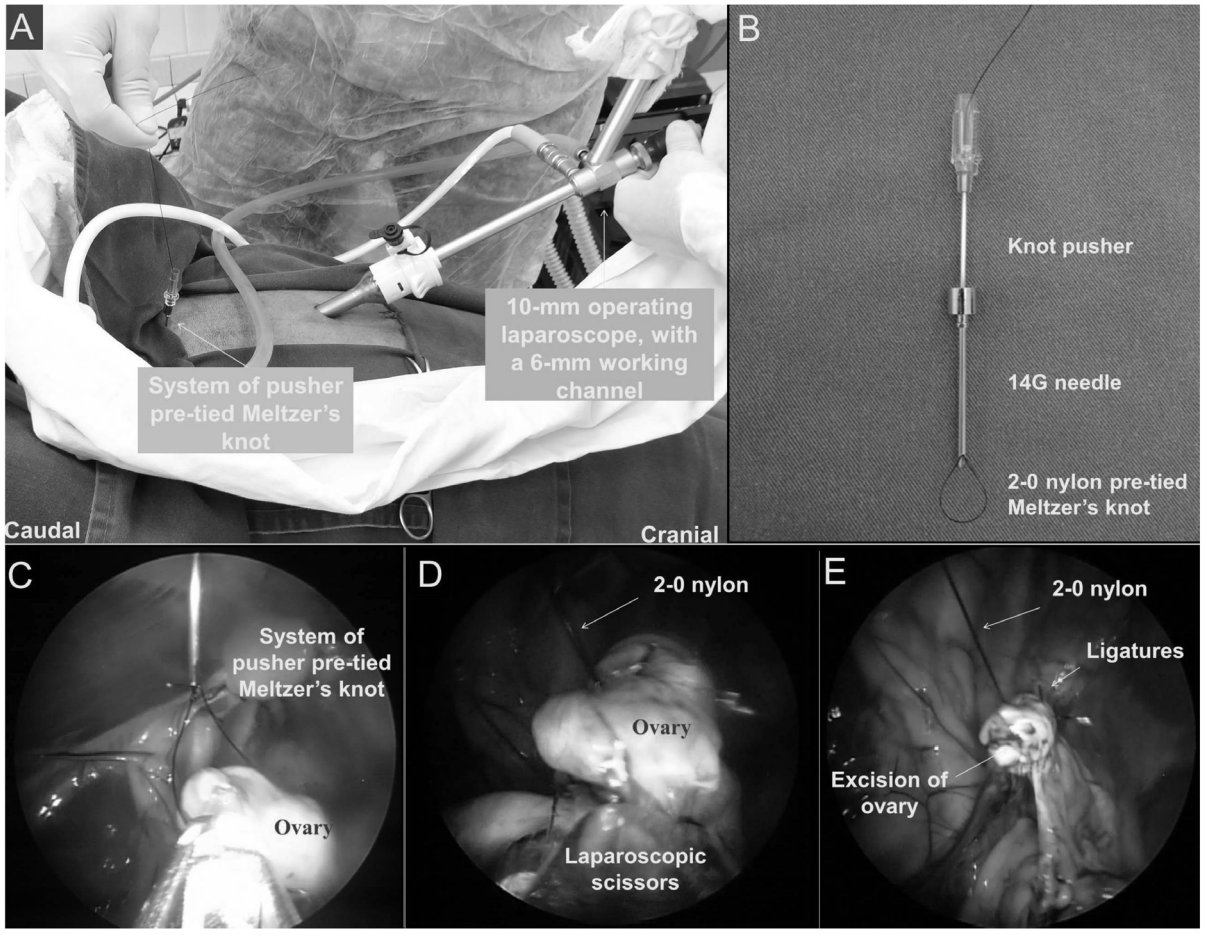

Figure 1 - Position of laparoscope and instrument portals, with a 11-mm trocar inserted through the abdominal wall in the midline, 20cm cranial to the udder, a 10-mm operating laparoscope, with a 6 mm working channel, introduced into the abdominal cavity through the trocar, and a system of pusher pre-tied Meltzer's knot (A), System of pusher 2-0 nylon pre-tied Meltzer's knot which is introduced into the abdomen through a 14-gauge needle, using a 16-gauge thin hollow stainless steel stick as a knot pusher (B). Single-port laparoscopic ovarectomy in Santa Ines ewes using pre-tied loop ligature (inside view). (C) The ovary being grasped and pulled through the loop, (D) ovary resection by endoscopic scissors, and (E) image showing the excision and ligatures.

ovaries (manipulation of each ovary, ligature and resection), anesthesia time (premedication to extubation) and recovery of the animals (from extubation to spontaneous standing position and walking) were measured and expressed as mean ± standard deviation. The postsurgical pain was assessed using a modified visual analogue scale, adapted from other study (MELLOR & STAFFORD, 2004). In such scoring system, three parameters were considered to establish the final score: posture, locomotion and food intake. For each parameter, score ranging from 0 to 2 could be assigned. The final score was given by the sum of scores, which could range from 0 to 6. The postoperative pain assessment was carried out hourly, for the first six hours following the surgical procedure.

Body weight was scaled weekly, during four weeks after the surgical procedure. Control weight was measured one day before the surgery. Postsurgical inflammatory response was estimated by daily measurement of plasmatic fibrinogen, for five days, using a manual refractometer (mg dl^{-1}).

For statistical analysis, data normally distributed were assessed using repeated measures one-way ANOVA and Dunnett's post hoc test were used to assess data regarding weight and fibrinogen. For non parametrical data, the Friedman's test and the Dunn's post hoc test were performed ($P<0.05$).

RESULTS

The surgical procedures were carried out successfully in all animals. There was no bleeding during surgical procedures. The overall surgical time was 63±20 minutes. Time elapsed for manipulation, ligature and resection of each ovary was 20±10 minutes. Minimum and maximum surgical time in the current study was 36 and 99 minutes respectively.

Regarding the anesthesia protocol, there were no complications that impaired the surgical procedure. Mean anesthesia time was 91 (±26) minutes, and 63 (±44) minutes for total anesthesia recovery. Concerning the post-surgical pain, the ewes demonstrated low pain scores at all time-points (0.5±0.5). The plasmatic fibrinogen values were also within normal limits at all time-points (range 100-500mg dl^{-1}). There was no difference among times of assessment. Mean body weight differed significantly among days 7, 14, 21 and 28 in comparison to the control. The ewes had normal body weight gain during the weeks following the trial.

DISCUSSION

Bilateral ovariectomy using single-port laparoscopic approach and the Meltzer's knot for prophylactic hemostasis of the ovarian pedicles was successfully performed in all ewes. Reproductive tract was easily visualized using such technique, due to the pneumoperitoneum, Trendelenburg positioning and amplification of the image using the video system. Single portal techniques for ovariectomy have also been reported as feasible and safe in others domestic species, specially in dogs (DUPRÉ et al., 2009; MANASSERO et al., 2012) and cats (KIM et al., 2011; COISMAN et al., 2014). A 3-port laparoscopic assisted ovariohysterectomy technique using pre-tied loop ligature was assessed in the canine specie, which resulted in bleeding in three dogs (MAYHEW & BROWN, 2007). Nevertheless, no reports of the use of a single-port approach for gonadectomy in domestic animals were found on the literature available.

Intra-operative bleeding was not reported in the current study, contrasting the results of other study on laparoscopic ovariectomy in mares (RODGERSON & HANSON, 2000) and on laparoscopic-assisted ovariohysterectomy in dogs (MAYHEW & BROWN, 2007). Therefore, in order to avoid ligature failure, at least two ligatures should be applied on each pedicle (FREEMAN, 1999).

The affordable, reusable and accessible nature of the instrument used for ligating the pedicles in the current study makes such technique simpler and less expensive than other ovariectomy techniques described in the literature available. In humans, pre-tied ligatures are indicated in some surgical techniques such as salpingectomy (LIM et al., 2007), appendectomy (BELDI et al., 2004; YILDIZ et al, 2009) and other gastrointestinal surgeries (KATSARELIAS, 2007).

The surgical time obtained in the current study was longer than other laparoscopic techniques described in other trial (TEIXEIRA et al., 2011). Approximately 12 minutes were spent for unilateral ovariectomy in donkeys, using a specific laparoscope specially design and manufactured in other study (AZIZ et al., 2008). Longer surgical time (35 minutes) was found in a technique of ovariectomy in llamas using hemostatic clips for pedicular hemostasis (RODGERSON et al., 1998). In other trial, bilateral ovariectomy was performed in standing mares using slipknot ligatures in minimum of 50 and maximum of 120 minutes (BOURÉ et al., 1997). In human patients, obtained shorter surgical time was found using pre-tied ligatures in comparison to the use of monopolar electrocoagulation for salpingectomy (LIM et al., 2007), and to the use of hemostatic clips in gastrotomy (KATSARELIAS, 2007). The high value for surgical time found in our study may have occurred due to the surgical team's short learning curve on such surgical technique. Depending on the technique, a minimum of 20 surgical procedures are required in order to achieve proficiency (SILVA et al., 2011).

Regarding the pain score, results of our study were similar to other laparoscopic techniques, in another trial (TEIXEIRA et al., 2011). In dogs, laparoscopic ovariectomy was compared with conventional open ovariectomy (CULP et al., 2009). It was observed that bitches undergoing open technique had significant decreases in activity postoperatively than those undergoing laparoscopy. Furthermore, the use of pre-tied ligatures resulted in lower post-surgical pain score in women submitted to salpingectomy compared to electrocoagulation (LIM et al., 2007). In contrast, other studies regarding the feline specie revealed that pain score was significantly higher in those submitted to extracorporeal ligature in comparison to bipolar-sealing device for hemostasis of the pedicles (COISMAN et al., 2014). The plasmatic fibrinogen values were within normal limits established for sheep (JAIN, 1993) at all time-points. The pattern of raise in post-surgical plasmatic fibrinogen among the moments of evaluation was similar to those found

in other studies involving ruminants orchiectomy (EARLEY & CROWE, 2002; PANG et al., 2006).

The ewes gained body weight satisfactorily following the surgical procedures and during the weeks following the trial, demonstrating no negative influence of the surgical technique on the body condition. Other study also revealed no negative influence of laparoscopic ovariectomies on the physical condition of the ewes (TEIXEIRA et al., 2011). The castration of young females is indicated for a faster weight gain in cattle (GARBER et al., 1990). However, other studies found that flank laparotomy (CARVALHO et al., 2010) and transvaginal approach using latex ring for pedicle ligation in cows submitted to ovariectomy (MEIRELLES et al., 2007) caused negative influence concerning post-surgical weight gain. In another trial, no benefits were found regarding the influence of flank ovariectomy on the weight gain in heifers (SILVA et al., 2006). But, the authors obtained better carcass quality. We highlight that none of those articles that reported negative or no benefits of ovariectomy employed minimally invasive laparoscopic or video-assisted techniques, which could have dramatically influenced the results. Thus, further studies are required in order to support such hypothesis.

CONCLUSION

The proposed technique for single-port laparoscopic ovariectomy was feasible in ewes and caused no bleeding, surgical stress, postoperative pain or weight loss.

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BIOETHICS AND BIOSSECURITY COMMITTEE APPROVAL

This study was conducted following approval by the Animal Ethics and Welfare Committee of the School of Agrarian and Veterinary Sciences of São Paulo State University (protocol N. 025988-08).

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