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Stapled side-to-side jejunocecostomy as surgical treatment for ileocecal intussusception in a 6 years old criollo mare

Jejunocecostomia latero-lateral com grampeadores como tratamento cirúrgico de intussuscepção ileocecal em égua crioula de 6 anos de idade

Yeyunocostomía laterolateral con grapadoras como tratamiento quirúrgico de la intususcepción ileocecal en una yegua criolla de seis años de edad

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Abstract
Colic is a common and dangerous condition that causes abdominal discomfort in horses. Its resolution can be clinical or surgical, caused by a range of possible abnormalities. One such alteration is intussusception, where one segment of the intestine (the intussusceptum) is enveloped by an adjacent aboral segment (the intussuscipiens). The progression of this condition leads to ischemia and necrosis of the involved intestinal loops, underscoring the importance of early diagnosis and intervention. When the ileum is involved and complete resection is necessary, jejunocecostomy is the recommended surgical technique, leaving a remnant ileal stump and creating a new ileocecal valve. This work aims to report the case of a 6-year-old Crioulo mare, which was presumptively diagnosed with acute intussusception through clinical and ultrasonographic findings (bull's eye formation), confirming the suspicion during exploratory celiotomy that was promptly performed. The anastomosis of the cecum to the resected end of the jejunum was accomplished using gastrointestinal staplers. The surgery was successful and the patient was discharged from the hospital without complications 7 days post-procedure, subsequently returning to its activities satisfactorily. This report emphasizes the impact of the time between presentation and resolution on the prognosis of patients with colic, due to the progressive local and systemic damages caused by this syndrome.
Keywords: Colic; Intussusception; Jejunocecostomy; Gastrointestinal Staplers.

Resumo
A síndrome cólica é uma comum e perigosa afecção que provoca desconforto abdominal nos equinos, cuja resolução pode ser clínica ou cirúrgica, decorrente de um conjunto de possíveis alterações. Entre elas está a intussuscepção, em que um segmento intestinal - o intussuscepto - é envolvido por um segmento aboral adjacente - o intussuscipiente. A evolução do quadro provoca isquemia e necrose das alças intestinais envolvidas, justificando a importância do diagnóstico e da resolução precoces. Quando envolve o íleo e faz-se necessária sua completa ressecção, a jejunocecostomia é a técnica cirúrgica recomendada para resolução, deixando um coto ileal remanescente e criando um novo orifício ileocecal. Este trabalho tem o objetivo de relatar o caso de uma égua, Crioula, 6 anos de idade que foi diagnosticada presuntivamente através dos achados clínicos e ultrassonográficos (formação do "olho de touro"), com uma intussuscepção aguda, confirmando-se a suspeita durante a celiotomia exploratória à qual foi encaminhada precocemente. A anastomose do ceco à extremidade resseccionada do jejuno, deu-se por meio de grampeadores gastrointestinais. A cirurgia foi bem sucedida e a paciente recebeu alta hospitalar, sem complicações, 7 dias após o procedimento, retornando posteriormente às suas atividades de forma satisfatória. O presente trabalho reforça o impacto

do tempo entre atendimento e resolução no prognóstico dos pacientes com cólica, graças aos prejuízos progressivos, tanto locais como sistêmicos, provocados por essa síndrome.
Palavras-chave: Cólica; Intussuscepção; Jejunocecostomia; Grampeadores Gastrointestinais.

Resumen
El síndrome cólico es una condición común y peligrosa que ocasiona malestar abdominal en los caballos, cuya resolución puede ser clínica o quirúrgica, resultado de un conjunto de posibles alteraciones. Entre ellas se encuentra la intususcepción, en la que un segmento intestinal (el intususcepto) es afectado por un segmento aboral adyacente (el intususcipiente). La progresión de la enfermedad provoca isquemia y necrosis de las asas intestinales implicadas, lo que justifica la importancia del diagnóstico y resolución precoz. Cuando afecta al íleon y es necesaria su resección completa, la yeyunocecostomía es la técnica quirúrgica recomendada para su resolución, dejando un muñón ileal remanente y creando un nuevo orificio ileocecal. Este estudio tiene como objetivo reportar el caso de una yegua Criolla de 6 años de edad, que fue diagnosticada presuntivamente mediante hallazgos clínicos y ecográficos (formación del "ojo de toro"), con invaginación aguda, confirmándose la sospecha durante la celiotomía exploradora a la que fue derivada precozmente. La anastomosis del ciego al extremo resecado del yeyuno se realizó utilizando grapadoras gastrointestinales. La cirugía fue exitosa y la paciente fue dada de alta hospitalaria, sin complicaciones, 7 días después del procedimiento, reincorporándose posteriormente a sus actividades de manera satisfactoria. Este estudio refuerza el impacto del tiempo entre la atención y la resolución en el pronóstico de los pacientes con cólico, debido al daño progresivo, tanto local como sistémico, que ocasiona este síndrome.
Palabras clave: Cólico; Intususcepción; Yeyunocecostomía; Grapadoras Gastrointestinales.

1. Introduction

Intussusceptions are defined by the invagination of an intestinal segment (intussusceptum) into the interior of an aboral segment (intussuscipiens) that could cause stenosis, venous infarct and necrosis of the segment (Sanchez, 2018) because of progressive congestion, edema and hemorrhage (Nelson & Brounts, 2012). Damage caused to the mucosa increases endotoxins and bacteria translocation, leading to endotoxemia and bad prognosis (Gandini & Giusto, 2024; Barton & Peroni, 2019).

Causes of intussusception are not clear yet, although excessive peristaltism conditions are considered important factors (Haddad et al., 2022). When a portion of the ileum is intussuscepted by the cecum through the ileocecal orifice, it's called ileocecal intussusception (Hackett, 2013) and it's the most common type of intussusception of the small intestine (Ford et al., 1990). They can be acute or chronic and usually affect horses at 3 years old or younger, causing mild recurrent abdominal pain (Freeman, 2019). The length of the intussusceptum is usually longer when it's acute and the blood flow is occluded, while chronic intussusceptions include short segments and no damage to the blood flow (Ford et al., 1990; Freeman, 2019). Its diagnosis is made through history, degree of pain and other clinical parameters such as motility, ultrasonography findings ("bull's eye") and transrectal palpation (Edwards, 1986b; Freeman, 2019; Nelson & Brounts, 2012).

Treatment is surgical and may require resection depending on the viability of the segment. Jejunocecostomy can be done using side-to-side or end-to-side techniques and sutured with staples or manual sutures. Prognosis is reserved due to progressive damage to the intestine (Rudnick et al., 2022; Proudman, 1992). This article aims to describe a stapled jejunocecostomy performed as treatment of an ileocecal intussusception with a great prognosis in a Criolo mare.

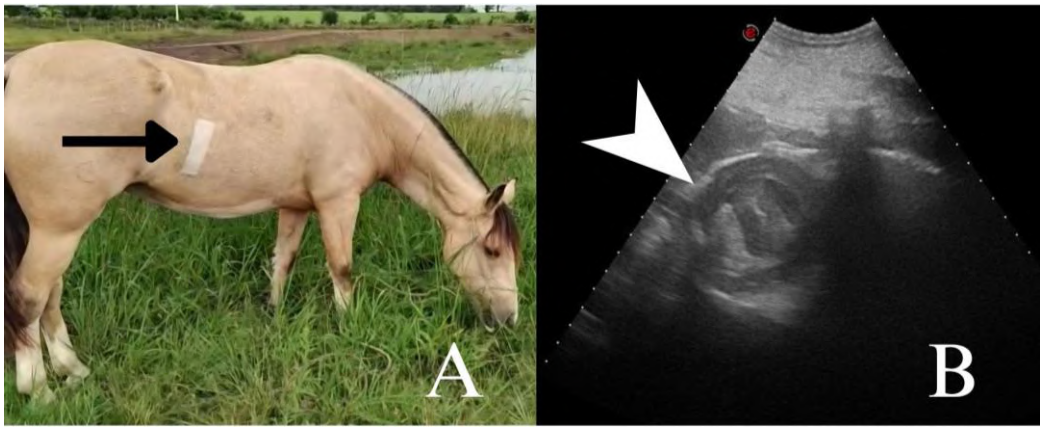
2. Methodology

The present study is an observational and descriptive case report of qualitative nature (Pereira et al., 2018; Toassi & Petry, 2021) and direct source of documentation (medical and surgical records). It's supported by a secondary literature review with relevant data regarding intussusception's etiology, consequences and possible treatments. The patient was presented at Monte Real Equine Clinic and underwent celiotomy for jejunocecal anastomosis as ileocecal intussusception treatment with the use of staples. Ethical aspects were respected. Data began being collected since the arrival of the horse at the clinic to 8 months post procedure.

3. Case Report

A 6-year-old Criollo mare weighing 440kg was referred to an equine hospital (Monte Real Equine Clinic) in Santa Maria, Brazil, with a history of intense intermittent pain, not responsive to analgesia, with a 4-hour evolution from the first care, prior to leaving the property. At the arrival, the patient was presented with a heart rate of 44 beats per minute, hematocrit of 36% and unaltered temperature. Mucous membranes were pinkish and moist, and nasogastric tubing was not productive for enterogastric reflux. Intestinal auscultation revealed hypomotility in the lower quadrants, absence of ileocecal discharge, and ammolytility in the small intestine. During abdominal ultrasonography on the right flank (Figure 1), using a convex probe, thickened sections of the small intestine could be observed, forming a structure composed of two rings around a hypoechoic structure, similar to a target or "bull's eye" (Figure 2). This kind of image is strongly suggestive of intussusception (Nelson & Brounts, 2012). Taking into account the clinical parameters and ultrasonographic findings, the patient was referred to exploratory celiotomy with suspicion of intussusception.

Figure 1 - Abdominal ultrasonographic study through the right flank.Arrowhead indicates the "bull's eye".



Criollo mare diagnosed with ileocecal intussusception. (A) Arrow indicates the exact region where the "bull's eye" was seen during abdominal ultrasonography. (B) Arrowhead indicates the "bull's eye" seen during the exam. Source: The authors (2023).

The patient was prepared to enter the surgical room after cleaning the mouth and feet. The preanesthetic medication used was 1.1mg/kg xylazine at 10% (Sedanew®) intravenously (IV), followed by anesthetic induction with 2.2mg/kg/IV of ketamine (Cetamin ®) at 10% and 0.06mg/kg/IV of diazepam (Diazepam®) at 5mg/mL. The patient was intubated, positioned on the surgical table and maintained under general anesthesia in a closed circuit with Isoflurane (Isoflurano Syntec®) on demand, vaporized with oxygen. Fluidtherapy with Ringer's Lactate at 9ml/kg/h was maintained during the entire surgical procedure, in association with lidocaine chloride at 20mg/mL (Lidovet®) ia a 1.3mg/kg dose in a slow bolus followed by continuous infusion at 0.05mg/kg/min rate. As preventive antibiotic therapy prior to the induction, 22,000IU/IV of benzylpenicillin (Gentopen®) and 6.6 mg/kg/IV of gentamicin (Pangram ®) were administered along with the use of 1.1 mg/kgIV non-steroidal anti-inflammatory flunixin meglumine (Flumax®). The antisepsis of the abdominal region was carried out in two stages, first with 2% chlorhexidine sponges and removal after 5 minutes with 70º alcohol, aiming to eliminate the excess and fat present in the skin, and second also with 2% chlorhexidine sponges, followed by lavage with sterile saline solution, with the objective of reducing the local microbial load.

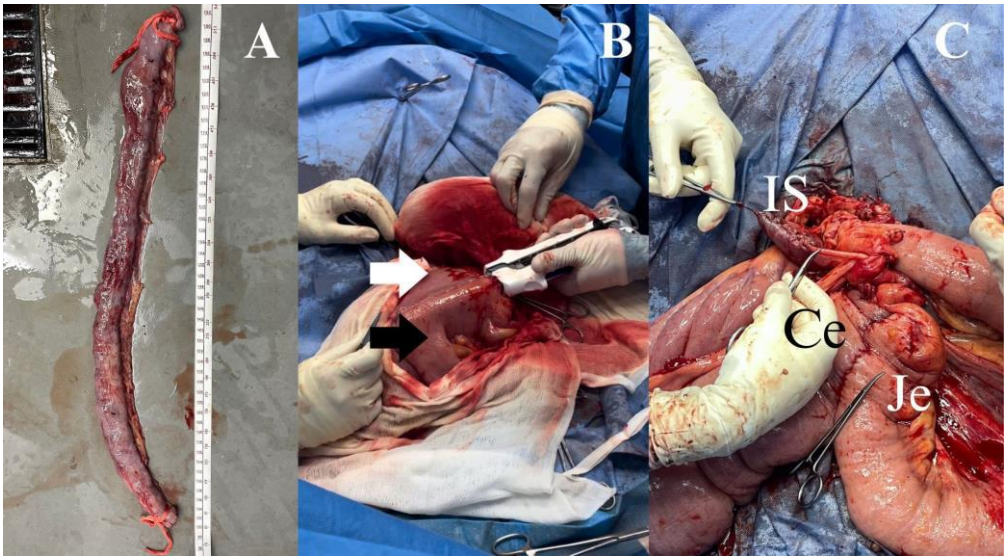
After placement of the surgical drapes, the abdominal cavity was accessed through a pre-umbilical ventral median celiotomy. An incision was made in the skin and subcutaneous tissue, exposing the linea alba and incising it craniocaudally, to a length of approximately 22 centimeters, sufficient for the viscera to be exteriorized without being pressed during manipulation,

aiming to reduce iatrogenic injuries to the serosa and trauma to the incision tissue, as discussed by Marshall & Blikslager (2019). Exploration of the abdominal cavity was then performed and evidenced the ileocecal intussusception. The affected segment was exteriorized and the injury was undone with caution, pulling the intussusceptum out of the intussuscipiens, not requiring cecostomy to access the affected segment. Approximately 80 centimeters of ileum were released from inside the cecum and the viability of the loop was assessed. This assessment was performed subjectively by observing the serosa and surface of the loop, based on color, motility, wall thickness and presence of pulse, as described by Cook et al. (2019). The segment presented dark coloration, thick and edematous wall, engorged vasculature and hemorrhagic appearance, with no motility or pulse present.

The observed characteristics evidenced that the segment aspect was non-viable and it was decided to resect it with subsequent reanastomosis. To this purpose, the affected loop was isolated using Doyen intestinal clamps wrapped in compresses soaked in sterile saline solution, avoiding possible reflux of intestinal contents. To release the segment from its mesentery the ileal arteries were ligated following the technique described by Freeman (2019), performing ligation with absorbable polyglactin 910 2-0 suture in the first blood vessel of the segment to be resected, keeping the short portion of the suture held by a hemostatic clamp, while the long portion of the suture was held by a needle holder and used to gather the entire mesentery, as each vessel was ligated and transected by an independent simple suture. Each vessel was sutured and kept held by a hemostatic clamp, facilitating the final inspection and avoiding blood leakage into the cavity (Rötting, 2017), for subsequent correction of the mesenteric defect.

An ileal segment of approximately 90 centimeters was resected (Figure 2). The portion of ileum adjacent to the ileocecal valve was maintained and its lumen was sutured in two patterns, the first being Parker-Kerr, covered by a second pattern of continuous Lembert (Freeman, 2019b; Rötting, 2017), both with absorbable polyglactin 910 2-0 suture. The ileal stump was left as short as possible, preventing it from being intussuscepted into the cecum at a length sufficient to cause obstruction of the cecocolic orifice, as pointed out by Edwards (1986b). The jejunum at the other end of the resection also had its end closed using Parker-Kerr sutures. Afterwards, the jejunum was laterally incorporated by its antimesenteric edge to the cecum between the dorsal and medial bands, close to its base, as described by Hackett (2013) using support sutures. The anastomosis was performed using Covidien® Gastrointestinal Anastomosis (GIA) staples, in a side-to-side manner, introducing one side of the stapler into the lumen of each organ, as illustrated in Figure 2, through previously created holes.

Figure 2- Jejunocecostomy after ileal resection in a criollo mare diagnosed with ileocecal intussusception.



(A) Resected ileal segment measuring 90 centimeters. (B) Stapler being applied to perform a jejunocecostomy. White arrow indicates the cecum and black arrow indicates the jejunum. (C) Final result of the jejunocecostomy. Cecum (Ce), ileal stump (IS) and jejunum (Je). Source: The authors (2023).

When applying the stapler, a stoma of approximately 8 centimeters was created between the anastomosed organs, surrounded by two lines of staples on each side, as shown in Figure 3. The holes created for the introduction of the instrument were subsequently closed with a continuous Lembert suture with absorbable polyglactin 910 2-0 suture.

Figure 3 - Covidien GIA® suture pattern.

Two lines of staples are applied on each side of the incision. Source: Kümmerle (2019).

After the anastomosis, the mesenteric defect was corrected. For this purpose, the sectioned face of the jejunal mesentery was sutured to the mesentery belonging to the remaining ileum stump and to the ileocecal valve, as described by Freeman (2009), in a continuous simple suture pattern with absorbable polyglactin 910 2-0. Since the ileal mesentery is dramatically inserted into the base of the cecum and it's attached to the dorsal abdominal wall, complete exteriorization of the ileum through celiotomy is not possible (Edwards, 1981), which led, in the present report, to the presence of a strip in the mesentery that could not be closed. Given the conditions, the defect that had to be maintained was as large as possible, aiming not to create an orifice narrow enough that would predispose to future entrapment of the small intestine. After rigorous inspection of all sutures and ligatures, the anastomosis was tested for leaks by milking the contents of the small intestine into the cecum. Finally, the abdominal cavity was reinspected to ensure that there were no remaining pathologies and the viscera were repositioned to their anatomical positions. With these steps completed, celiorrhaphy began. The abdominal wall was sutured bringing the edges of the linea alba closer together in a simple continuous pattern with polydioxanone-bioPDO 4 sutures. Subsequently, the subcutaneous tissue was sutured in a simple continuous pattern with polydioxanone-bioPDO 2-0 sutures and finally the skin was sutured with Nylon 2-0 in a simple continuous pattern.

The patient was taken to the recovery room where it was positioned in lateral decubitus and extubated. Recovery from anesthesia was satisfactory, without complications, and the animal was taken to the stable after regaining consciousness and balance. A 6-hour fast was established before feeding was reintroduced with exclusively pasture grass for at least 2 weeks. For the postoperative period, antibiotic therapy was established with 22,000 IU/kg/IV of benzylpenicillin (Gentopen®) every 6 hours and 6.6 mg/kg/IV of gentamicin (Pangram®) every 24 hours for 5 days, in addition to 1.1 mg/kg/IV of flunixin meglumine (Flumax ®) every 12 hours for 5 days. The patient was monitored intensively, maintaining stable vital parameters until the date of hospital discharge which occurred seven days after the surgical procedure. The incisional wound evolved extremely satisfactorily during the hospitalization period. The animal did not present postoperative complications in the short, medium or long term, according to reports from the owner 2 and 8 months after discharge, and returned to activities adequately.

4. Discussion

Some of the digestive pathologies in horses have a predilection for sex but this is not the case with intussusceptions (Nelson & Brounts, 2012). However, these conditions are frequently associated with foals and young horses, with average ages ranging from 6 months to 3 years (Ford et al., 1990; Freeman, 2009; Greet, 1992). Such a relationship between intussusception and the age range of young horses was not observed in the present report, as the patient was 6 years old. Furthermore, in an epidemiological study by Dunkel et al. (2017), strangulating and obstructive conditions of the small intestine occurred more frequently in horses of breeds considered small which was in agreement with the Criollo breed recorded in the current case. The

time between the onset of a strangulation injury, consultation and diagnosis until its resolution is a factor that is strongly associated with the prognosis, since in some cases in which referral is extremely early, the affected segment may still be viable, avoiding the need for resection and anastomosis (Freeman et al., 2014). If there is no other option but resection, rapid resolution can at least avoid progressive ischemia and subsequent necrosis of the intestine (Southwood, 2023). It is possible to relate the therapeutic success of the present report to the short period between the onset of clinical signs and referral for surgery of approximately 6 hours, avoiding a serious or irreversible condition.

The severity and type of injury also influence the prognosis and it's important to recognize the clinical signs and associate them with possible injuries. Due to the acute condition with rapid evolution, intermittent pain and unresponsiveness to analgesia, the hypothesis of strangulation injury was raised, which was confirmed intraoperatively, showing a long extension of compromised ileum. This finding is in agreement with that observed in studies such as those by Ford et al. (1990) and Freeman (2019), in which long obstructions cause acute colic with pain unresponsive to analgesia. Regarding the 90-centimeter extension of the compromised intestinal segment that required resection, it can be stated that the measurement fits the study by Ford et al. (1990) who observed acute obstructions in intestinal segments of horses, with an average of 60 centimeters, ranging from 6 to 467 centimeters.

Among the most commonly used diagnostic methods in cases of acute abdomen are abdominal ultrasonography and transrectal palpation. Specifically in ultrasonography, when there is formation of a structure similar to a target or "bull's eye" located on the right flank, it can be considered a strong indication of intussusception (Nelson & Brounts, 2012). This means that this finding helps the veterinarian in making the decision to refer the patient for surgery as occurred in the case of this report. The observation of the so-called "bull's eye" during abdominal ultrasound of the right flank was decisive in raising suspicions and defining the diagnosis. As for transrectal palpation, it is known that sensitivity is considered low, but in some cases, it is possible to palpate a tubular structure close to the base of the cecum (Ford et al., 1990). In the present report, rectal palpation did not allow the identification of a similar structure, which also reinforces the low sensitivity of this exam in helping to identify these alterations. According to White et al. (2005), abnormal findings in transrectal palpation are not significantly associated with the need for surgery, reinforcing the low sensitivity of rectal palpation as an effective tool in aiding the diagnosis of intussusceptions. However, in the same study, it was observed that the total absence or decline in intestinal motility through auscultation, as occurred with the patient in this report, are significantly related to the need for surgical referral.

Despite the success observed in this patient, jejunocecostomy is not the preferred technique for many surgeons, discouraging them. In most case studies, jejunocecal anastomosis presents the highest rate of mortality and/or episodes of colic and other complications after surgery (Stewart et al., 2014; Freeman, 2008; Morton & Blikslager, 2002; Proudman et al., 2002; Freeman et al., 2000). Such pessimism about the technique may be related to the possible fact that patients who require jejunocecostomy usually present a more severe and extensive primary intestinal injury than in other types of anastomosis, which impairs their prognosis (Freeman & Schaeffer, 2010; MacDonald et al., 1989; Ducharme et al., 1983). Furthermore, there is disagreement between data from Brown et al. (2015), who state that there is no significant difference in prognosis between the side-to-side and end-to-side techniques, while Röcken & Ross (1994) observed a more favorable prognosis for patients undergoing the side-to-side technique, due to the lower risk of complications in the stoma. The choice of jejunocecostomy in the present report, despite the low survival rates, was justified by the involvement of the entire length of the patient's ileum, making jejunoileostomy impossible. The side-to-side technique performed was chosen by the surgeon due to the lower risk of mechanical obstruction at the anastomosis site and was successful and allowed for a favorable prognosis.

The use of gastrointestinal staples reduces surgical time and contamination (Rötting, 2017), despite presenting a higher risk of complications, possibly due to bleeding and leaks (Giusto et al., 2014). However, studies have shown that manual suturing and staple suturing for jejunocecostomy presented similar results regarding long-term prognosis (Freeman & Shaeffer, 2010;

Proudman et al., 2007). The surgeon's experience and safety, as well as the costs and materials available, guide the decision between manual or staple suturing (Rötting, 2017). The choice of the gastrointestinal stapler allowed jejunocecostomy to be performed with a shorter surgical time and lower risk of contamination than if performed manually, favoring surgical and anesthetic recovery, in addition to not generating postoperative complications.

5. Conclusion

Although colic syndrome is still a common cause of illness and death in horses, advances in diagnostic and therapeutic methods have favored the survival and return to activities of affected animals. Given the complexity associated with surgeries involving resection and anastomosis such as jejunocecostomy, due to intestinal involvement, surgical time and complications at the anastomosis site, the early referral and diagnosis are essential for a favorable prognosis. Thereby, irreversible damage to the intestine is avoided and better postoperative conditions are provided. The success of jejunocecostomy depends on several factors, such as the duration of colic and degree of intestinal involvement, the surgeon's experience and mastery of the technique, as well as individual patient factors and surgical time. In this sense, gastrointestinal staples play an important role in reducing contamination of the anastomosis site and surgical time, also contributing to survival, hospital discharge and favorable return to previous activities.

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