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Case Study

Chromobacterium violaceum Infection in a Domestic Shorthaired Cat with Dog Bite Wounds

Syamira Syazuana Zaini*, Amal Amyrun Mohd Yusoff and Wei Yee Chan

Faculty of Veterinary Medicine, Universiti Putra Malaysia, 43400 Serdang, Selangor, Malaysia

ABSTRACT

Chromobacterium violaceum is a motile, facultative anaerobe and Gram-negative *Bacillus*, a common inhabitant of soil and water in tropical and subtropical regions. *Chromobacterium violaceum* is recognised as an opportunistic pathogen of humans and animals. Although rare, a few chromobacteriosis cases were reported in humans and several species of animals. However, there is no published report of *Chromobacterium* infection in cats. This report describes a *C. violaceum* infection in a cat with a history of non-healing dog bite wounds. The bacterial culture of the wounds revealed pure growth of *C. violaceum* on both aerobic and anaerobic cultures. The infection in this cat was successfully treated after changing the antibiotic to enrofloxacin based on an antibiotic sensitivity test (AST). This case demonstrates the importance of culture and AST tests in non-healing wounds. Chromobacteriosis can be included in the differentials, especially if wounds are contaminated by soil or stagnant water.

Keywords: Cat, chromobacteriosis, *Chromobacterium violaceum*, dog bite wound, Malaysia, zoonosis

INTRODUCTION

Chromobacterium violaceum is a motile, facultative anaerobe and Gram-negative *Bacillus*, which can grow readily on simple nutrient media, including MacConkey agar, at 35–37°C. This organism is a common inhabitant of soil and water in tropical and subtropical regions (Saigin et al., 1994; Teoh et al., 2006). *Chromobacterium violaceum* is recognised as an opportunistic pathogen of humans and animals (Ciprandi et al., 2013). Its transmission route is through the exposure of wounds and traumatic lesions to soil and water containing *C. violaceum* (Ciprandi et

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E-mail addresses:
syamirasz@upm.edu.my (Syamira Syazuana Zaini)
191921@student.upm.edu.my (Amal Amyrun Mohd Yusoff)
weiyee@upm.edu.my (Wei Yee Chan)
*Corresponding author

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al., 2013). The main clinical presentations are fever, abdominal pain, skin lesions, and the formation of metastatic abscesses (Chen et al., 2003; Manjunath, 2007). Although rare, a few chromobacteriosis cases were reported in humans, for example, in Malaysia (Ang, 2004; dan Lin et al., 2016; Saigin et al., 1994; Sharmin et al., 2019), Brazil (de Siqueira et al., 2005), Argentina (Kaufman et al., 1986), China (Teoh et al., 2006), India (Parajuli et al., 2016), and Bangladesh (Mazumder et al., 2020).

There were also a few reports on several species of animals, such as horses (Hammerschmitt et al., 2017), calves (Soares et al., 2019), dogs (Crosse et al., 2006), turtles (Scheelings et al., 2012), cougar (*Puma concolor*) (Mesquita et al., 2021), pig (Liu et al., 1989), and non-human primate in Malaysia and Costa Rica, e.g., gibbon (Donny et al., 2018) and monkey (Baldi et al., 2010). There is no published report on chromobacteriosis in a cat with wounds. Therefore, this report describes the first reported case of *C. violaceum* in a domestic shorthaired (DSH) cat in Malaysia, diagnosed based on clinical presentation, cytology, and bacterial culture.

CASE REPORT

A 6-month-old male DSH cat was presented with a history of non-healing dog bite wounds sustained two weeks prior. According to the owner, it had fallen into a drain containing stagnant water after escaping from the dog and has been inappetent since then. Details of initial treatment by a private practice could not be obtained. Physical examination revealed that the cat was alert and responsive; all vitals were within normal limits.

The right periorbital and nasal bridge were mildly swollen (Figure 1). Multiple punctured and lacerated wounds were found on the cat's dorsum, the base of the tail, and the left perianal region.

Figure 1. Swelling at the right periorbital and nasal bridge

The following diagnostic tests were conducted: haematology and serum biochemistry, impression smear for cytological analysis, and wound swab sample for bacterial (i.e., aerobic and anaerobic) and fungal culture and AST. The haematological analysis was normocytic normochromic nonregenerative anaemia (packed cell volume [PCV] = 0.19, normal range = 0.24–0.45, reticulocyte index [RI] = 0.6).

The leukogram result was moderate neutrophilia (21.79, normal range = 2.5–12.5) with a left shift and monocytosis (1.09, normal range = 0.2–0.8), which indicates infection or inflammation. Serum biochemistry revealed low normal sodium (145, normal range = 146–156) with slight hypoalbuminemia (24.2, normal range = 25–40) could be due to inappetence and hyperglobulinemia (50.6, normal range = 25–45) due to infection or inflammation.

Impression smears of the wounds only showed red blood cells with intact and degenerated neutrophils.

For bacterial culture, there was a pure growth of *C. violaceum* isolated on equine blood agar and MacConkey agar. The cultures were incubated aerobically at 37°C for 24 hr. After 24 hr incubation, smooth, round, convex, butyrous, and violet-coloured colonies were noticed (Figure 2). The colonies were characterised as Gram-negative *Bacillus*, sulphate (negative), indole (negative), motility (positive), and oxidase positive (more details in Table 1). There is no microorganism isolated from the fungal culture.

The *in vitro* AST was performed using the Kirby-Bauer Disc diffusion method. The *C. violaceum* was sensitive to enrofloxacin (5 µg), gentamicin (10 µg), norfloxacin (10 µg), polymyxin B (300 iU), and tetracycline (30 µg). The *C. violaceum*, however, was found resistant to ceftriaxone (30 µg).

The cat was initially treated empirically with metronidazole (5 mg/ml) (Metogryl®, Unique Pharmaceutical Laboratories, India) at 10 mg/kg, intravenous, given slowly twice a day for 4 days only. The antibiotic was changed to enrofloxacin (50 mg, KVP Pharma + Veterinär Produkte GmbH, Germany), 5 mg/kg, orally, once a day based on AST results. Concurrently, the cat was given tramadol (50 mg/ml, Duopharma (M) Sdn. Bhd, Malaysia) at a dosage of 3 mg/kg, subcutaneously, twice daily for 5 days as pain management. Wound cleaning once a day was also performed using chlorhexidine gluconate 4% (Pahang Pharmacy Sdn.

Table 1
Biochemical characteristics of Chromobacterium violaceum *isolated from cat wounds*

Test	Results
Gram-staining	-
Growth on MacConkey agar	+
Oxidase	+
β-haemolysis	+
Motility	+
Indole production	-
Growth on TSI agar	-
Glucose	O/F
Gas glucose	-
H_2S production	-
Citrate	-
Urease production	-

Note. - = Negative; + = Positive; TSI = Triple Sugar Iron; O/F = Oxidative/Fermentative; H_2S = Hydrogen sulfide

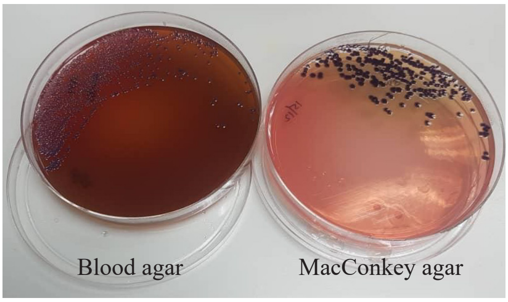

Figure 2. Colonies of *Chromobacterium violaceum* on blood (equine) and MacConkey agar

Bhd., Malaysia), followed by flushing with normal saline (sodium chloride [NaCl] 0.9%) and dabbing the wound surface with povidone-iodine 10% (Pahang Pharmacy Sdn. Bhd., Malaysia). Then, the wounds were left open for aeration. The wounds improved and healed completely with this combination of treatments and wound management for 14 days (Figures 3 and 4). The second bacterial culture and AST were performed after 14 days of treatment, and the results revealed negative results for *C. violaceum*; instead, there were opportunistic bacteria from the isolates, such as *Bacillus* sp., *Staphylococcus pseudintermedius*, and *Aggregatibacter actinomycetemcomitans*. The cat was treated for another two weeks with enrofloxacin (50 mg, KVP Pharma + Veterinär Produkte GmbH, Germany) beyond resolution.

Figure 3. Mild erythema and dried scab at tail base, left perianal, and dorsum region

Figure 4. A dried wound on the right supraorbital region

DISCUSSION

As described, *C. violaceum* is a facultative pathogenic opportunistic saprophyte (inhabitant of soil and stagnant water), which can be transmitted through exposure to wound contamination or any traumatic lesions (Ansari et al., 2015; Baker et al., 2008; Teoh et al., 2006). For a case such as a chronic non-healing animal bite wound with a history of wounds contaminated with contaminated soil and water, *C. violaceum* infection should be considered as one of the potential differential diagnoses. Based on physical examination findings, a few differential diagnoses were also listed for the non-healing dog bite wound (i.e., multiple punctured and lacerated wounds at the dorsal body, tail-based, and perianal region). For example, this condition would be caused by a bacterial infection (e.g., *Pasteurella multocida*, *Staphylococcus* spp., *Streptococcus* sp., and *Corynebacterium* sp.) (Presutti, 2001). Fungal infection can also be suspected in the non-healing wound in cats, for example, *Cryptococcus* spp., where there is a possibility that spores from the contaminated environment can infect the open wound (Duncan et al., 2006).

In mild chromobacteriosis cases, the infected patients will experience inappetence with a non-healing wound similar to clinical manifestations in the current case. However, in severe cases, where the patient is immunocompromised (Hammerschmitt et al., 2017) or with concurrent illness, for instance, due to feline leukaemia virus (FeLV) or feline immunodeficiency virus (FIV) infection, the patient might experience poor wound healing and possible promote the infection of *Chromobacterium* spp. As a result, this organism could lead to bacterial sepsis or septicaemia. For example, the previous case report on two black-handed gibbons showed several clinical signs, such as diarrhoea, inappetence, and pyrexia (Donny et al., 2018). The gibbons, however, died after 48 hr of treatment with antipyrexia and multivitamins. Post-mortem of the two gibbons revealed isolation of *C. violaceum* via bacterial isolation and identification from the lung, liver, spleen, and kidney (Donny et al., 2018). Since early treatment with antimicrobials was not performed, systemic infection would have occurred, causing septicaemia resulting in organ failure and death (Donny et al., 2018).

In human chromobacteriosis cases, better diagnostics and appropriate choices of antibiotics aid in the reduction of the rate of fatality (Batista & da Silva Neto, 2017). Because of the rapidly progressive nature of this infection, empirical antibiotic administration should be considered pending AST results (Crosse et al., 2006). In humans, a few antibiotics are effective against chromobacteriosis, such as fluoroquinolones and carbapenems (de Siqueira et al., 2005; Teoh et al., 2006). Besides that, fluoroquinolone, tetracycline, and gentamicin are demonstrated to be effective in animals such as calves (Soares et al., 2019), sheep (Carrasco et al., 1996), and dogs (Crosse et al., 2006). Therefore, the antibiotics can be used empirically prior to receiving AST results.

However, precautions should be taken in treating and managing chromobacteriosis as *C. violaceum* is recognised to develop antibiotic resistance easily in mammals such as sheep (Carrasco et al., 1996) and horses (Hammerschmitt et al., 2017). Due to that, treatment failure may occur, leading to death (de Siqueira et al., 2005). These can be seen in a few reported cases, for example, in a calf (Ajithdoss et al., 2009) and human (de Siqueira et al., 2005), where these patients were reported to die within three days of presentation due to lacked diagnostic tests: bacterial culture and AST (Ajithdoss et al., 2009; de Siqueira et al., 2005). A study showed that the isolation and identification of *Chromobacterium* spp. can take up to 48 hr (Vishnu & Palaniswamy, 2016) and in general, the AST results can be retrieved by day four or five from a bacteriology laboratory. When bacterial culture and AST are performed, the recovery chance is high.

For instance, chromobacteriosis was diagnosed in two critically ill dogs from Florida. Evidence showed that the bacterial culture and AST were done before prescribing enrofloxacin to the infected dogs (Crosse et al., 2006). As a result, the prescribed antibiotic helped in the complete resolution of chromobacteriosis within two weeks of treatment in one of the infected dogs, but the other dog did not survive (Crosse et al., 2006). The use of empiric therapy, thus, helps to reduce the chance of a flare-up of the infection, and it is highly recommended to prescribe fluoroquinolones such as enrofloxacin in future cases if there is a possibility of bite wounds in cats with possible soil or water contamination with the organism, *Chromobacterium* spp. and if the animal is systematically ill.

Chromobacterium violaceum is a potential zoonotic disease (Scheelings et al., 2012). Therefore, precautions should be taken seriously, especially for those handling chromobacteriosis cases in animals (i.e., veterinarian, veterinary assistant, staff, and client). For example, there is a safety guideline published by the University of South Carolina on how to manage *C. violaceum*, and one of them is the Animal Biosafety Level 2 (ABSL-2), which will be applied to activities that involve experimentally infected animals (more details in the guideline, University of South Carolina, 2022). Apart from that, the need to use personal protective equipment (Donny et al., 2018), such as wearing proper gloves, an apron or laboratory coat, closed-toed shoes, and eye protection (i.e., for potential splashes, sprays, or droplets), are required. It is also recommended to disinfect the contaminated area or cages (e.g., *C. violaceum* is susceptible to 10% bleach [i.e., sodium hypochlorite] and 70% ethanol) (University of South Carolina, 2022).

CONCLUSION

It is the first reported case of chromobacteriosis in a cat in Malaysia. Although rare, it is recommended to include it in the list of differential diagnoses, especially for a case with a history of chronic non-healing animal bite wounds exposed to contaminated soil and water. Bacterial culture and AST are highly recommended to provide accurate information on the type of organism and reduce the chance of treatment failure. In this case, the *C. violaceum* in the cat was isolated and successfully treated with enrofloxacin. Therefore, in future cases, empirical therapy with fluoroquinolones, such as enrofloxacin, can be considered highly suspected of chromobacteriosis.

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