Acta Scientiae Veterinariae, 2022. 50(Suppl 1): 771.

CASE REPORT
Pub. 771

ISSN 1679-9216

Pneumocephalus and Suppurative Meningoencephalitis in a Dog after Craniofacial Trauma

Larissa Sasaki Yamaguchi, Alexandre Coltro Gazzone, Silvana Marques Caramalac, Simone Marques Caramalac, Felipe Foletto Geller & Mariana Isa Poci Palumbo

ABSTRACT

Background: Pneumocephalus is characterized by the presence of gas in the intracranial compartment, and it can be developed by trauma, craniofacial surgery or spontaneously. Clinical signs start within days or months after the injury and vary according to the site of involvement. Computed tomography is the ideal diagnostic tool, however skull radiography can also be used. Treatment varies according to the severity of the case, and it can be conservative or associated with surgical intervention in the most severe cases. The purpose of this report is to describe the case of a dog that developed pneumocephalus and suppurative meningoencephalitis after head trauma caused by a bite from another dog.
Case: A 2-month-old bitch, mixed breed, with 3.2 kg, was referred to the Veterinary Hospital because it had been bitten on the head by another dog. Shortly after the incident, the animal showed no clinical signs. However, 2 days later, the bitch became depressed and in persistent lateral decubitus. A lesion with a crust of approximately 0.5 cm was found close to the occipital region, with bone irregularity on palpation. The animal was in lateral decubitus with muscular hypotonia, bilateral mydriasis unresponsive to light and stupor. Radiographic images showed parietal fracture and pneumocephalus. Based on the findings of physical and laboratorial exams, diagnosis of suppurative meningoencephalitis and pneumocephalus secondary to craniofacial trauma was established. Empirical broad-spectrum antimicrobial therapy was started in addition to mannitol, corticoids, and analgesics. The animal was referred for surgical debridement by trepanation, when samples were collected to bacterial culture, which was negative. Despites the care, the animal died 14 h after the surgical procedure. Histopathological examination of the frontal cortex was performed, being the histological changes compatible with suppurative meningoencephalitis.
***Discussion*:** Dog bites on the head and neck are particularly severe, and can create intracranial bleeding, disfigurement of the face, damage to peripheral structures or cranial fractures. In this report, through radiographic images, it was found that the patient had an intracerebral aerocele, since there was presence of gas in the intracranial compartment. This alteration should always be considered in animals with neurological alterations and a history of craniofacial trauma. The main neurological changes observed in the reported case were unresponsive to mydriasis and altered mental status 2 days after the trauma, and this delay in the onset of clinical signs is frequently reported in cases of pneumocephalus. Neutrophilia and leukocytosis observed can be justified by the suppurative meningoencephalitis, confirmed by the histopathological exam. Antimicrobial therapy should be started as soon as possible, and the choice must be based on their capacity to cross the blood-brain barrier and the broad spectrum. The administration of antibiotics before collecting the material for bacterial culture may explain the negative result of this test, so that it is not possible to determine whether the intracranial gas observed on the radiograph may have developed from the trauma or because of gas-producing bacteria. Head trauma can induce suppurative meningoencephalitis and pneumocephalus even in the absence of perforating wounds at the time of the consultation. The neurological signs can start days after the trauma. Besides the clinical and surgical treatments, the prognosis of any bacterial infection of the central nervous system is poor.

Keywords: aerocele, brain syndrome, Glasgow scale, radiography, trepanation.

Descritores: aerocele, síndrome cerebral, escala de Glaslow, radiografia, trepanação.

DOI: 10.22456/1679-9216.117868

Received: 16 November 2021 Accepted: 6 March 2022 Published: 31 March 2022

Veterinary Medicine and Zootechnics College, Universidade Federal de Mato Grosso do Sul (UFMS), Campo Grande, MS, Brazil. CORRESPONDENCE: M.I.P. PALUMBO [mariana.palumbo@ufms.br]. UFMS. Av. Senador Filinto Müller n. 2443. Cidade Universitária. CEP 79074-460 Campo Grande, MS, Brazil.

INTRODUCTION

Considered uncommon in veterinary medicine [7], pneumocephalus consists in the presence of gas in the intracranial compartment and is commonly associated with trauma [6, 8] complications of craniofacial surgery [1,3-5] or of spontaneous origin [15]. Neurological signs occur due to increased intracranial pressure, varying according to the location and extent of the injury [14] and can develop in hours, weeks, or months after the initial injury [4,6,8,14]. Clinical signs include lethargy, disorientation, walking in circles, behavioral changes, seizures, paresis, and others [1,3,4,6].

The treatment of pneumocephalus depends on the severity of the case, and can range from conservative, with antimicrobial therapy and analgesia, or surgical, to remove intracranial air or correct the anatomical defect [11]. Although computed tomography is the most indicated image test for the diagnosis of pneumocephalus, radiography has already been widely used for this diagnosis [11]. The aim of this study is to report a case of pneumocephalus in a dog secondary to traumatic cranial injury after a bite wound.

CASE

A 2-month-old bitch, mixed breed, with 3.2 kg, was referred to the veterinary hospital because, 2 days earlier, it had been bitten on the head by another dog. Shortly after the incident, the dog showed no clinical signs, just a small abrasion on the skin in the region of the trauma. However, 6 h before being taken to veterinary care, the dog became depressed and in persistent lateral decubitus.

At the physical exam, there were no changes in heart and respiratory rates, rectal temperature and degree of hydration. A lesion with a crust of approximately 0.5 cm was found close to the occipital region, with bone irregularity on palpation. The animal was in lateral decubitus with muscular hypotonia, bilateral mydriasis unresponsive to light and stupor. The modified Glasgow scale was performed, being classified as grade 4 (from 1 to 5) [2].

Radiographic images of the skull were performed (Figure 1), which showed discontinuity of the cortical bone in the frontal/parietal intersection region, with a discreet area of radiolucency immediately ventral to the region, suggestive of a parietal fracture and pneumocephalus. The blood count showed leukocytosis (22.900/mm^3, reference 6.000 to 17.000/mm^3) due to neutrophilia (21.984/mm^3, reference 3.000 to 11.500/mm^3), lymphopenia (0/mm^3, reference 1.000 to 4.800/mm^3), and presence of toxic neutrophils. The albumin, creatinine and alanine aminotransferase values were within the reference range.

Based on the findings of physical, radiographic, and hematological examination, diagnosis of suppurative meningoencephalitis and pneumocephalus secondary to traumatic cranial injury was established. Empirical broad-spectrum antimicrobial therapy was started with metronidazole[1] [15 mg/kg, i.v.] cephalothin[2] [30 mg/kg, i.v.] in addition to mannitol[3] [1 g/kg, i.v.], hydrocortisone[4] [10 mg/kg, i.v.], and tramadol[5] [Tramadon® - 4 mg/kg, QID]. The animal was referred to the surgery for debridement of the penetrating wound by trepanation (approximately 1cm^2), when material for culture and antibiogram was collected, which was negative.

Despites the care, the animal died 14 h after the surgical procedure. Histopathological examination of the frontal cortex showed infiltration of neutrophils with central areas of liquefactive necrosis (Figure 2). The cerebellum had meninges with moderate inflammatory infiltrate composed of lymphocytes, plasmocytes and neutrophils, being the histological changes compatible with suppurative meningoencephalitis.

DISCUSSION

Pneumocephalus should always be considered in animals with neurological disorders and a history of craniofacial trauma [6]. In this report, through radiographic examination, it was found that the patient had an intracerebral aerocele, since there was presence of gas in the intracranial compartment, which could also be called pneumocephalus or pneumatocele [13]. This condition is associated with head or facial trauma, tumors at the base of the skull or surgery and infections by gas-producing bacteria, which can rarely occur spontaneously [13]. Although tomography is considered the ideal exam for diagnosis [11], it is still a test restricted to large centers, due to the structure and specialization necessary for its performance and interpretation. In this case, radiography proved to be efficient for making this diagnosis.

Dog bites on the head and neck are particularly serious, and can create intracranial bleeding, disfigurement of the face, damage to peripheral vessels or nerves or open or sinking cranial fractures. In these cases, the onset of neurological disturbance is immediate, and the

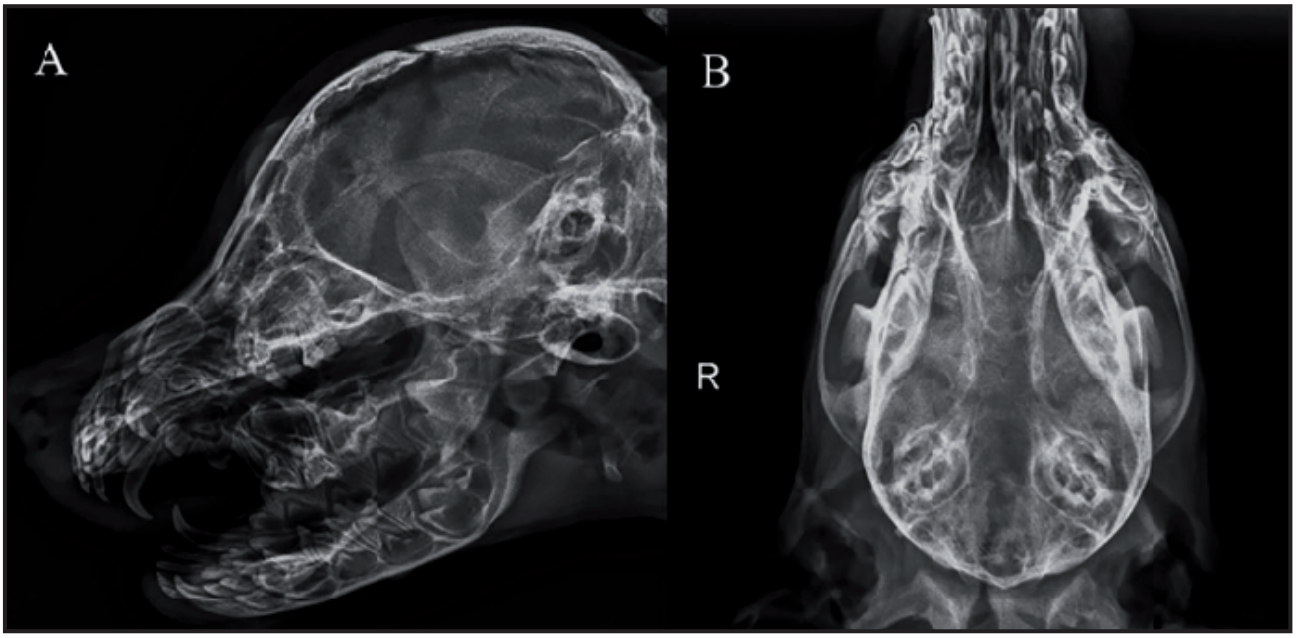

Figure 1. A- On the lateral view, a loss of continuity is seen on parietal bone, consistent with a fracture. A thin, elongated area of gas opacity within the cranial vault ventrally to all the length of the parietal bone. B- On the dorsoventral view, the margins of the gas opacity area are seen as a thin, linear area through the encephalic length, on the left side.

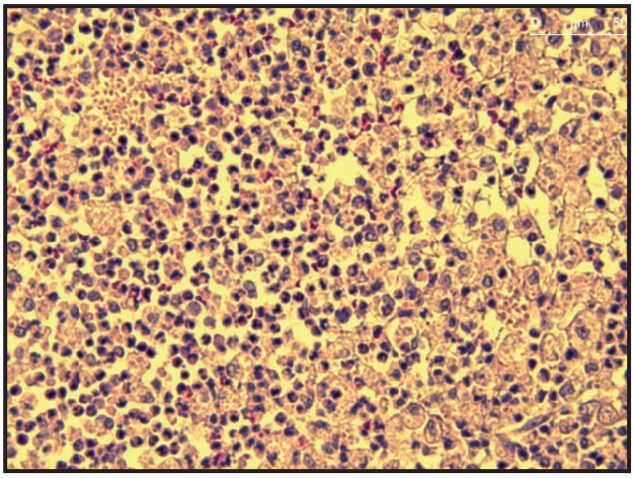

Figure 2. Histopathological examination of the frontal cortex with marked infiltration of neutrophils with central areas of liquefactive necrosis, surrounded by macrophages with a large and vacuolated cytoplasm [HE; 40×].

damage is associated with high mortality [10]. The main neurological signs observed in the report were unresponsive mydriasis and altered mental status 2 days after the trauma. This delay in the onset of clinical signs is frequently reported in cases of pneumocephalus [4,6,8,14].

Neutrophilia and leukocytosis observed in the present report can be justified by the suppurative meningoencephalitis confirmed by histopathological examination [12]. The therapy for the resolution of bite injuries must include immediate treatment of the wound and prevention of infections [10]. The lesion must be meticulously examined since deep wounds have a greater risk of progressing to abscesses after superficial healing [10].

It is known that wounds from dog and cat bites are important causes of morbidities and often require specialized care and specific therapy [10]. Antimicrobial therapy should be started as soon as possible, until the results of the culture and antimicrobial susceptibility testing are obtained, the choice of the drugs is based on their ability to cross the blood-brain barrier and their broad spectrum of action. Metronidazole and cephalothin were initially chosen due to the wide spectrum of action of this pharmacological association. Drugs that have the capacity to cross the blood-brain barrier and the broad spectrum, such as sulfa-trimethoprim, metronidazole and enrofloxacin, are the most indicated [9]. Monotherapy with cephalexin, clindamycin or erythromycin is not indicated, since *Pasteurella* spp., a microorganism that frequently colonizes the oral cavity of animals, is not susceptible [10]. Treatment with mannitol performed is indicated, as it contributes to the reduction of edema and intracranial pressure [2]. Infections already installed require hospitalization for surgical debridement and drainage [10]. The drainage of the purulent content was performed through trepanation, a surgical procedure that aims to form a small opening in the skull, allowing local washing and removal of the infectious focus.

The negative result of the bacterial culture of the material obtained from the trepanation can be attributed to antimicrobial therapy administered before the collection of the material, and not the

absence of bacteria, since the histopathological findings also pointed to suppurative meningoencephalitis. Unfortunately, as it was not possible to carry out bacterial isolation, we cannot determine whether the observed gas occurred only because of craniofacial trauma or due to colonization by gas-producing bacteria.

Head trauma can induce suppurative meningoencephalitis and pneumocephalus even in the absence of perforating wounds at the time of the consultation. The neurological signs started 2 days after the head trauma. Despite the clinical and surgical treatments, the prognosis of any bacterial infection of the central nervous system is poor.

MANUFACTURERS

[1]Hypofarma Instituto de Hypodermia e Farmácia Ltda. Ribeirão das Neves, MG, Brazil.
[2]Antibióticos do Brasil Ltda. Cosmópolis, SP, Brazil.
[3]Sanobiol Ltda. Pouso Alegre, MG, Brazil.
[4]União Química Farmacêutica Nacional S.A. Embu-Guaçu, SP, Brazil.
[5]Cristália Produtos Químicos Farmacêuticos Ltda. São Paulo, SP, Brazil.
[6]Wcor Corantes Comercio E Servicos Eireli. Guarulhos, SP, Brazil.
[7]Vetec Química Fina Ltda. Rio de Janeiro, RJ, Brazil.

***Acknowledgements*.** This study was financed in part by the Coordenação de Aperfeiçoamento de Pessoal de Nível Superior - Brasil (CAPES) - Finance Code 001.

***Declaration of interest*.** The authors report no conflicts of interest. The authors alone are responsible for the content and writing of paper.

REFERENCES

1 Cavanaugh R.P., Aiken S.W. & Schatzberg S.J. 2008. Intraventricular tension pneumocephalus and cervical subarachnoid pneumorrhachis in a bull mastiff dog after craniotomy. *Journal of Small Animal Practice*. 49(5): 244-248. DOI: 10.1111/j.1748-5827.2007.00467.x

2 Dewey C.W. & Fletcher D.J. 2017. Traumatismo cranioencefálico. In: Dewey C.W. & Costa R.C. (Eds). *Neurologia Canina e Felina - guia prático*. São Paulo: Editora Guará, pp.274-288.

3 Flecher D.J., Snyder J.M., Chiu A.G. & Vite C.H. 2006. Ventricular pneumocephalus and septic meningoencephalitis secondary to dorsal rhinotomy and nasal polypectomy in a dog. *Journal of American Veterinary Medical Association*. 229(2): 240-245. DOI: 10.2460/javma.229.2.240

4 Garosi L.S., Penderis J., Brearley M.J., Brearley J.C., Dennis R. & Kirkpatrick P.J. 2002. Intraventricular tension pneumocephalus as a complication of transfrontal craniectomy: A case report. *Veterinary Surgery*. 31(3): 226-231. DOIi:10.1053/jvet.2002.32449

5 Garosi L.S., McConnell F.J. & Lujan A. 2005. What is your diagnosis? pneumocephalus. *Journal of American Veterinary Medical Association*. 226(7): 1057-1058. DOI: 10.2460/javma.2005.226.1057.

6 Haley A.C. & Abramson C. 2009. Traumatic pneumocephalus in a dog. *Journal of the American Veterinary Medical Association*. 234(10): 1295-1298. DOI:10.2460/javma.234.10.1295

7 Hicks J., Stewart G., Kent M. & Platt S. 2020. Delayed asymptomatic progressive intraventricular pneumocephalus in a dog following craniotomy. *Journal of Small Animal Practice*. 61(5): 316-320. DOI: 10.1111/jsap.12858

8 Moral M., Blanco C., Martínez J. & Lorenzo V. 2021. Delayed traumatic pneumocephalus and cervical pneumorrhachis in a dog. *Veterinary Record Case Reports*. e70. DOI: doi.org/10.1002/vrc2.70

9 Muñana K.R. 1996. Encephalitis and meningitis. *Veterinary Clinics of North America: Small Animal Practice*. 26(4): 857-874. DOI: 10.1016/S0195-5616(96)50109-9

10 Oehler R.L., Velez A.P., Mizrachi M., Lamarche J. & Gompf S. 2009. Bite-related and septic syndromes caused by cats and dogs. *The Lancet infectious diseases*. 9(7): 439-447. DOI: 10.1016/S1473-3099(09)70110-0.

11 Pereira C.U., Dezena R.A., Meguins L.C. & Teixeira M.P.S. 2015. Pneumoencéfalo. Revisão de Literatura. *Jornal Brasileiro de Neurologia*. 26(1): 47-56. DOI: 10.22290/jbnc.v26i1.1301

12 Radaelli S.T. & Platt S.R. 2002. Bacterial meningoencephalomyelitis in dogs: a retrospective study of 23 cases (1990-1999). *Journal of Veterinary Medicine*. 16: 159-163. DOI: 10.1111/j.1939-1676.2002.tb02348.x.

13 Schirmer C.M., Heilman C.B. & Bhardwaj A. 2010. Pneumocephalus: case illustrations and review. *Neurocritical Care*. 13(1): 152-158. DOI: 10.1007/s12028-010-9363-0.

14 Sena J.O., Costa K.C.R., Costa P.M., Miranda F.G., Silva J.F. & Tôrres R.C.S. 2017. Intraventricular pneumocephalus associated with nasocephalic necrosis in a puppy: a case report. *Arquivo Brasileiro de Medicina Veterinária e Zootecnia*. 69(2): 333-339. DOI:10.1590/1678-4162-8913

15 Shea A., Dominguez E. & Stewart J. 2018. Spontaneous non-traumatic pneumocephalus in a dog with nasal meningoencephalocele. *Veterinary Record: Case Reports*. 6(4): e000670. DOI:10.1136/vetreccr-2018-000670