P-ISSN: 2304-3075; E-ISSN: 2305-4360
International Journal of Veterinary Science
www.ijvets.com; editor@ijvets.com

Clinical Article https://doi.org/10.47278/journal.ijvs/2024.162

Mesenteric Abscessation caused by *Pseudomonas aeruginosa* in a Thoroughbred Mare: Clinical, Etiological, Hematobiochemical, Sonographic and Treatment Follow-up

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Article History: 24-450 Received: 21-Mar-24 Revised: 11-Apr-24 Accepted: 13-Apr-24

ABSTRACT

This report describes an 8-year-old, 2-month-pregnant, Thoroughbred mare that was admitted with a week history of pyrexia, decreased appetite, respiratory distress, lethargy and recurrent fits of colic. The referring veterinarian had administered electrolyte solution and glucose, anti-inflammatory, antibiotic and analgesics; but this treatment had resulted in no improvement. The mare was admitted with a history of fever, colic, weight loss, inappetence, and signs of depression. Ultrasonographic examination was performed on both sides of the abdomen using a real-time scanner equipped with a 3.5 and/or 5.0 MHz convex transducer but no mass was imaged as there was relatively long distance between the mass and the anus. After sedation with xylazine and infiltration of 10mL of procaine Hcl, sampling of the abdominal lesion was carried out by the use of a 14-gauge spinal biopsy needle. Ten mL of the mass contents were collected and then submitted immediately for bacteriologic culture and antibiotic sensitivity. On day 7, percutaneous ultrasound-guided aspiration of the mass was performed for cavity evacuation under sedation with xylazine 2%. The area between the 9th and the 17th intercostal spaces was clipped, shaved and aseptically prepared. With ultrasonography, the best site for aspiration was determined to be the 14th intercostal space where 10mL of procaine HCl was infiltrated locally. The aspiration location was selected so that the needle was advanced through the thickest portion of the mass. With ultrasound guidance, a 14G×170mm spinal needle was inserted into the abdominal mass using a free-hand technique. When the needle was advanced to the correct depth, the inner needle was removed, and a 50-mL syringe attached and pus was gradually aspirated. In conclusion, in the present report, results of physical and laboratory examination were not helpful. Sonography accompanied with fine-needle aspiration yielded a diagnosis and assisted in suspecting the prognosis of the case. To the best of the authors' knowledge, this case represents the 1st confirmed report of successful treated abdominal abscess in the horse caused by *Pseudomonas aeruginosa*. Early sonographic location of abdominal abscess, accompanied with transcutaneous aspiration of the lesion and ultrasonographic follow-up monitoring is therefore recommended in horses with such presentations.

Key words: Animals, Mesenteric abscessation, Pathology, *Pseudomonas aeruginosa*, Ultrasound

INTRODUCTION

Abdominal abscessation is not much common in adult equines (Rumbaugh et al. 1978; Zicker et al. 1990; Aleman et al. 2003) and in foals (DiPietro et al. 1983; Valdes and Johnson 2005). The most common first abnormal symptoms in diseased horses are depression, colic, weight loss and anorexia (Rumbaugh et al. 1978). In a 15-year-study, 40 horses with intra-abdominal masses were studied; of them 3 horses (7.5%) had mesenteric abscesses (Zicker et al. 1990). In second study examined 25 horses affected with internal abdominal abscessation, 15 horses had mesenteric abscesses (Arnold and Chaffin 2012). In a third study reported 25 horses with abdominal abscessation, 15 horses had mesenteric abscesses (Rumbaugh et al. 1978).

Cite This Article as: Tharwat M, El-Magawry S, Kandeel A and Alkheraif AA, 2024. Mesenteric abscessation caused by *Pseudomonas aeruginosa* in a thoroughbred mare: clinical, etiological, hematobiochemical, sonographic and treatment follow-up. International Journal of Veterinary Science 13(6): 1017-1022. https://doi.org/10.47278/journal.ijvs/2024.162

The pathogenesis of abdominal abscessation in horses is presumably the same as in ruminants (Aleman et al. 2003). In cattle, abdominal abscesses have been reported in association with abomasal ulceration (Floyed et al. 1988), foreign body penetration of the ventral wall of the rumen and idiopathic omental bursitis (Grymer et al. 1982). It was not possible to determine the cause of abdominal abscess in the present case. In addition, in equines it seems likely that the abscess formed as a direct extension of a hematogenous infectious process, similar to the development of mesenteric abscess in a bull with chronic peritonitis (Voros et al. 1997) and mesenteric abscesses in horses with strangles (Rumbaugh et al. 1978). It may be hypothesized also that an initial inflammatory gastrointestinal disease may have been the predisposing factor.

Abdominal abscessation usually originate from a systemic microbial infection and may be a sequela to an infectious disease of the respiratory system such as *Corynebacterium pseudotuberculosis* and *Streptococcus equi* subsp *equi* in juvenile or adult horses and *Rhodococcus equi* in foals. Scattered reports of abdominal abscessation have also been found due to infection with *Blastomyces dermatitidus*, *Clostridium novyi* type A, *Parascaris equorum*, and *Fusobacterium necrophorum*. Secondary abdominal abscessation may also be caused by ulceration or perforation of the gastrointestinal tract, trauma, or abdominal surgical intervention. *Pseudomonas aeruginosa* can also induce mesenteric abscesses in horses (Arnold and Chaffin 2012). This clinical report describes the clinical, etiological, hematobiochemical, sonographic and treatment follow-up in a thoroughbred mare with mesenteric abscessation due to infection with *Pseudomonas aeruginosa*.

MATERIALS AND METHODS

An 8-year-old, 2-month-pregnant, 480-kg female Thoroughbred mare was referred at Zagazig University, Veterinary Teaching Hospital with a 7-days history of pyrexia, decreased appetite, respiratory distress, lethargy and recurrent fits of colic. The referring veterinarian had administered electrolyte solution and glucose, anti-inflammatory, antibiotic and analgesics; but this treatment had resulted in no improvement. On admission, the mare was admitted with a history of fever, colic, weight loss, inappetence, and signs of depression (Fig. 1). Six milliliter of blood was collected from the jugular vein: 2mL on EDTA and 4mL on plain tubes. The total and differential leukocytic count, erythrocytes, hematocrit, hemoglobin, and the red blood cells indices including mean corpuscular hemoglobin (MCH), mean corpuscular volume (MCV), and mean corpuscular hemoglobin concentration (MCHC) were measured in the EDTA blood sample (VetScan HM5, Abaxis, California, USA). An automated biochemical veterinary analyzer (VetScan VS2, Abaxis, California, USA) was used to assess the serum levels of total protein, albumin, globulin and the activity of aspartate aminotransferase (U/L), alanine aminotransferase (U/L), γ-glutamyl transferase (U/L) and alkaline phosphatase (U/L).

Sonographic examination, aspiration of abdominal mass and culture and sensitivity

On admission (day 0), ultrasonographic examination was performed on both sides of the abdomen by a real-time scanner with a 3.5 and/or 5.0 MHz convex probe (Pie Medical 240 Parus, The Netherlands). After sedation with Xylazine (6mL IV; 0.18mg/kg BW) and infiltration of 10 ml of procaine Hcl as a local anesthetic solution, aspiration of the abdominal mass was carried out in standing position by the use of a 14-gauge spinal biopsy needle. Using the process of aspiration, 10mL of the mass contents were collected and then submitted immediately for a commercial laboratory for bacteriologic culture and antibiotic sensitivity.

Fig. 1: An 8-year-old, 2-month-pregnant, 480-kg female Thoroughbred mare with intra-abdominal abscess. She was referred with a history of 7-days-pyrexia, decreased appetite, respiratory distress, lethargy and recurrent fits of abdominal pain.

On day 7, percutaneous ultrasound-guided aspiration of the mass was performed for cavity evacuation under sedation with Xylazine 2% (6mL IV; 0.18mg/kg BW). The area between the 9th and the 17th intercostal spaces was clipped, shaved and aseptically prepared. With ultrasonography, the best site for aspiration was determined to be the 14th intercostal space where 10mL of procaine HCl was infiltrated locally. The puncture location was selected so that the needle was advanced through the thickest part of the mass. With ultrasound guidance, a 14G×170 mm spinal needle (Kurita Co., Ltd, Tokyo, Japan) was inserted into the abdominal mass using a free-hand technique (Mohamed et al. 2003a,b,c,d; Mohamed et al. 2004; Mohamed and Oikawa 2008; Tharwat et al. 2012a,b; Tharwat et al. 2013). When the needle was forwarded to the intact depth (Fig. 2), the inner needle was removed and a 50-mL syringe attached and pus was gradually aspirated.

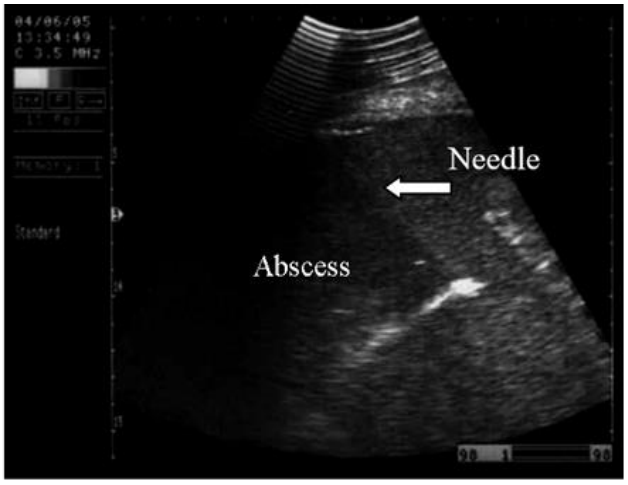
RESULTS

On admission (day 0), initial physical examination revealed a nervous mare with a body temperature of 38.8ºC, heart rate of 84 beats/min and respiratory rate of 52 breaths/min with a prominent dyspnea, and mucous membranes were highly injected. Results of a complete blood count (CBC) and biochemical parameters were normal other than relative anemia and a left shift (Table 1). Abdominal ultrasonographic examination revealed a large abdominal mass (12.33cm in diameter) with a thick capsule (0.86cm thickness) located adjacent to the right abdominal wall. The content of the mass was homogenous, thick and echogenic.

Table 1: Hematobiochemical findings in a mare with abdominal abscess

Parameter	Day 0	Day 17	Reference value*
Hematocrit (%)	36	41	32.0-53.0
Erythrocyte ($\times 10^6$/mL)	4.0	4.7	6.8-12.9
Hemoglobin (g/dL)	11.6	13.8	11.0-19.0
Leukocyte count (/mL)	12800	9200	5400-14300
Neutrophils (/mL)	7296	4968	2260-8580
Bands (/mL)	256	92	0-100
Lymphocytes (/mL)	4736	3956	1500-7700
Monocyte (/mL)	384	92	0-1000
Eosinophils (/mL)	124	92	0-1000
MCV (fL)	87	90	37.0-58.5
MCH (pg)	29	29	12.3-19.7
MCHC (g/dL)	33	32	31.0-38.6
Total protein (g/dL)	6.9	6.4	6.0-7.7
Albumin (g/dL)	3.6	3.2	2.9-3.8
Globulin (g/dL)	3.3	3.2	3.1-3.9
Aspartate aminotransferase (U/L)	198	148	220-600
Alanine aminotransferase (U/L)	47	17	2.9-3.8
γ-glutamyl transferase (U/L)	41	35	4-44
Alkaline phosphatase (U/L)	94	68	140-4003

MCV, Mean Corpuscular Volume; MCH, Mean Corpuscular Hemoglobin; MCHC, Mean Corpuscular Hemoglobin Concentration. * Constable et al., 2017.



A

B

Fig. 2: Ultrasonograms from an 8-year-old Thoroughbred mare with abdominal abscess. Image A shows fine-needle aspiration technique that was used to drain the content of the abscess. Image **B** an ultrasound-guided aspiration of pus from the abdominal abscess.

The mass was located close to the liver compressing its right lobe (Fig. 3). This picture was indicative of abdominal abscessation. No other lesions were found by sonography. The lesion was imaged from the 13th to the 17th intercostal spaces. Ultrasound-guided aspiration of 10mL of the mass contents was performed. Transrectal ultrasonography was performed, but the mass could not be imaged, because the relatively long distance between the mass and the anus.

Examination of a Giemsa-stained smear of the aspirated purulent material revealed fibrin, cellular debris and a large number of dead neutrophils. Until getting the results of culture and sensitivity, treatment had consisted of IV fluid therapy supported with an electrolyte solution, antibacterial, anti-inflammatory and analgesics. Ninety-six hours later, result of bacteriologic culture was arrived and revealed the growth of *Pseudomonas aeruginosa*. In addition, the sensitivity results showed that the organism was sensitive to Cefotaxime, Amikacin and Tobramycin; but not to Cefadroxil, Augmentin, Chloramphenicol, Erythromycin, Colistin, Ciprofloxacin, Ofloxacin, Ampicillin, and Cephadrine.

On day 7, and during aspiration and evacuation of the mass contents, it was surprising that a total of 10L of thick, reddish - creamy, odorless pus was removed (Fig. 4).

A

B

Fig. 3: Ultrasonograms from an 8-year-old Thoroughbred mare with abdominal abscess. Image **A** shows a sonogram obtained at admission (day 0) where a mass with a thick echogenic capsule with homogenous and echogenic internal contents was identified. The mass was located close to the liver deforming its right lobe margins (**B**).

The internal cavity of the mass was then washed by 0.9% sodium chloride. This lavage procedure was carried out until the fluid appeared clear and the cavity was then infused with 5g cefotaxime. The mare left the hospital with directions to the owner to keep therapy with cefotaxime (15mg/kg BW daily) for 3 weeks.

On day 17, the mare was referred to the clinic for the third time for further investigation. She was alert, bright, and responsive; it had a good appetite with a history of good improvement and complete cessation of colicky pain. Sonographic assessment of the abdominal cavity showed a significant decrease in the size of the mass that; in this time showed a complete hypoechogenic pattern (Fig. 5). Percutaneous ultrasound-guided aspiration of the lesion was also surprising where only a 1L of serosanguineous fluid was aspirated with complete absence of the purulent material. The abscess cavity was washed twice with physiological saline and finally 5g of the antimicrobial was infused inside the lesion. A CBC revealed at day 17 normal hematological and other biochemical parameters (Table 1). The mare has left the clinic on day 17; the owner was given directions to keep on the antimicrobial therapy until one month of presentation. Ultrasonographic examination of the abdomen was repeated at day 30 where only traces of hypoechogenic fluid was imaged and the mare appeared totally healthy (Fig. 6). The owner was contacted 6 and 12 months later and reported that the mare made a full recovery.

DISCUSSION

To our knowledge, neither detail of ultrasonographic characteristics of mesenteric nor follow-up monitoring of treatment response in equines with mesenteric abscessation have not been reported. The mare with abdominal abscessation documented in this investigation had a history of fever, colic, weight loss, inappetence, and signs of depression of different durations. Neither historical, physical and laboratory examination nor laboratory abnormalities were specific, helpful and characteristic. Anemia and shift to left were the only recorded hematobiochemical abnormalities.

In the diagnosis of abdominal lesions in equines, sonography shows findings that are superior to other imaging modality such as radiography and is more available and attainable, especially for adult animals. Accuracy of sonography in emphasizing a diagnosis of a liver abscess is dependent on the goodness of the image taken, depth, quality of the scanner, skill of the sonographer and appearance, size and site of the lesion (Chaffin et al. 1992). In the mare of this investigation, abdominal abscessation was highly suspected on the basis of sonographic findings. Differential diagnoses included abscessation, neoplasia or hemorrhage. A free-hand, ultrasound-guided technique was used in several studies for aspiration and biopsy of pathologic lesions as we reported previously (Tharwat et al. 2017; Tharwat and Al-Sobayil 2017; Tharwat et al. 2018a,b,c; Tharwat 2021; Tharwat et al. 2023). Similar, the technique was helpful in current study to get a transcutaneous needle aspirate for bacteriologic evaluation and also facilitated intra-lesional antibiotic administration and drainage as the thick lesion capsule hinders the antibiotic diffusion.

Fig. 4: An aspirated 10 liters of thick, reddish-creamy, odorless pus obtained from a mare with abdominal abscess. After culture of pus sample, the causative agent was found to be *Pseudomonas aeruginosa*.

Fig. 5: Ultrasonograms from an 8-year-old Thoroughbred mare with abdominal abscess taken 17 days after initial admission. Image shows that the mass appeared much smaller and had hypoechoic contents with the capsule no longer seen and a fibrous tissue (arrow) is seen surrounding the lesion.

Fig. 6: The mare at day 30 from the initial day of examination where she appeared healthy and made a complete recovery.

A poor prognosis was firstly given to the owner; the location and size of the abscess was predicted to predispose the presenting mare to abdominal pain because of the relative relation and potential adhesions of the lesion to the viscera, especially parts of the small intestine. Follow-up ultrasonography permitted us to monitor the response to treatment and to ascertain the reduction in abscess size and hypoechogenicity of the contents; and then a better prognosis was given for the owner. From the results of the present case, ultrasound-guided percutaneous drainage had several advantages. First, the animal does not have to be anesthetized. Second, surgical interference is not required, and consequently postoperative drawbacks will not evolve. Third, percutaneous drainage is typically cost-effective, as only one veterinarian and assistant and one needle are required, versus the staff, materials and time required for surgery. Moreover, the patient may not require hospitalization. Last, transcutaneous ultrasound-guided drainage can be done immediately after performing sonography, because the methodology does not need any special planning or preparations and can be achieved quickly if the sonographer is skilled. Complications associated with the ultrasound-guided percutaneous aspiration of the abscess in the present case were not encountered. The same approach of ultrasound-guided free-hand aspiration and biopsy methodology was also reported to be helpful for getting pathological aspirate and specimens (Mohamed et al. 2003a,b,c,d; Mohamed et al. 2004; Mohamed and Oikawa 2008; Tharwat et al. 2017; Tharwat and Al-Sobayil 2017; Tharwat et al. 2018a,b,c; Tharwat 2021; Tharwat et al. 2023).

The cause of mesenteric abscess in the horse has most been attributed to unusual or infection with *Streptococcus equi*, *Streptococcus zooepidemicus* and *Corynebacterium pseudotuberculosis*, *Clostridium novyi*, *Rhodococcus equi* (Rumbaugh et al. 1978; Aleman et al. 2003; Valdes and Johnson 2005). The actual pathogenesis of abdominal abscesses has not been delineated. *Pseudomonas aeruginosa* was isolated from the mesenteric abscesses in the present report. The pathogenesis of abdominal abscessation in horses is presumably the same as in ruminants (Aleman et al. 2003). In cattle, abdominal abscesses have been reported in association with abomasal ulceration (Floyed et al. 1988), foreign body penetration of the ventral wall of the rumen and idiopathic omental bursitis (Grymer et al. 1982). It was not possible to determine the cause of abdominal abscess in the present case. However, it seems likely that the most likely possibility is that the abscess formed as a direct extension of a hematogenous infectious process, similar to the development of mesenteric abscess in a bull with chronic peritonitis (Voros et al. 1997) and mesenteric abscesses in horses with strangles (Rumbaugh et al. 1978). It may be hypothesized that a primary inflammatory bowel disease in the present case may have been the underlying predisposing factor.

Conclusion

The results of physical and laboratory examination were not helpful in the diagnosis. Sonography accompanied with fine-needle drainage provided a diagnosis and assisted in evaluating the prognosis of the case. To the best of the authors' information, this case represents the 1st confirmed report of successful treated abdominal abscess in the horse caused by *Pseudomonas aeruginosa*. Furthermore, it represents the first equine case in Egypt to be verified with internal abscess and managed successfully. Primary sonographic detection of mesenteric abscess, followed by transcutaneous drainage of the lesion and ultrasonographic follow-up monitoring is therefore recommended in horses with such presentations.

Acknowledgments

The researchers would like to thank the Deanship of Scientific Research, Qassim University for funding the publication of this project.

Conflicts of interest statement

The authors have no conflicts of interest to disclose.

Author contributions

MT: concept, design and writing the manuscript draft. MT and AK: practical work. AAA revised, edited the manuscript draft. All authors revised and approved the final manuscript for publication.

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