Bacterial endophthalmitis caused by *Serratia* sp. nov. In rabbit (*Oryctolagus cuniculus*)

Endoftalmite bacteriana causada por *Serratia* sp. Em coelho (*Oryctolagus cuniculus*)

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ABSTRACT
Bacterial endophthalmitis is a rare inflammation (TANAKA, 2019) that causes destruction and necrosis (TANAKA et al., 2011) of the structural components of the eyeball, through the penetration of infectious agents (JAIN et al., 2009; TIECCO et al., 2022) for the posterior segment of the eye, especially after intraocular surgeries (CARVALHO et al., 2021), traumas and systemic diseases (DURAND, 2017; TRAD et al., 2018; PUJARI et al., 2022), leading to vision loss (COELHO et al., 2015) and in more severe cases, enucleation (JACKSON, T. L. et al., 2014; JACKSON, TIMOTHY L. et al., 2014).

Keywords: Bacterial, *Serratia* Sp, Rabbit, *Oryctolagus Cuniculus*.

RESUMO
A endoftalmite bacteriana é uma inflamação rara (TANAKA, 2019) que causa destruição e necrose (TANAKA et al., 2011) dos componentes estruturais do globo ocular, por meio da penetração de agentes infecciosos (JAIN et al., 2009; TIECCO et al., 2022) para o segmento posterior do olho, principalmente após cirurgias intraoculares (CARVALHO et al., 2021), traumas e doenças sistêmicas (DURAND, 2017; TRAD et al., 2018; PUJARI et al., 2022), levando à perda da visão (COELHO et al., 2015) e em casos mais graves, enucleação (JACKSON, T. L. et al., 2014; JACKSON, TIMOTHY L. et al., 2014).

Palavras-chave: Bacteriana, *Serratia* Sp, Coelho, *Oryctolagus Cuniculus*.

1 INTRODUCTION

Bacterial endophthalmitis is a rare inflammation (TANAKA, 2019) that causes destruction and necrosis (TANAKA et al., 2011) of the structural components of the eyeball, through the penetration of infectious agents (JAIN et al., 2009; TIECCO et al., 2022) for the posterior segment of the eye, especially after intraocular surgeries (CARVALHO et al., 2021), traumas and systemic diseases (DURAND, 2017; TRAD et al., 2018; PUJARI et al., 2022), leading to vision loss (COELHO et al., 2015) and in more severe cases, enucleation (JACKSON, T. L. et al., 2014; JACKSON, TIMOTHY L. et al., 2014).

The main clinical signs are blepharospasm, blepharoedema, conjunctival hyperemia, corneal edema, hypopium and conjunctival secretion, and corneal ulcer may occur (NES, 2018; WINARTI et al., 2021; AGRAWAL, 2022; XIE et al., 2022). Culture (BARBOSA et al., 2017; CAIADO et al., 2020) and

histopathological analysis (NEVES et al., 1990; GALERA et al., 2017) are diagnostic methods used to identify the pathogen and confirm endophthalmitis (MEREDITH et al., al., 1990; Shirmbeck et al., 2000; GUERRA et al., 2012).

It is a difficult disease to treat, and this is usually performed through the association of broad-spectrum antimicrobials with topical and systemic corticosteroids, in addition to supportive treatment (CIULLA et al., 1999; TANAKA et al., 2019; PINTO et al., 2020; Singh et al., 2022).

2 GOAL

To report a case of bacterial endophthalmitis caused by *Serratia* sp. in a domestic rabbit (*Oryctolagus cuniculus*) treated at a veterinary ophthalmology service.

3 METHODOLOGY

3.1 LITERATURE SEARCH METHOD

We searched articles in the literature written in English and in Portuguese, as well as translations into English of articles in other languages with the combination of keywords, *Serratia*, rabbit, endophthalmitis and gatifloxacin, in Medline, Lilacs, PAHO and SciELO through Google Scholar and by direct search, without time cut, with refinement for the last five years, when possible.

Individual case reports, case series and literature reviews on Serratia sp.-induced endophthalmitis in all species were selected. Cross-references of these non-highlighted articles in the cited research databases were also obtained and reviewed.

3.2 CASE REPORT

This case report used information from the medical records, history and medical records of a case attended by the Volante service of Veterinary Ophthalmology. Animal models, experiments, or any other intentional intervention in animals other than those described here were not used during specialized clinical care. The person responsible for the animal authorized the disclosure of information and images for scientific dissemination purposes, respecting the ethical criteria regarding personal information.

He was assisted by the mobile service of veterinary ophthalmology, in Brasília, Distrito Federal, Brazil; a domestic rabbit, of the species Oryctolagus cuniculus, uncastrated male, aged 3 years and 7 months.

The patient had a history of possible perforating trauma to the left eye (LE) and at the time of the consultation presented blepharospasm, blepharoedema, conjunctival hyperemia, corneal edema, serous secretion and hypopium (figure 1).

Figure 1. Clinical photograph of the left eye of *Oryctolagus cuniculus* showing blepharospasm, blepharoedema, conjunctival hyperemia, corneal edema, serous secretion, and hypopio.

During the anamnesis, the tutor described the patient's history. According to him, the animal had already undergone previous systemic treatment with Enrofloxacin and Meloxicam. Unfortunately, the tutor was not able to inform the dosage or dosage of each drug.

On ophthalmologic examination, pupillary reflex, threat test and walking test were positive in both eyes (OA). Schirmer's tear test (TLS) (BIRTH, 2019; DIAS et al., 2020; BORGES et al., 2021) was performed only in the right eye (RE) with a result of 3mm/min. The fluorescein test was positive and the Seidel test was negative for OE (DÍAZ BARRÓN et al., 2020; Sevillano et al., 2020; BASTOS et al., 2021).

Tonometry was performed with TonoVet® Plus (GLOE et al., 2019) to measure intraocular pressure (IOP), which resulted in 34mmHg for LE and 15mmHg for RE. The blood count (Figure 2) revealed erythrocytosis, hyperproteinemia, relative monocytosis and presence of reactive lymphocytes (antigenic stimulation).

Figure 2. CBC showing erythrocytosis, hyperproteinemia, relative monocytosis, and presence of reactive lymphocytes.

Data Entrada..: 26/01/2021

Nome .....: GUCCI
Especie.....: COELHO
Sexo.....: MACHO
Prop. .....: RENATA

Raça..:COELHO
Idade..: 1 Ano(s) Mes(es) Dia(s)
Médico Vet..: HANS REUTER
Clínica Vet.: EXOTIC LIFE

HEMOGRAMA COELHO

Eritrograma

		VALORES DE REFERÊNCIA
Hemácias	8,45	4,0 - 8,0 x10/ul
Hemoglobina	17,23	8 - 17 g/dl
Volume Globular	54,00	30 - 50 %
VCM	63,90	58 - 65 fl
CHCM	31,90	29 - 37 %
PPT	8,8	6 - 8 g/dl
Metarrubrícitos	0	0

Eritrocitose
Hiperproteinemia

Leucograma

			VALORES DE REFERÊNCIA Relativo	Absoluto
Leucócitos Totais	8,600 /mm3			5,200 - 12,500/ul
Mielócitos	0	0,000	0%	0/ul
Metamielócitos	0	0,000	0%	0/ul
Bastonetes	0	0,000	0%	0/ul
Heterófilos	67	5,762	20 - 75 %	1,040 - 9,375/ul
Linfócitos	28	2,408	30 - 85 %	1,560 - 10,625/ul
Eosinófilos	0	0,000	0 - 4%	0 - 500/uL
Monócitos	5	0,430	0 - 4%	0 - 500/uL
Basófilos	0	0,000	0 - 7%	0 - 875/uL

Monocitose relativa
Presença de linfócitos reativos (estimulação antigênica)

Plaquetas 512.000 250 a 650 mil/ul

Presença de agregado plaquetário na amostra

Then, corneal material was collected with swab (LEAL et al., 2021) in Stuart medium (STUART, 2020) for culture (LEBER, 2020) and antibiogram by the disc-diffusion method (BALOUIRI et al., 2016; CHIN et al., 2023). The clinical suspicion was intraocular abscess and the clinical diagnosis was uveitis and traumatic glaucoma. Treatment was started with eye drops based on Moxifloxacin (5.45mg/ml) every 4 hours for 7 days, and every 6 hours for another 10 days, 0.35% EDTA every 6 hours and Dorzolamide (20mg/ml) every 6 hours. After 15 days, the patient returned for reevaluation, where it was seen that the EO presented intense neovascularization, negative fluorescein, cornea in the aspect of keratoconus, IOP 25mmHg and negative pupillary reflex (Figure 3).

Figure 3. Clinical photograph of the EO of *Oryctolagus cuniculus* showing intense neovascularization, keratoconus, and negative pupillary reflex.

In view of the symptoms, intrastromal abscess was suspected. To investigate this suspicion, ocular ultrasound was requested, which was not authorized by the tutor. Culture and antibiogram (BELL; SMITH, 1975) of material collected from the cornea. As a result, *Serratia* sp. was isolated, showing sensitivity to Ciprofloxacin, Chloramphenicol and Meropenem (Figure 4).

Figure 4. Result of the culture of the material collected from the cornea of the EO *of Oryctolagus cuniculus* with isolation of *Serratia* sp. and antibiogram with sensitivity to Ciprofloxacin, Chloramphenicol and Meropenem.

Data Entrada..: 29/01/2021

Nome .....: GUCCI
Especie.....: COELHO
Sexo.....: MACHO
Prop. .....: RENATA

Raça..:COELHO
Idade..: 3 Ano(s) Mes(es) Dia(s)
Médico Vet..: NÃO INFORMADO
Clínica Vet.: EXOTIC LIFE

IDENTIFICAÇÃO BACTERIANA E ANTIBIOGRAMA

Material analisado: Córnea

Resultado

Microorganismo isolado: *Serratia sp.*

Antibiograma - Teste de sensibilidade a antimicrobianos

Meropenem	26	mm	Sensível
Ciprofloxacina	25	mm	Sensível
Cloranfenicol	18	mm	Sensível
Neomicina	14	mm	Intermediário
Doxiciclina	13	mm	Intermediário
Enrofloxacina	13	mm	Resistente
Tobramicina	9	mm	Resistente
Amoxicilina	0	mm	Resistente
Amox + Clavulanato	0	mm	Resistente
Cefalexina	0	mm	Resistente

The therapeutic approach was adjusted, initiating treatment with Gatifloxacin eye drops (3mg/ml) associated with Prednisolone (10mg/ml) every 6 hours for 7 days, maintaining Dorzolamide (20mg/ml)

every 6 hours. After 30 days of the institution of the appropriate treatment, there were no significant changes in the blood count (Figure 5) and, therefore, the patient was submitted to the enucleation procedure.

Figure 5. CBC performed 30 days after adjusted treatment, showing erythrocytosis, hyperproteinemia and relative monocytosis.

Data Entrada..: 12/03/2021

Nome .....: GUCCI
Especie.....: COELHO
Sexo.....: MACHO
Prop. .....: RENATA

Raça..:COELHO
Idade..: 3 Ano(s) Mes(es) Dia(s)
Médico Vet..: HANS REUTER
Clínica Vet.: EXOTIC LIFE

HEMOGRAMA COELHO

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		VALORES DE REFERÊNCIA
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CHCM	34,11	29 - 37 %
PPT	9,2	6 - 8 g/dl
Metarrubrícitos	0	0

Eritrocitose
Hiperproteinemia

Leucograma

			VALORES DE REFERÊNCIA Relativo	Absoluto
Leucócitos Totais	8,900 /mm3			5,200 - 12,500/ul
Mielócitos	0	0,000	0%	0/ul
Metamielócitos	0	0,000	0%	0/ul
Bastonetes	0	0,000	0%	0/ul
Heterófilos	57	5,073	20 - 75 %	1,040 - 9,375/ul
Linfócitos	35	3,115	30 - 85 %	1,360 - 10,625/ul
Eosinófilos	3	0,267	0 - 4%	0 - 500/uL
Monócitos	5	0,445	0 - 4%	0 - 500/uL
Basófilos	0	0,000	0 - 1%	0 - 875/uL

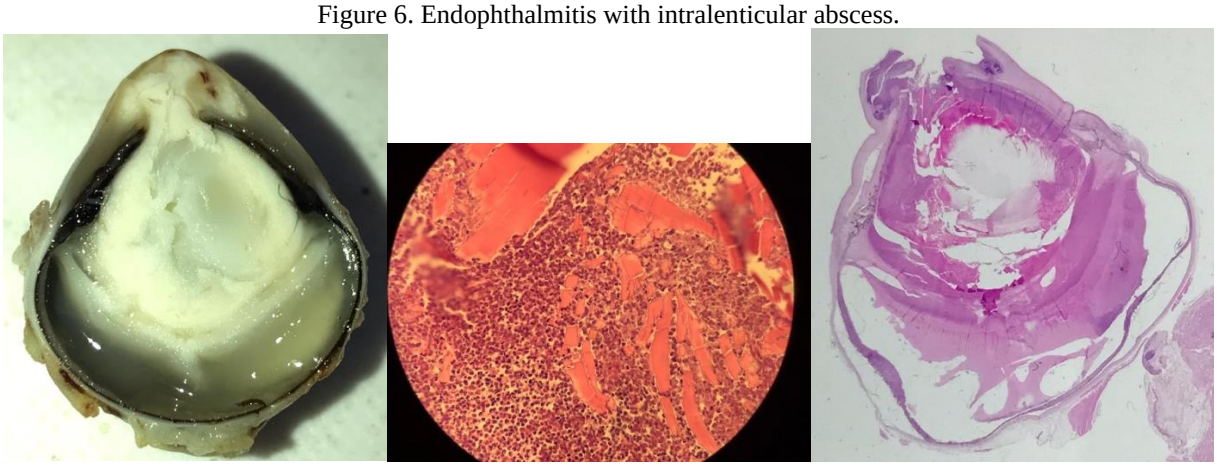
Monocitose relativa

Plaquetas 336.000 250 a 650 mil/ul

Presença de agregado plaquetário na amostra

Before surgery, during anesthetic induction, the patient presented cardiorespiratory arrest due to probable sepsis. Resuscitation maneuvers were performed, but the patient did not respond and died shortly after. Then, enucleation was performed to collect a corneal sample. The sample was sent for histopathological diagnostic examination. The histopathology result was endophthalmitis with intralenticular abscess (Figure 6).

Figure 6. Endophthalmitis with intralenticular abscess.



4 DISCUSSION

The bacterium *Serratia* sp. is a rod (GRIMONT; GRIMONT, 1978; BIEDENBACH et al., 2004), Gram negative (SADER et al., 2014; SARALEGUI et al., 2020), of the family Enterobactereaceae (SOENENS; IMPERIAL, 2020; CASTRO-SAINES et al., 2022), saprophytic (HOFF, 1984; PAGANINI et al., 2021) opportunist (NARENDRA KUMAR et al., 2023), described as causing nosocomial infections (FOX et al., 1981; MATSUSHITA et al., 2009), especially in cases of lung disease (POOLE; Clark, 2020; WALTERS et al., 2022), still poorly described in veterinary medicine (KECK et al., 2020).

Even so, there are already studies that indicate the genus *Serratia* causing experimental infection and/or disease in an induced way, in nematodes (PRADEL et al., 2007), guinea pigs (LYERLY; Kreger, 1983; Kamata et al., 1985; MOLLA et al., 1987), mice (CARLSON, 1983; LYERLY; Kreger, 1983; GONZÁLEZ-JUARBE et al., 2015), cats (PEDERSEN et al., 1998) and dogs (KUNSTYR; POSPISIL, 1962; MIYATA et al., 1980; OGILVIE et al., 1992).

In addition to these, there are also studies that indicate natural infection and disease caused by the genus *Serratia* in other species, namely: birds (MÜLLER et al., 1986; POETA et al., 2016; KASHASH et al., 2022), cats (HOHENHAUS et al., 1997; KELLY et al., 2015; GUYONNET et al., 2019), dogs (FRANKE; Richert, 1944; Wilkins, 1973; PLAVEC et al., 2008; PEREZ et al., 2011; COALL et al., 2022; FRANCHINI et al., 2022), cattle (BARNUM et al., 1958; Nicholls et al., 1981; ISAKSSON; Holmberg, 1984; BOWMAN et al., 1986; WILSON et al. , 1990; Todhunter et al., 1991; RUEGG et al., 1992; Kamarudin et al., 1996; DI GUARDO et al., 1997; Schukken et al., 2012; FRIMAN et al., 2019), mollusks (MÜLLER et al., 1995), turtles (HALL et al., 2022) and other reptiles, amphibians and fish (CLAUSEN; DURAN-REYNALS, 1937).

These studies report different types of diseases, which affect various structures of organs and systems, among which we can mention: ocular and pulmonary involvement; mastitis, transfusion reaction, abscess involving muscles and adjacent skin, among others.

Although there are experimental studies involving the genus *Serratia* in rabbits (BECKERDITE-QUAGLIATA et al., 1975; SIMBERKOFF et al., 1976; POINAR et al., 1979; Yerly et al., 1981; Kreger et al., 1986; Bugnon et al., 1996; Hume et al., 1999; PERRUCCI et al., 2005; MAH et al., 2007; ROMANOWSKI et al., 2021), no reports of infection and uninduced disease were found in the species *Oryctolagus cuniculus*, this being the first case reporting natural infection affecting the eye in this species.

As for the cases of the genus *Serratia* as a cause of endophthalmitis in animals, there is still not much information beyond the report of a cat presenting ophthalmological examination with panuveitis, increased IOP and unsatisfactory treatment (GUYONNET et al., 2019), similar to what happened in this study.

The main clinical signs of bacterial endophthalmitis are conjunctival hyperemia (SOSUAN; LEUENBERGER, 2020; WANG et al., 2020; BALASOIU et al., 2022), corneal edema (RELHAN; FLYNN, 2018; BHIKOO et al., 2022; KUMAR et al., 2022), blepharoedema (NIYADURUPOLA, 2018; NAKAI et al., 2019; KATOCH; DOGRA, 2020), conjunctival secretion (BAWANKAR et al., 2019; Sinha et al., 2021; AL-ABRI et al., 2022) and hypopium (BRAZZANO et al., 2019; MAKUSHA et al., 2020; SASI et al., 2023), corroborating the signs presented by the patient described in this case.

The antibiogram provides an assertive treatment, because the bacteria of the genus *Serratia* present intrinsic resistance (MAHLEN, 2011; MESSAOUDI et al., 2021; PICCIRILLI et al., 2022). In this report there was sensitivity to a drug from the fluoroquinolone group (CIOFU; TOLKER-NIELSEN, 2019; HARASSIM et al., 2021), Ciprofloxacin. However, it was decided to treat the patient with another fluoroquinolone, Gatifloxacin, which is specific for ocular bacterial infections and has proven activity against Gram-negative enterobacteria such as *Serratia* sp. (BISPO et al., 2008; GALVIS et al., 2019; MENDES et al., 2019; CASTILLO AVILA et al., 2020; SANTOS et al., 2021; SATOBA GARZÓN et al., 2021; SPINOZA SANCHEZ, 2022; JULITZA, 2022).

5 FINAL CONSIDERATIONS

Bacterial endophthalmitis is a pathology little described in veterinary medicine, and the bacterium *Serratia* sp. is an uncommon pathogen.

No studies were found describing the natural infection by *Serratia sp. in* rabbits, and this is the first report in the literature of ocular infection in the species *Oryctolagus cuniculus*.

The clinical signs of this type of infection for this species were severe, treatment was unsatisfactory and enucleation becomes inevitable. Histopathological examination proved to be efficient as a definitive diagnostic method for the present case.

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