

Cecal cannulation in horse; an experimental study

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Abstract:

BACKGROUND: In order to analyze the cecum-colon ecosystem and the treatment of the cecal impaction and hindgut acidosis, cecal cannulation is needed. It is essential to select a simple, fast and inexpensive cecal cannulation method. Because of different complications in general anesthesia, the standing surgery is known as a better option for the horse emergency surgery. **OBJECTIVES:** The objective of the present study was to design a simple, fast and inexpensive cecal cannulation method in standing horses. **METHODS:** For this purpose, at first a cannula with approximately 7cm, 2cm and 2.6cm in length, internal and external diameters, respectively was designed. Immediately before the standing surgery, the horses were sedated with xylazine (1mg/kg) and morphine (0.3 mg/kg). After incising the subcutaneous tissue, the external abdominal oblique, internal abdominal oblique and transverse abdominis muscles were opened by grid incision. The peritoneum was bluntly perforated and the abdomen was exposed. The muscles were separated only enough to permit one hand to enter the abdomen. The cecum was readily identified by palpation of the cecal base and the dorsoventrally oriented tenia. At this stage, a purse string was secured on the serosal surface of the cecum by nylon and a stab incision was made. Then the cannula was inserted into the cecum and the suture was tightened. **RESULTS:** The surgery was successfully performed for all horses, however, some complications such as increasing body temperature, transient signs of colic, ileus, pneumoperitoneum, subcutaneous emphysema and necrosis of the borders of the skin in the sutural places were detected. All complications were alleviated by proper nursing management. **CONCLUSIONS:** The surgical method was successfully terminated. Therefore, the method is recommended as a simple and inexpensive emergency surgical method for cecum in order to conduct different investigation, diagnosis and treatment techniques.

Introduction

It is essential to understand and describe

the feed degradation mechanisms in the equine digestive system in general, and in the hindgut ecosystem in particular. The ce-

cum-colon ecosystem is very important for analysis or investigation of the nutritional status of the horse. Besides, the importance of this ecosystem has not been fully investigated yet, and few studies have focused on deeply on the effect of the hindgut microbial population on the nitrogen and energy requirements of the horse (Santos et al., 2010). However, there are some studies about the performance of the cecal cannulation in horses related to different nutritional, physiologic or pharmacologic aspects which require sampling of cecal contents. Cecal disorders and ingesta movements within the equine cecum have been monitored by endoscopy through a cecal fistula (Boyd, 1988).

The pathogenesis of the cecal dysfunction is not determined and it is multifactorial. As a result, a singular treatment of the cecal dysfunction is often treated by bypass procedures after the initial disease identification. However, because of the decreased prognosis and increased cost caused by the bypass procedure of the caecum, this procedure should be retained and used only for the chronic cecal impactions, reiterated laparotomies and evidence of chronic leakage. The first time dysfunction cases with no prior history of chronic colic, seem to have a good prognosis with typhlotomy alone as many horses appear to get back normal function (Roberts and Sloned, 2000).

General anesthesia has some drawbacks and it is more costly. In the anesthetized horses, the shifts of the muscle planes and difficult anesthetic recovery may lead to the dehiscence of the stoma which is created by the surgery. Today, the available drugs for standing chemical restraint have made standing surgery a better option than it was before. Most of the standing surgery pro-

cedures are originally described (Beard et al., 2014). The purpose of this report is to present a simple, fast and inexpensive cecal cannulation method, as a new emergency surgery method, in standing horses to study the effects of dietary change from hay to concentrate on biochemical parameters of blood, cecum and cecal bacterial population.

Materials and Methods

Designed cannula: The cannula with retaining flanges and caps (Fig. 1) is a modification of the Simmons design and is manufactured from sticks of an acetyl homopolymer plastic (Simmons and Ford, 1988). The research was performed in winter 2016 at the hospital of veterinary medicine, Shahid Chamran University of Ahvaz, Ahvaz, Iran.

The length of the designed cannula was approximately 7cm and its internal and external diameters were 2cm and 2.6cm respectively. In order to prevent the necrosis and crush of the cecal base, while it was placed between the convex part and the screw holder, the part of the cannula which was entered into the cecum was built in a convex shape. For the maintenance and the tuning of the screw holders in all of the external surface of the cannula, small threads having 1mm diameter, were lathed on it. In order to consolidate the internal screw holder on the cecum and the external screw holder on the skin by some retentive stitches, small holes were created in the screw holders. In order to prevent the leakage of the cecal discharges from its external part, a screw cap was used. This cap was made from the plastic with an external diameter, internal diameter and length 2.5cm, 2cm

Table 1. Surgical complications in each horse.

	Post surgery fever	Colic and ileus	Pneumoperitoneum	Subcutaneous Emphysema	Necrosis of the skin borders	Accumulation of granulation tissues
Horse1	-	-	+	+	-	+
Horse2	+	-	-	+	-	+
Horse3	+	-	-	+	-	+
Horse4	-	+	-	+	+	-

Table 2. Temperature in each horse.

Day \ N. Horse	0	1	2	3	4	5	6
1	37.4	38.1	38.2	38.1	38	38	38.1
2	38	40	40.5	40.2	40	39	38.3
3	38	39.9	40.5	40.3	40	39.1	38.2
4	37.7	38.1	38.2	38	38	37.9	38

Table 3. Heart rate/min in each horse.

Day \ N. Horse	0	1	2	3	4	5	6
1	36	39	45	42	40	39	37
2	40	45	49	45	43	41	39
3	43	46	50	48	46	44	42
4	38	40	44	43	40	38	38

Table 4. Respiratory rate /min in each horse.

Day \ N. Horse	0	1	2	3	4	5	6
1	13	16	18	17	15	14	14
2	16	17	22	20	20	18	17
3	14	16	19	18	16	16	15
4	15	16	18	17	17	15	15

and 2.5cm respectively. In order to prevent the inflammatory reactions, the whole surface of the cannula which was directly connected to the body tissues was smoothed.

Animals: Four healthy Iranian horses (Stallion) with the average age of 10 years (range 7 to 13 years) and with a mean BW of 290 kg (range 270 to 320 kg) were used in this study. Horses were housed individually in box stalls. Alfalfa and water were available at all times and 1.5 kg of barley was offered to them twice daily. Feeding

was withheld for 18 h prior to the surgery.

Surgical procedure: After shaving, a povidone iodine surgical scrub was used to aseptically prepare the right paralumbar fossa. Before draping, skin and flank muscles at the surgical site were desensitized by an inverted L block using 40 to 50 mL of 1% lidocaine per horse. Immediately before the standing surgery, horses were sedated with 1mg/kg of xylazine and 0.3 mg/kg of morphine intravenously (Smith, B.P., 2015). After draping, a skin incision was

made from the middle of the last rib to the tuber coxa, beginning 5 cm ventral to the transverse process of the lumbar vertebrae extending for 10 to 15 cm. After incising the subcutaneous tissue, the external abdominal oblique, internal abdominal oblique and transverse abdominis muscles were opened by grid incision. The peritoneum was bluntly perforated and the abdomen was exposed. The muscles were separated only enough to permit one hand to enter the abdomen. The cecum was readily identified by palpation of the cecal base and the dorsoventrally oriented tenia (Fig. 2). At this stage, a purse string was secured on the serosal surface of the cecum by nylon suture 1 and a stab incision was made. Then the cannula was inserted into the cecum and the suture was tightened (Fig. 3). The first screw keeper was placed on the cannula and a few simple interrupted sutures were used for fixation of cecum to the holes of screw keeper. Then, the second screw keeper was placed on the cannula and a few simple sutures were used for fixation of skin to the holes of second screw keeper. The remaining incised skin was sutured by the simple pattern using nylon suture 1 (Fig. 4). The total duration of the surgery was 30 minutes for each horse. The vital signs of the horses were examined and recorded every day for the first few days after each surgical procedure. The existence of the clinical signs such as colic and fever was monitored and dictated with a specific monitoring interval. The intervals between the examinations were gradually extended as the horses were stabilized after the surgery until they were being monitored at 24-h intervals at the end of the first month after the surgery.

Medications: Immediately after the surgery, horses were intramuscularly injected

procaine penicillin and dihydro-streptomycin b.i.d. at a dosage of 20000 IU/kg B.W for 7 days. Flunixin meglumine was injected at a dosage of 1.1 mg/kg intravenously, immediately after the surgery and continued for 5 days (Constable, 2017). Horses that required tranquilization for the surgical preparation were injected 0.05mg/kg of acepromazine intravenously (Smith, B. P. (2015). Antiseptic solutions (povidone-iodine 2%) were used to clean and wipe around the cannula and nitrofurazone ointment was applied around the wound for the skin protection.

Results

Surgical complications, temperature, respiratory and heart rate of 4 horses are shown in Table I to IV, respectively. The average temperature of the body of the horses before the surgery was 37.7 °C. Two horses became febrile (temperature >38.2°C), within 5 days after the surgery, which was attributed to inflammation at the surgical site (Table II).

One of the horses became recumbent with signs of colic and ileus (in physical examination) in the second day after the surgery. Oral fluids and electrolytes, three liters of mineral oil (paraffin) with a nasogastric tube, flunixin meglumine (1.1mg/kg, intravenously) for analgesia, solution of metoclopramide 0.3mg/kg in one liter of normal saline (infused over 30 min), were administered. Eventually, the peristaltic and cecal movements were returned to normal.

After the surgery, pneumoperitoneum occurred in one of the horses. After sealing the skin, it recovered after 24 h.

Twelve hours after the surgery, subcutaneous emphysema was observed in all

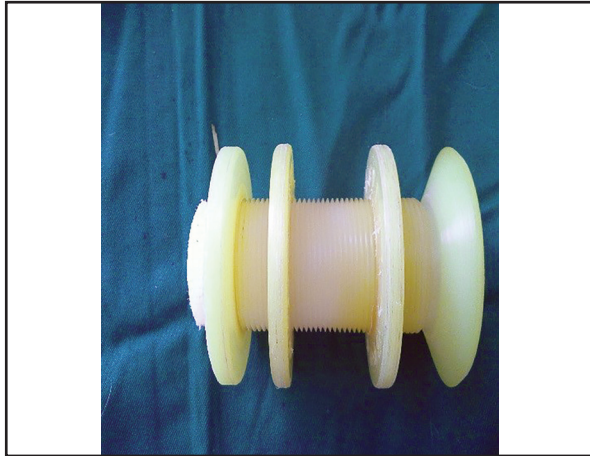


Figure 1. The cannula with retaining flanges and caps.



Figure 2. Identification of the cecum by palpation of the cecal base and the dorsoventrally oriented tenia.



Figure 3. Insertion of the cannula into the cecum.

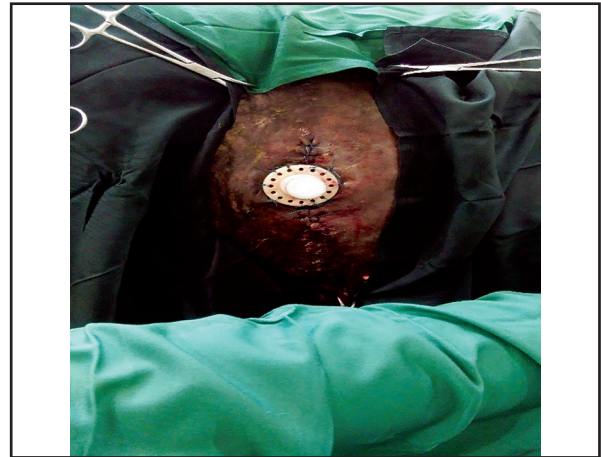


Figure 4. The cannula in place after fixation suture to the skin.

horses and continued up to 8 days after the surgery. It was soft and painless but was relieved spontaneously.

Excessive granulation tissue around the cannula caused opening of the skin sutures in two horses. To solve this problem, the edges of the wounds were refreshed and sutured again after granulation tissue excision. Fourteen days after the surgery, accumulation of the granulation tissue near the cannula caused error in sampling cecal secretion. To avoid this complication, the granulation tissue was removed by scalpel and normal saline solution substituted for povidone-iodine 2%.

Two months later, the cannula was re-

moved by releasing the peripheral adhesions by similar anesthesia protocol in standing horses. The fistula was formed around the cannula. In this fistula, drains were placed to discharge secretions. Three weeks later, the healing of this fistula occurred by daily washing with normal saline. The health of the horses was followed after 8 months (at the time of writing the present article) of the second surgery. As a result, all of them are healthy and do not have any problem.

Discussion

In this experience, a fast method for cecal cannulation in standing horses was demonstrated. This method is similar to one of the

reports (Beard et al., 2014) and differs from the other previous methods (Jasper and Cupps, 1950; Simmons and Ford, 1988). General anesthesia is more costly. Besides, the requirement for equipment and recovery facilities for the general anesthesia limits the location in which the procedure can be safely performed (Beard et al., 2014). Therefore, for sedation and analgesia of the standing horses, xylazine and morphine were utilized for the emergency surgery. One study revealed that the majority of after-hours equine admissions to a university hospital referral require medical intervention and are mostly due to the gastrointestinal disorders. Information resulted from this study can be used in emergency referral planning (Viljoen et al., 2009).

Post-operative ileus occurred in horses. Ileus can directly develop from diseases involving the digestive system, or it can be the result of diseases in other body systems, such as trauma to retroperitoneal structures or irritation of the peritoneum. Shock, electrolyte imbalances, hypoalbuminemia, peritonitis, endotoxemia, distension, ischemia or inflammation of the intestinal tract have all been implicated as contributing to the pathophysiology of ileus in the horse (Adams, 1988).

Because of having an antagonistic effect on dopaminergic DA₂ receptors, metoclopramide prevents the inhibitory effect of dopamine on gastrointestinal smooth muscle. The prokinetic capacity of metoclopramide appears substantial, but its potential side effects, for clinical use, have to be considered. Unfortunately, horses showed transient excitement after the administration of metoclopramide. There are similar side effects such as sweating, excitement, and restlessness in humans (Koenig and Cote,

2006).

In diseases in which there is a leakage of air from the lungs or airways into the subcutaneous space, the subcutaneous emphysema can occur. The etiology of subcutaneous emphysema is varied. It could be resulted from the air entering through a cutaneous wound made surgically or accidentally. Treatment of subcutaneous emphysema is clinically important. Because, the disease can lead to a life-threatening pneumothorax if the pressure is great enough to migrate through the mediastinum into the pleural cavity. Similar to this experience, this complication successfully responded to the treatment with penicillin and antitetanic serum. This way, the subcutaneous emphysema was completely recovered within a week of treatment (Ghanem and Abdel-Galil, 2011).

Accumulation of granulation tissue near the cannula was removed by scalpel. One study showed that, wound healing of surgical resection of hyper granulation tissue was faster than the non-surgical resection. For example, the mean time of wound healing was 25 days in non-surgical removal of hypergranulation tissue subgroup while it was 20 days in surgical one (Bader and Eesa, 2011).

Closure of this fistula is resulted from the daily washing with normal saline. Cleaning is a vital part of the wound management. However, there are few studies that inform the development of protocols. Research has revealed that the use of antiseptic solutions may compromise the healing process and, as a result, the use of normal saline as a cleaning solution is widely recommended (Fernandez et al., 2001).

It seems that the technique described in this report is easy, fast and affordable. The application of this procedure is recommend-

ed to cannulate the cecum for emergency goals and any other diagnostic, therapeutic and researchable plans. Eventually, the success of the surgery and post-operative survival horses as noted in the results, is directly associated with wound management and nursing services. Although this study was conducted in healthy horses, because of the difference in sensitivity and even anatomical differences between horses with digestive disorders, especially colic and healthy horses, it is recommended that this method should be used in horses suffering from colic to be better measured.

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کانولا گذاری سکوم در اسب، یک مطالعه تجربی

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چکیده

زمینه مطالعه: به منظور تحلیل اکوسیستم سکوم، عملیات اندوسکوپی از قسمت خلفی روده و درمان انباشتگی سکوم و درمان اسیدوز روده خلفی، لازم است که کانولا گذاری در سکوم انجام پذیرد. برای اجرای یک جراحی بهتر، لازم است که روشی ساده، سریع و ارزان برای کانولا گذاری در سکوم انجام شود. به دلیل مشکلات و عوارضی که بیهوشی عمومی دارد، اجرای جراحی ایستاده گزینه بهتری برای جراحی اورژانسی اسب است. **هدف:** هدف از انجام این مطالعه طراحی یک روش ساده، سریع و ارزان کانولا گذاری سکوم در اسب‌های ایستاده بوده است. **روش کار:** در این تحقیق یک کانولای جدید طراحی شده و بر روی چهار اسب نر، مورد آزمایش قرار گرفته است. ابتدا یک کانولا به طول ۷ cm و با قطر داخلی ۲ و قطر خارجی ۲/۶ cm طراحی شد. بلافاصله قبل از انجام جراحی ایستاده، زایلازین (۱ mg/kg) و مورفین (۰/۳ mg/kg) به عنوان آرام‌بخش به صورت وریدی تزریق شد. بعد از شکاف پوست و بافت‌های زیر پوست ماهیچه‌های مورب شکمی خارجی به صورت موازی با شکاف روی پوست شکافته شد. ماهیچه‌های مورب شکمی داخلی و ماهیچه‌های شکمی عرضی هر کدام با فشار دو دست در جهت الیاف بافت آن‌ها از یکدیگر جدا شدند. سپس صفاق با دو دست باز شده و شکم در دسترس قرار گرفت. ماهیچه‌ها فقط به اندازه‌ای از هم جدا شدند که یک دست وارد فضای داخل شکم شود. با استفاده از لمس کردن سطح سکوم و نواری که به سمت پشتی و شکمی سکوم قرار گرفته است، به راحتی سکوم تشخیص داده شد. در این مرحله با نصب بخیه سرکیسه‌ای روی سطح سروزی سکوم، یک شکاف سر نیزه‌ای بر روی سطح مذکور ایجاد شد. سپس کانولا داخل سکوم قرار گرفت و با استفاده از نایلون شماره دو، بخیه شد سپس مراقبت صحیح و شستشوی زخم‌ها انجام گرفته است. **نتایج:** عمل جراحی با موفقیت بر روی هر چهار اسب انجام گرفت. البته بعد از عمل، عوارضی هم برای اسب‌های جراحی شده مشاهده شد. از این جمله می‌توان به افزایش حرارت بدن، زمین‌گیری با علائم کولیک و فلجی روده، پنوموپریتون، آمفیزم زیرجلدی و نکروز در حاشیه‌های پوست در محل‌های بخیه‌ها اشاره کرد. نتیجه‌گیری نهایی: تمامی عوارض پیش آمده، با اجرای مراقبت‌های صحیح پرستاری برطرف شد و عمل جراحی با موفقیت به پایان رسید. بنابراین روش ذکر شده به عنوان یک روش جراحی ساده و ارزان برای اهداف تحقیقی، تشخیصی و درمانی پیشنهاد می‌شود.

واژه‌های کلیدی: کانولا گذاری، سکوم، اورژانس، اسب، جراحی