LAPAROSCOPIC APPROACHES IN BOVINE FETUSES UMBILICAL STRUCTURES: LATERAL OR VENTRAL APPROACH?

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ABORDAGENS LAPAROSCÓPICAS EM ESTRUTURAS UMBILICAIS DE FETOS BOVINOS: ABORDAGEM LATERAL OU VENTRAL?

RESUMO: O objetivo deste estudo foi identificar o melhor acesso laparoscópico para visualização e manipulação das estruturas umbilicais no interior da cavidade abdominal de fetos bovinos. Foram utilizados nove fetos de bezerros de vacas no terço final da gestação, todos submetidos a laparoscopia com dois portais de acesso, primeiro no flanco direito e depois na região ventral do abdomen, onde foram verificadas as possibilidades de acesso às estruturas umbilicais. Em ambas as abordagens, os portais de acesso permitiram visualizar e manipular as estruturas de interesse, mas a abordagem lateral foi mais eficaz com melhor visualização e manipulação. Os acessos ventrais não proporcionavam a mesma facilidade de visualização e manipulação, pois as estruturas umbilicais fixadas na parede abdominal ficavam muito próximas aos portais. Esses resultados demonstram que a laparoscopia pode ser utilizada para manipulação e visualização das estruturas umbilicais, sendo a abordagem lateral mais eficaz.

PALAVRAS-CHAVE: Cirurgia videoassitida; laparoscopia, estrutura umbilical de bezerros, acesso laparoscópico

Conditions affecting umbilical structures in newborn calves require special attention, as they occur with a high incidence in dairy and beef herds (Steerforth and Winden, 2018). The umbilical cord is an entry point for microorganisms that cause infection of umbilical structures and sepsis in young calves, therefore generating considerable economic losses due to calf mortality and veterinary care expenses (Silva et al., 2021).

Physical examination, mainly palpation is routinely used for diagnosis of umbilical disorders; however, these resources have limitations in identifying intra-abdominal changes, both in umbilical structures and in the liver and bladder, which are possibly affected by ascending umbilical infection (Constant et al., 2018). In these circumstancest require other diagnostic methods, being the ultrasonography is an excellent complementary examination, as it allows complete inspection of umbilical components (Guerri et al., 2019). Laparoscopy can complement ultrasonography with the advantage of diagnosing adhesions and offering a wide view of the cavity, capable of allowing the diagnosis of other alterations not identified by ultrasonography (Robert et al., 2016).

Laparoscopy is a minimally invasive technique that allows a complete inspection and a magnified view of the abdominal cavity, thereby ensuring better morphological and situational evaluation of intracavitary organs in cattle. It allows for procedures such evaluation of umbilical disorders in calves and resection of the umbilical veins/urachus of bovine fetuses, among other complementary diagnostic procedures, with minimal morbidity related to the procedure (Robert et al., 2016; Monteiro et al., 2021).

The present work initially proposes to perform laparoscopy in bovine fetuses, constituting a necessary step for subsequent application in live calves. The objective of the study was to identify the best laparoscopic access for visualization and manipulation of umbilical structures inside the abdominal cavity of bovine fetuses, comparing two approaches for establishing the access ports – the lateral and the ventral approaches.

This study was carried out in accordance with the recommendations of the National Council for Experimentation Control in Brazil (CONCEA). The Animal Ethics and Welfare Committee of the Federal University of Pará (protocol N ° 4848261017) approved this research. The experiment was conducted at the Institute of Veterinary Medicine (IMV), in Animal Anatomy Laboratory. Nine bovine fetuses with an approximate gestational age of 230 days weighing between 30 and 40 kg from cows slaughtered in a legal slaughterhouse were used, which were submitted to laparoscopy via two ports for access to umbilical structures. The access ports were created in the lateral and ventral regions of the abdomen, i.e., a lateral approach (LA) and a ventral approach (VA), respectively. Both approaches, with 1 laparoscopic portal and 1 instrument portal, were performed in all bovine fetuses in a sequential and standardized manner by the same surgeon and assistant.

Te experimental simulation took into consideration all the surgical principles applicable to laparoscopy and necessary equipment and instruments to perform the technique. We used a 10-mm laparoscope, 10-mm or 5-mm Babcock forceps, 5-mm laparoscopic scissors,

a set of gas insufator/light source/monitor, and basic surgical instruments for conventional surgery.

The LA was performed on the nine bovine fetuses by establishing two access ports in the right flank, with the bovine fetuses placed in left lateral recumbency (Fig. 1A). The VA was subsequently performed on the nine bovine fetuses, where two access ports were established in the ventral region of the abdomen, proximity to the umbilical region, with the bovine fetuses positioned in dorsal recumbency (T = 2, *n* = 9) (Fig. 1B). To establish the access portals, two 5 mm trocar cannula units were placed in the working field, inserted transmurally through their respective trocars into the abdominal cavity, forming the two access ports in the abdominal wall.

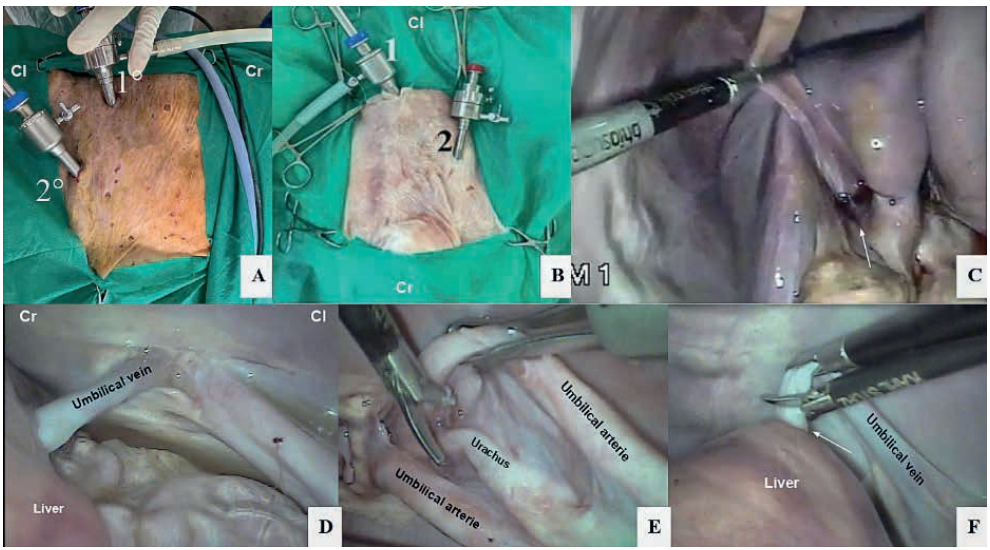

Figure 1. Working field with a view of the layout of the laparoscopic access ports and visualization of the bovine fetuses umbilical structures (Cr-Cranial, Cl-Caudal). A - Lateral laparoscopic approach. B - Ventral laparoscopic approach. C – Umbilical artery and its insertion into the internal iliac artery. D – Visual field of the umbilical estructures (umbilical vein) through the lateral laparoscopy approach. E - Visual field of the umbilical estructures (umbilical arteries and urachus) through the lateral laparoscopy approach. F – Manipulation and insertion of the umbilical vein in liver.

An 8 mmHg carbon dioxide (CO_2) pneumoperitoneum was established through the first access port, laparoscopic portal, and a 5 mm 0˚ laparoscope were inserted for inspection of the abdominal cavity; the image was displayed on the monitor. Through the second port, 5 mm laparoscopic Babcock forceps were inserted for handling the umbilical structures.

Then, the possibilities of intra-abdominal access, visualization and manipulation, to the three umbilical structures of interest were determined: umbilical vein, urachus, and umbilical arteries, from the umbilical ring to their insertions in the liver, bladder, and internal iliac artery, respectively. The possibilities of visualization and manipulation of the liver and

bladder were also tested. The comparison was made in a descriptive manner investigated to identify the best approach to establish the laparoscopic access ports.

LA allowed intra-abdominal visualization and manipulation of all umbilical structures (Fig. 1D and Fig. 1E), especially the umbilical vein (Fig. 1F), which was the first identified structure and was inspected from the region of the umbilical ring to its insertion in the liver (Fig. 1F). Other structures, such as the umbilical arteries and the urachus (Fig. 1E), were also inspected and manipulated from the umbilical ring to their insertions in the internal iliac artery (Fig. 1C) and bladder (Fig. 1E) respectively. Liver and bladder were explored using this approach, only visceral surface.

Visualization and manipulation of the umbilical structures fixed to the abdominal wall, in the region of the umbilical ring and surrounding areas were subjectively more difficult with VA because the access ports were located near these structures. The umbilical vein was visualized and manipulated in its proximal portion, until its hepatic insertion. The urachus was visualized and manipulated, with great difficulty, near its insertion in the bladder. The umbilical arteries were also visualized and manipulated; this required altering the conventional triangulation with displacement of the laparoscope and forceps in the caudal direction. Although the liver and bladder can be explored with this approach, exploration of structures near the umbilical ring was compromised.

The use of laparoscopy in the diagnosis of umbilical disorders and their complications in newborn calves allows for great advances in the treatment of these disorders, given its potential application in the surgical treatment of both umbilical components and adjacent and associated organs, such as the liver and bladder, which are usually affected by ascending infections of the umbilical cord (Hopker, 2014; Robert et al., 2016).

Surgical treatment associated with antibiotic therapy is still the most widely used therapeutic method for treating umbilical diseases (Baird, 2016). In this context, intervention with laparoscopy gains importance when applied to production animals, both to diagnose and treat umbilical diseases and their complications. (Borges et al., 2017).

Thus, minimally invasive alternatives for surgical interventions in calf umbilical disorders are necessary to reduce tissue trauma and minimize bleeding because celiotomy is conventionally performed in umbilical repair surgery, with the abdominal wall incision made in the midline or in a paramedian direction (Baird et al., 2016; Borges et al., 2017). The use of laparoscopy with two portals can cause less surgical trauma to patients *in vivo*, with precise and objective visceral manipulation; this can also reduce postoperative discomfort compared to conventional surgical procedures; however, *in vivo* studies are needed to prove this assumption.

The accesses portals in this study were performed for use in the treatment and complementary diagnosis of intra-abdominal calf umbilical disorders; however, their application may be extended to other species of production animals such as sheep and goats, or even other wild ruminants, taking into consideration their specific characteristics

(Robert et al., 2016; Monteiro et al., 2021).

Traditionally, the method of choice for diagnosing urachal diverticulum in cattle is exploratory laparotomy, and it is not always possible to identify the point of perforation or rupture (Marques et al., 2010). The cystoscopy is a useful technique for urethral exploration but also that it is not a good method for assessing the cranial portion of the bladder in heifer (Borges et al., 2017). It was possible to inspect the urachus and obtain an excellent bladder access using both studied laparoscopic approaches.

The laparoscopy can be another diagnostic alternative, especially in cases requiring exploratory laparotomy, that can overcome many limitations of known semiological methods such as identification of adhesions and inspection of the insertion sites of the umbilical vein and arteries into the liver and internal iliac artery, respectively, with the potential of being established as an excellent diagnostic and therapeutic alternative in many cases (Robert et al., 2016). Video-assisted surgical accesses are planned according to the procedure; however, they can be adapted or changed in specific cases to obtain a better visual field (Milovancev et al., 2015). Although LA has allowed better visualization and manipulation, VA is a viable alternative in cases where satisfactory manipulation of both sides of the abdomen is required.

In both approaches, the laparoscopic access ports were shown to be efficient and satisfactory for the visualization and manipulation of the umbilical structures of bovine fetuses, with the lateral approach via the right flank being the most appropriate because it ensured complete exploration of the umbilical structures without difficulties. This demonstrates that the laparoscopic technique can be used to exploracion of the umbilical structures of the bovine fetuses, being the most effective LA for this exploration.

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