ENTEROPATHOGENS OF JUVENILE EURASIAN BADGERS (*MELES MELES*) – DIAGNOSIS, TREATMENT AND CONTROL

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Introduction

Eurasian badgers (*Meles meles*) are commonly presented to veterinarians in Great Britain as casualties of road traffic accidents or following conspecific wounding (Mullineaux, 2003a). Badger cubs are less common patients and usually present as abandoned 'orphans', without clinical signs of injury or disease, but require specialist rearing and rehabilitation (Mullineaux, 2003b; SWWR *et al.*, 2003). Enteric disease is frequently encountered in badger cubs and a number of potential enteropathogens have been identified in wild badgers in Great Britain. As well as having clinical significance for individual captive animals, investigation of enteric disease in rehabilitated cubs provides further opportunity to study the clinical, microbiological and, when mortality occurs despite veterinary treatment, histopathological findings associated with these diseases.

Study population

Over a three years period, causes of enteric disease were investigated in badger cubs admitted to Secret World Wildlife Rescue (SWWR), a large wildlife centre in the south west of England were the badger density is high. Orphan badger cubs from a few days old were mixed into small social groups of 6-8 animals for eventual release according to standard protocol (Mullineaux, 2003b; SWWR *et al.*, 2003). Individual animals came from a variety of different geographical locations throughout the south of England and some had previously spent time at other rescue centres. Each release group was kept in isolation during the rearing process. No routine screening for parasites was carried out or prophylactic treatments for enteric diseases administered to the cubs during the study period.

Single deaths occurred in two groups of 6-8 weeks old cubs in 2009 and in a group of eight cubs of 8-12 weeks old in 2010 (a), all cases presented with clinical signs of diarrhoea and dehydration. Later in 2010 (b) five 8-12 weeks old badger cubs died over a two-weeks period following acute severe diarrhoea. Supportive treatment on each occasion included oral and intravenous fluid therapy, anti-diarrhoeals and dietary control, where such treatment failed to control symptoms and/or animals died further investigations were carried out.

Badger cubs of around 10 days old (above). Cubs may be presented from as young as one day old. Bottle feeding (right) continues until weaning at around 8 weeks old.

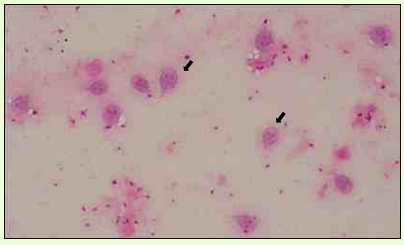
Results of diagnostic investigations

On each occasion of disease outbreak, cadavers of animals that died and faecal samples from in-contact animals were sent to AHVLA Langford for diagnostic investigation. The table below summarises the findings:

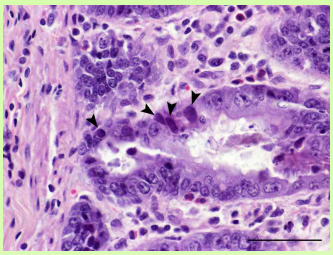
Pathogen isolate/ sample	Salmonella spp.	Giardia spp.	Coccidia spp.	Helminth spp.	Viruses
2009	10/8	5/6*	1/3	1/2	0/0
2010a	6/8	0/6	5/7	2/7	0/0
2010b	4/4	0/4	0/4	1/4	3/3
2011	0/1	0/0	1/1	0/1	0/0

The pathogens were further identified as:

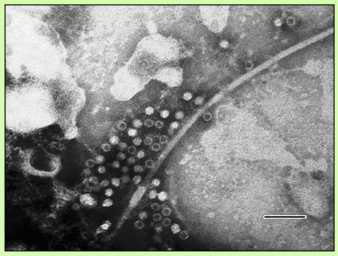
Salmonella spp.; 6/20 *S.* Agama and seven other serotypes.
Giardia spp.; *Giardia duodenalis* assemblage E. (*3 samples from same cub)
Coccidia spp.; majority *Eimeria melis*, few *Isospora melis*
Helminth spp.; *Capillaria* spp.
Viruses; Parvovirus, orthoreovirus



Giadia spp. shown (arrows) in a giemsa stained intestinal scrape. This sample was taken from the cub which died during the outbreak of enteritis in 2009



Intra-nuclear inclusion bodies (arrow heads) in enterocytes in the small intestine of a cub sampled in 2010(b). Scale bar = 50 microns



20nm virus particles with morphology suggestive of parvovirus, from a cub sampled in 2010(b). Scale bar = 100nm

Treatment and control

Following confirmation of *Giardia* spp. in 2009 all in-contact badger cubs were treated with fenbendazole (Panacur SA 2.5% oral suspension®; Intervet UK Ltd.), at a dose of 50mg/kg orally on three consecutive days. In 2010 following isolation of coccidia all in-contact cubs were treated with toltrazuril (Baycox Bovis 50mg/ml oral suspension®; Bayer PLC.), at a dose of 30mg/kg and repeated 10 days later. On both occasions no further clinical cases were observed following treatment.

SWWR had historically vaccinated badgers against parvovirus, as an outbreak of disease ten years earlier has been clinically suspicious of the infection (Mullineaux, 2003a) but vaccination had lapsed in the absence of further suspicious cases. Following confirmation of parvovirus infection in 2010 a live canine parvovirus vaccine (Nobivac Parvo-C®; Intervet UK Ltd.) was reintroduced for all remaining badger cubs. Dogs, cats and foxes at SWWR were already vaccinated and none were in direct contact with the badger cubs, nor did they present with clinical signs of infection.

Following all three outbreaks of enteric infection basic barrier nursing procedures were implemented and pens rigorously cleaned with a quaternary ammonium compound (Vetaclean Parvo®; Animalcare Ltd.) used at manufacturer's recommendations.

Badger cubs of around 12 weeks old in rearing pens (right). Cubs must be free of enteric infections before being moved to grassed enclosures (below), prior to their eventual release.

Discussion

A number of potential enteropathogens have been previously identified in Eurasian badgers in Great Britain. These include protozoa such as *Eimeria melis* and *Isospora melis* (Anwar *et al.*, 2000; Newman *et al.*, 2000), helminths (Hancox 1980; Jones *et al.*, 1980), and salmonellae (Wray *et al.*, 1977; Euden, 1990; Wilson *et al.*, 2003). *Giardia* species have only been described in association with this study (Barlow *et al.*, 2011) and viral enteropathogens have not previously been confirmed in Great Britain or within the range of the Eurasian badger (Barlow *et al.*, 2012).

Salmonella species, most commonly *S. Agama,* were most frequently isolated in this study of clinical cases of enteritis in rehabilitated badger cubs. Clinical salmonellosis was not a significant problem, however it is a zoonotic risk to staff and possible risk by fomite spread to other species.

Coccidia and helminths were usually seen as subclinical infections and uncomplicated clinical cases responded to treatment. Chronic diarrhoea and mortality resulted from mixed infections including *Giardia duodenalis* assemblage E. A 100% sequence match for *Giardia duodenalis* assemblage E was shown. This is the most common genotype (52%) of cattle and sheep identified in studies carried out by the School of Veterinary Science at Liverpool University and the AHVLA. Despite treatment for possible concomitant coccidia, giardia and helminths infections, acute diarrhoea and deaths occurred in cubs with dual parvovirus and orthoreovirus infection.

Conclusions

In this study of clinical cases of enteritis in rehabilitated badger cubs, a range of parasitic and viral infections have been shown to result in morbidity and mortality.

The study illustrates a significant risk to badger cubs of enteric infections, especially in rehabilitation situations where cubs from several sources are mixed. Wildlife centres must take suitable appropriate precautions to prevent outbreaks of such infections including measures such as screening for parasites, vaccination and suitable disinfection.

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