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Observations of scrotal mass, liver mass, haemolytic jaundice, and central vestibular disorder in *Brugia pahangi*-infected dogs

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Abstract. *Brugia pahangi* is known to infect humans and dogs. Its associated symptoms and complications, however, have not been fully understood in dogs. Herein, we reported the observations of *B. pahangi* infections in dogs with scrotal mass, liver mass, haemolytic jaundice, and central vestibular disorder.

INTRODUCTION

Brugia pahangi has been shown to infect humans and animals (Denham *et al.*, 1977; Muslim *et al.*, 2013). Yet, its associated clinical manifestations and its complications have not been well documented. Migration of *Wuchereria bancrofti*, *Dirofilaria immitis* and other species of microfilariae to the other sites of tissues or organs has been commonly reported and often associated to neoplasm and malignancy including malignant lesions (Agarwal *et al.*, 1982; Kapila *et al.*, 1986; Khan *et al.*, 1993; Jha *et al.*, 2008; Gupta *et al.*, 2001, Burgess *et al.*, 2016). However, cases of *B. pahangi* associated with tumor has been scarcely documented. Herein, we presented three cases where the dogs were diagnosed positive to *B. pahangi* and exhibited the presence of tumor or mass in different parts of the respective organs.

Case 1

A 2-year-old male dog undergoing regular blood parasite screening was found to be infected with 900mf/100µl of blood. Based on the micrometry and staining characteristics (i.e., microfilariae with sheath in mean lengths of 250µm and 53µm of innerkoper) the microfilariae were identified as *B. pahangi* (Figure 1) which was additionally confirmed via the PCR method. Overall haematological results indicated the dog as healthy but mild leucocytosis was present (12.8x103/mm^3), suggesting an ongoing infection or inflammation. No signs of anaemia were observed from the blood results. Physical examination revealed the presence of a mass around the scrotum region of the dog. Previous study has reported the migration of microfilariae of *Dirofilaria repens* to the scrotum of dogs (Ravindran *et al.*, 2016), supporting the hypothesis that another species of filarial worm such as

Figure 1. *Brugia pahangi* microfilaria on Giemsa stained blood smear at 100x magnification.

B. pahangi can also possibly cause scrotal mass. Previously, an experimental study tested on Mongolian gerbil showed 35.7% of *B. pahangi* larvae were found in the lymphatic system associated with the spermatic cord (Porthouse *et al.*, 2006). Another study by Rao *et al.* (2006) also proved that granulomas in jirds were associated with *B. pahangi*, which was responsible for the localized cellular inflammatory responses involving cytokines. Both studies supported an association between *B. pahangi* infection and scrotal mass.

Case 2

In August 2015, a 7-year-6-month-old mongrel female dog was referred and presented to Gasing Veterinary Hospital due to the complaint of liver mass. Upon examination, heart murmur was auscultated on the right side of the heart, but the lung sounds appeared clear. Enlargement of right popliteal lymph node was observed, and there was an odd enlargement of the cranial abdomen. Complete blood count showed low levels of haemoglobin (9.5 g/dl) and platelet count ($103x10^3/mm^3$) with an elevated granulocyte count ($87.4x10^3/mm^3$). Primary observation on the blood smear slide showed no parasitic infection but high numbers of neutrophils were seen despite low neutrophils reading in complete blood count.

The dog had serious diarrhoea on the subsequent day. On the third day after hospitalization, the abdomen of the dog seemed to be distended during the physical examination with appetite loss during the fourth day of hospitalization.

On the next day, the dog looked dull and jaundice was present during the examination. Petechial hemorrhage was observed around the belly area and the platelet count has decreased rapidly to $97\ x10^3/mm^3$. The dog was in pain and laboured breathing was also observed. Body temperature was recorded at 40.1°C. In the next two days, the platelet count rose to $100\ x10^3/mm^3$. Malena was then observed after one week of hospitalization. Finally, the dog was put to sleep due to its severe body condition.

Giemsa stain showed the presence of *B. pahangi* microfilariae (microfilariae with sheath in average lengths of 255µm and 52.8µm of innerkoper), and the dog was diagnosed with liver mass. Evidence of *D. immitis* microfilariae in liver of dog (Ceribasi and Simsek, 2012) and the presence of large granulomata in the liver of *B. pahangi*-infected Mongolian gerbil (Klei *et*

al., 1981) have been documented previously, further supporting the association between microfilariae and liver mass.

In addition, haemolytic jaundice was also presented on the fifth day of admission. Jaundice is a sign caused by increased production of bilirubin. Ambily *et al.* (2009) suggested that the presence of *B. pahangi* may be associated with haemolytic jaundice in dogs. In our study, the drop in haemoglobin level might be due to the haemolysis of red blood cells which was caused by the destructive migration of microfilariae (Kitagawa *et al.*, 1989), leading to haemolytic jaundice. The decrease of oxygen supply to the hepatocytes due to red blood cell destruction causes an irreversible damage to centrilobular zone of the liver which may result in hepatic centrilobular necrosis, followed by cholestasis and hyperbilirubinaemia (Ambily *et al.*, 2009).

Case 3

In July 2015, a 2-year-old local male dog was referred and presented to Gasing Veterinary Hospital, Selangor, Malaysia. During physical examination, neck stiffness and trembling of hind limbs were observed. The body temperature was normal during the physical examination. Complete blood count showed unremarkable results. On the second day of hospitalization, the dog was found to have collapsed in the cage and nystagmus was observed. However, the nystagmus stopped after the dog was taken out from the cage. On the third day of hospitalization, the dog began to lose its appetite, started to pant and was reluctant to walk. Neurological examination performed showed apathy in the dog and its head was swaying left and right mildly when being placed on sternal recumbency. The palpebral reflex, menace response, facial sensation, cranial radialis reflex and bilateral miotic pupil were demonstrated to be normal bilaterally. However, vertical nystagmus was observed when the dog was positioned on dorsal recumbency. Proprioception was absent on all limbs except the right fore limb with extensor postural thrust reflex shown to be absent bilaterally. In addition, wheelbarrowing reflex was reduced without neck support and mild increment in bilateral patella reflex was present. Superficial pain was present on all four limbs. The neurological examination was concluded with a case of suspected central vestibular disorder due to inflammatory/infection or neoplasia. Unfortunately, before a final diagnosis was established the dog experienced hematemesis and passed away on the third day of hospitalization.

The presence of microfilariae with sheath (average length of 248µm and presence of innerkoper with the measurement of 53.4µm) was observed during microscopy screening and identified as *B. pahangi*.

Migration of microfilariae to the subcutaneous tissue and other systemic location is a common observation but the cerebral migration of microfilariae is unusual. In 1995, a study demonstrated that microfilariae of *B. malayi* can survive in the cerebral hemisphere of an experimental animal host, *Mastomys natalensis* (Paily *et al.*, 1995). We suggest that *B. pahangi* is one of the causative agents manifesting the neurological symptoms. Blood brain barrier acts as the protective barrier between bloodstream and brain fluid, whereby it is hard for parasites to invade the brain (Ballabh *et al.*, 2004). However, in some exceptional cases, microfilariae can enter from the blood stream into the cerebrospinal fluid due to extraordinarily high parasite load or multiple species of filariasis infection which may lead to neurological abnormalities such as epileptic seizures (Paily *et al.*, 1995; Adamolekun *et al.*, 1993).

CONCLUSION

Observations of *B. pahangi*-infected dogs with central vestibular diseases and neoplastic illness in the present study were purely incidental. Given that no autopsy nor biopsy was performed is one of the limitations of the present study. However, with many documented studies on the correlation of other filarial parasites with neoplasm and central vestibular diseases in dogs, there

should be heightened awareness about *B. pahangi* as a possible differential diagnosis or causative agent by the veterinarians. Granted that *B. pahangi* is known to infect humans, hence, the presence of *B. pahangi* in dogs in Malaysia may expose humans to greater risk of infection due to the close contact with dogs. Initiation of surveillance of this disease is vital to prevent its spread to humans and other dogs.

Conflict of interest

The authors report no conflict of interest.

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