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Assessment of Laparoscopic Adhesiolysis in the Genitourinary Tract of Ewes

Avaliação da Adesiólise Laparoscópica no Trato Geniturinário de Ovelhas

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Abstract

Peritoneal adhesions are bridges of fibrous tissue that connect two or more structures, and can cause anatomical and functional changes in organs. Adhesions result from the imbalance between fibrinolysis inhibitors and activators, which are mediated by cytokines. After inflammation, there is an increase in vascular permeability and local fibrin exudation. The aim of this study was to assess adhesiolysis in ewes using laparoscopy after adhesion induction in the uterus, ovary, and adjacent organs using monopolar diathermy. Five ewes were used. For adhesion induction, the ewes underwent laparotomy. A skin incision was performed in the mid-inguinal line, exposing the uterus, ovaries and uterine tubes. The adhesion induction was performed at three points on the right side of the uterus and at three points on the right ovary. Laparoscopic adhesiolysis was performed 15 days after the first surgery. After 30 days, a third procedure was made to evaluate resolution after adhesiolysis. One animal died after the surgery, the necropsy revealed a fistula due to adhesions that resulted in acute peritonitis. Concerning classification, adhesiolysis was impossible in one ewe (25%), partially possible in the reproductive tract, adjacent organs, omentum, and abdominal wall in two ewes (50%), partially possible in reproductive tract in one ewe (25%), and totally possible in none of the ewes. This study shows that monopolar diathermy can induce adhesions. The endo-surgery was only partially effective regarding morbidity, it produced good results as it reduces the occurrence of injuries and promotes clinical improvement by allowing abdominal adhesiolysis.

Keywords: Adhesions Treatment. Fibrous Tissue. Laparoscopy. Monopolar Diathermy. Ovary.

Resumo

As aderências peritoneais são pontes de tecido fibroso que conectam duas ou mais estruturas, podendo causar alterações anatômicas e funcionais em órgãos. As aderências resultam do desequilíbrio entre os inibidores e ativadores da fibrinólise, que são mediados por citocinas. Após a inflamação, ocorre aumento da permeabilidade vascular e exsudação local de fibrina. O objetivo deste estudo foi avaliar a adesiólise em ovelhas por meio de laparoscopia após a indução de aderências no útero, ovário e órgãos adjacentes por meio de diatermia monopolar. Foram utilizadas cinco ovelhas. Para indução de aderências, as ovelhas foram submetidas a laparotomia. Uma incisão na pele foi realizada na linha inguinal média, expondo o útero, ovários e tubas uterinas. A indução da adesão foi realizada em três pontos do lado direito do útero e em três pontos do ovário direito. A adesiólise videolaparoscópica foi realizada 15 dias após a primeira cirurgia. Após 30 dias, um terceiro procedimento foi realizado para avaliar a resolução após adesiólise. Um animal morreu após a cirurgia, a necropsia revelou uma fístula devido a aderências que resultaram em peritonite aguda. Com relação à classificação, adesiólise foi impossível em uma ovelha (25%), parcialmente possível no trato reprodutivo, órgãos adjacentes, omento e parede abdominal em duas ovelhas (50%), parcialmente possível no trato reprodutivo em uma ovelha (25%), e totalmente possível em nenhuma das ovelhas. Nosso estudo mostra que a diatermia monopolar pode induzir aderências. A endocirurgia foi apenas parcialmente eficaz quanto à morbidade, apresentou bons resultados, pois reduz a ocorrência de lesões e promove melhora clínica ao permitir adesiólise abdominal.

Palavras-chave: *Tratamento de Aderências. Tecido Fibroso. Laparoscopia. Diatermia Monopolar. Ovário.*

1 Introduction

Peritoneal adhesions are fibrous tissue bridges that connect two or more anatomically separate structures (HASSANABAD *et al*., 2021; SOLTANY, 2020). Although they are usually asymptomatic, they can cause anatomical and functional changes in organs (PENZIAS *et al*., 2019). Abdominal adhesions are the most common post-surgical complications, even in minimally invasive surgeries (HERRMANN *et al*., 2020). Further conditions, such inflammatory diseases, can induce adhesion formation when fibrinolytic activity is reduced (SOLTANY, 2020).

The use of preventive methods as separation of fibrin-covered peritoneal surfaces, use of barrier agents, use of pharmacological intraperitoneal agents and minimally invasive surgical techniques constitute necessary practices to prevent this complication (PARK *et al*., 2020; HASSANABAD *et al*., 2021). Endo-surgery is a method of postsurgical adhesion prevention because involves smaller incisions and introduction of fewer foreign bodies in the cavity, thereby resulting in less traumatic injury, less cavity exposure and less manipulation of organs (PULLIAM; GRISOTTI; TIAO, 2021; TIAN-SHAN; FEI, 2017).

The cost and clinical impact of endo-surgery should be considered when it is chosen for adhesion prevention, prevention, mainly with recent advancements in laparoscopic instrumentation and good practices in gynecology and obstetrics (SIEDHOFF, 2018). The surgeons should evaluate the necessity for each patient, the resources, and the limitations to themselves and to the hospital, and with good surgical techniques and incorporation of methods of adhesion prevention can benefit gynecological surgical patients (MORIS *et al*., 2017).

The aim of this study was to assess adhesiolysis in ewes using laparoscopy after adhesion induction in the uterus, ovary, and adjacent organs using monopolar diathermy.

2 Material and Methods

2.1 Ethical Approval

The study was approved by the ethics committee of Pará Federal University (Protocols CEUA/UFPA nº 7816250216).

2.2 Animals and establishment

Five ewes of Santa Ines breed were used in this study. They were adult pluriparous aged 2–5 years with body weight of 30–50 kg and a medium score of 3 (scale of 1–5). Ultrasonography of the reproductive organs was performed, and only healthy animals were selected.

The animals were kept and maintained in collective stalls with an area of 16 square meters at the veterinary hospital of the Veterinary Medicine Institute of Para Federal University (IMEV/UFPA). They were fed with Tifton hay and commercial food for the species (Presence® - line sheep maintenance, Presence Nutrição Animal, Brazil). They also received mineral supplements and drank water ad libitum. They had an adaptation period of 10 days.

2.3 Anesthesia

The ewes did not ingest solids or liquids in the 36 hours prior to surgery. Prophylactic antimicrobial therapy with 20 mg/kg of oxytetracycline (Terramicina LA®, Zoetis Indústria de Produtos Veterinários LTDA, Brazil) and anti-inflammatory therapy with 50 mg/mL of Flunixin Meglumine (Flunixamine®, Zoetis Indústria de Produtos Veterinários LTDA, Brazil)[2] were administered. A dose of 0.05 mg/kg of 1% Acepromazine (Acepromazin 1%®, Sintec do Brasil, Brazil) was also administered intramuscularly as a pre-anesthetic. After 15 minutes, anesthesia was induced with 6 mg/kg of 1% propofol (Propovan®, Cristalia Produtos Químicos Farmacêuticos LTDA, Brazil) administered intravenously. The animals were intubated using an endotracheal tube adapted for the species, and anesthesia was maintained with isoflurane (Isofluorano®, Cristalia Produtos Químicos Farmacéuticos LTDA, Brazil) at a 2 minimum alveolar concentration vaporized in 100% oxygen in closed circuit.

2.4 Adhesion induction

For adhesion induction, the ewes underwent ventral laparotomy. The animals were then positioned in dorsal recumbency and abdomen aseptic preparation was performed. A 10-cm skin incision was made in the mid-inguinal line and the uterus was carefully exposed from the abdominal cavity with the ovaries and uterine horns. Adhesions were induced using monopolar diathermy on coagulation mode and blend 2 at a power setting of 40 W. Adhesion induction was performed at three points on the right side of the uterus and at three points on the right ovary.

2.5 Adhesion assessment

Fifteen days after the first surgery, the ewes underwent a video laparoscopic procedure for adhesiolysis. The same anesthesia protocol as that used in the first surgery was used. The 3-port laparoscopic approach was used, and the first port was inserted using the open technique. The abdominal cavity was then inspected and pneumoperitoneum was created using an automatic CO_2 insufflator at a rate of 5 L/minute. Intra-abdominal pressure was maintained at 5 mmHg.

Babcock atraumatic forceps and Maryland forceps were used to promote adhesiolysis. Macroscopic injuries and adhesions in the reproductive tract were assessed by exploratory laparoscopy with the possibility to create adhesiolysis.

The adhesions were assigned scores ranging from 0 to 5 according to the number of adhesions found. A score of 0 was assigned when there were no adhesions, a score of 1 was assigned for a single adhesion, a score of 2 for 2 adhesions, a score of 3 for 3 adhesions, a score of 4 for 4 adhesions, and a score of 5 for more than 4 adhesions. A scale adapted which assigns a score of 0–4 was used according to the site of adhesions, type of adhesion, and organs involved (Table 1) (PACHECO *et al*., 2003).

Table 1 – Adhesion classification according to site of adhesions, type of adhesion, and organs involved

Score	Characteristics
0	No adhesion
1	Presence of a single thin adhesion at or near the site of injury
2	Presence of thin adhesions at the site of injury and involving only uterine segments or ovaries in the ovarian bursa
3	Presence of thin adhesions between the site of injury and the abdominal wall and/or involving the uterus, ovaries, and uterine horns
4	Presence of dense adhesions between the site of injury and the abdominal wall and/or adhesions involving the uterus, ovaries, and adjacent organs or tissues (for example, intestine, bladder, and peritoneum)

Source: Adapted from Pacheco *et al.* (2003)

After classifying the adhesions, the surgeon tried to perform adhesiolysis. Adhesiolysis was classified as

impossible; partially possible in the reproductive tract, adjacent organs, omentum, and abdominal wall; partially possible in the reproductive tract; and totally possible (complete adhesiolysis).

After 30 days, a third surgery was performed to evaluate resolution after adhesiolysis. All the findings from the three surgical procedures were recorded and assessed.

The data were assessed by descriptive statistics. The number and type of adhesions were reflected in the scores, which were expressed as mean and standard deviation. Regarding the adhesiolysis, the adhesions were assessed in terms of their frequency of occurrence. All statistical analysis was performed using the software BioEstat 5.0 (AnalistSoft Analysis Made Easy, EUA).

3 Results and Discussion

One animal died after the surgery, and necropsy revealed a fistula between the uterus and bowel due to adhesions that resulted in acute peritonitis, which may have been the cause of death. The other four ewes developed adhesions because of the monopolar diathermy. The numbers and types of adhesions are presented in Table 2.

Table 2 - Number and scores of adhesions

Animals	Adhesions (n)	Scores
Ewe 1	5	4
Ewe 2	2	1
Ewe 3	4	4
Ewe 4	4	3
Mean ± SD	3.7 ± 1.2	3.0 ± 1.4

SD, standard deviation.
Source: Resource data.

The degree of adhesion in these animals was high. The animals had adhesions between the omentum and the abdominal wall (at the site of incision) and adhesions connecting the ovaries and uterus to the bowel and bladder (Table 2).

Regarding classification, adhesiolysis was impossible in one ewe (25%), partially possible in the reproductive tract, adjacent organs, omentum, and abdominal wall in two ewes (50%), partially possible in the reproductive tract in one ewe (25%), and totally possible in none of the ewes. In the second laparoscopic evaluation, no more adhesions were seen in the organs.

The model for adhesion formation worked considerably well as the use of monopolar diathermy, which induces high-degree adhesions, resulted in adhesions with a mean adhesion score of 3.7 on a scale of 1–5. The adhesions were not diffuse but can be said to be controlled ones, which are defined as adhesions with a mean score of 3. This is consistent with findings of earlier studies, which reported that genitourinary procedures performed using the surgical approaches of laparotomy and laparoscopy caused high-degree adhesions (EWOLDT *et al*., 2004; HERMANN; WILDE, 2016).

Ovary is prone to adhesions with the abdominal wall, omentum, and adjacent organs because of its close proximity to the abdominal cavity (MARIANO et al., 2015), and this was in the study herein. Although, these authors reported no difficulty with adhesiolysis of the ovary, they reported greater ease of adhesiolysis and possible new oocyte collection after using solutions of NaCl and 1% lidocaine, which are known to reduce adhesion formation. In contrast, adhesiolysis was impossible in one ewe (25%) and totally possible in none of the animals in this study.

Adhesions have been found in animals where the abdominal cavity was irrigated with NaCl solution after uterine wall trauma with forceps, and one of the animals died due to peritonitis and other complications of adhesion, like in this study (EWOLDT *et al*., 2004).

In this study, it was found that monopolar diathermy promotes tissue injury at specific points and causes controlled high-degree adhesions, as reported by other authors (BORGES *et al*., 2018). Some other authors described some methods that induce adhesion, such as uterine and ovarian laparoscopic puncture and serosal friction with traumatic forceps (EWOLDT *et al*., 2004); however, these methods did not induce high-degree adhesions and the adhesions were not controlled. In contrast, ischemic incision of the abdominal wall and ileal friction with gauze pad in rats induced uncontrolled high-degree adhesions (AYSAN *et al*., 2007).

Adhesiolysis can cause complications such as ureteral and bladder injury, vascular trauma and perforation, and bowel fistula (HERMANN; WILDE, 2016). In the present study, abdominal wall injury resulted in acute peritonitis and death of one of the animals. Also, there were no chronic complications, such as intestinal obstruction (ABDUSALOMOVICH et al. 2021; MAZZETTI *et al*., 2018).

Infertility is the most reported complication of female reproductive tract adhesions (MORIS *et al*., 2017). The adhesions observed in this study (ovarian and uterine tube adhesions) could cause fertility problems. Some authors reported that surgical procedures on uterine tubes, ovaries, and bowels carry a relatively higher risk of adhesions, and this was stated in this study (DE WILDE *et al*., 2017).

Adhesiolysis is the most commonly used method for removal of adhesions between abdominal organs, although adhesions can reoccur (MORIS et al., 2017). In this study, there was no recurrence of adhesions in any of the ewes after adhesiolysis even though it was not easy to perform adhesiolysis in any of the ewes.

It was possible to perform adhesiolysis on the omentum, abdominal wall, and uterine horn. However, adhesiolysis is more difficult to perform in the immediate vicinity of the ovaries; therefore, it was not possible to completely remove all the adhesions in this area and this increases the need to use measures that prevent adhesion formation in abdominal and reproductive surgeries (BORGES *et al*., 2018). The results of studies reported by some authors support the stance of

this study on the importance of these preventive measures (HASSANABAD *et al*., 2021; MORIS *et al*., 2017).

Endo-surgery is known to be a method of adhesion prevention when used in the first surgical procedure. It is used because it involves smaller incisions, fewer foreign bodies inside the abdominal cavity, less trauma from the use of retractors, and less manipulation away from the original site of incision (PULLIAM; GRISOTTI; TIAO, 2021; TIAN-SHAN; FEI, 2017). In this study, endo-surgery was not used in the first surgery, but it is possible to state that considerable organ manipulation and long incisions are important factors that promote fibrin formation and consequently adhesion, which sometimes occurs in the abdominal wall at the site of incision.

4 Conclusion

This study shows that monopolar diathermy can induce controlled high-degree adhesions. Furthermore, endo-surgery is better used in the second surgical procedure following complications of adhesions as it yields positive results when adhesiolysis has to be performed. Although this technique was only partially effective regarding morbidity, it produced good results as it reduces the occurrence of injuries and promotes clinical improvement by allowing abdominal adhesiolysis.

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