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Research paper

Re-infection with *Fasciola gigantica* 6-month post-treatment with triclabendazole in cattle from mobile pastoralist husbandry systems at Lake Chad

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ABSTRACT

At Lake Chad in central Africa, livestock fascioliasis caused by *Fasciola gigantica* represents a major veterinary health problem, particularly in cattle reared in mobile pastoralist husbandry systems. We assessed re-infection after a single dose of triclabendazole with fascioliasis in cattle in a mobile pastoralist setting towards the end of the dry season. Within the cattle herds of 14 groups of mobile pastoralists, 375 cattle were randomly selected. A faecal sample was obtained from each animal to determine the prevalence of *F. gigantica*. Animals were administered a single oral dose of triclabendazole (12 mg/kg). A second faecal sample was obtained 6-month post-treatment after cattle had returned from the annual migration cycle. Faecal samples were fixed in sodium acetate-acetic acid-formalin (SAF), and examined for *F. gigantica* using the sedimentation technique. From the 375 cattle enrolled at baseline, 198 animals (53%) in 12 groups of mobile pastoralists were re-sampled at the 6-month follow-up. Baseline prevalence did not differ noteworthy between animals lost to follow-up and those re-examined. At baseline, bovine fascioliasis prevalence in cattle with follow-up data was 41.9% (95% confidence interval (CI) 35.2–48.9%). At the 6-month post-treatment follow-up, the prevalence was 46.0% (95% CI 39.2–52.9%), ranging between 0% and 75% at the herd level. The mean faecal egg counts at the unit of the herd were higher at follow-up compared to baseline. The observed persistent high prevalence of *F. gigantica* infection in cattle shows that a single pre-rainy season treatment does not prevent rapid re-infection despite the partial migration away from the high-risk areas at Lake Chad into drier areas. A locally adapted strategic control package for fascioliasis in cattle in the Lake Chad area ought to integrate targeted triclabendazole treatment and seasonal transhumance practices.

1. Introduction

Livestock fascioliasis caused by *Fasciola gigantica* and *F. hepatica* is of considerable veterinary importance and economic relevance, explained by reduced productivity and fertility in cattle and productivity losses (Wamae et al., 1998; Kaplan, 2001). Alongside the negative health outcomes, treatment expenses and condemnation of infected livers at slaughter impact negatively on the livelihoods of people depending on livestock (Suleiman et al., 2015). Although precise estimates of national, regional and global losses have yet to be determined, the impact is assumed to be considerable (WHO, 2015).

In the Sahelian belt of Africa, livestock is traditionally managed in mobile pastoralist husbandry systems that provides a livelihood to an estimated 20 million people (De Haan et al., 2014). According to the Chadian "Plan National de Développement Sanitaire II (PNDS2) 2013–2015", livestock production contributes an estimated 24% to the gross domestic product (GDP), which represents the second most important contribution to the national income after the export of crude oil. The Lake Chad area and its

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seasonal flood plains are home to mobile pastoralists with a seasonally high population density of indigenous livestock. Especially towards the end of the dry season, large numbers of cattle, goat and sheep are grazing on Lake Chad shores (Jean-Richard et al., 2015). The basin is long-known to be a trematode-endemic area, including *Paramphistomum* spp., *Schistosoma bovis* and *F. gigantica* (Bouchet et al., 1969; Quéval et al., 1971; Tager-Kagan, 1978). A recent abattoir study in the south-eastern Lake Chad area revealed that close to 70% of indigenous cattle were infected with *Fasciola* spp. with a slight trend to lower infection rates from August to October, including the rainy season (Jean-Richard et al., 2014). A study among mobile pastoralists on knowledge, attitudes and practice on fascioliasis and the use of anthelminthic drugs in the region showed high awareness of the disease but irregular and non-strategic use of anthelminthic drugs because of limited access, availability and financial resources. Available drugs – albendazole and bithionol sulfoxide – were administered only to those animals showing severe illness (Greter et al., 2016).

In Africa and elsewhere, strategic anthelminthic treatments of livestock have been demonstrated to be effective and beneficial (Zinsstag et al., 2000; Akkari et al., 2011). However, there is a gap in knowledge on strategic anthelminthic treatment experience in mobile pastoralist husbandry systems, specifically from the Sahel. To our knowledge, strategic control of fascioliasis in cattle in Chad has yet to be considered.

Triclabendazole is marketed for veterinary use since 1983 (Keiser et al., 2005). It is the drug of choice for the treatment of fascioliasis caused by *F. hepatica* and *F. gigantica.* In controlled studies in cattle, efficacy has been shown to be as high as 96.5% and 97.8% (Rapic et al., 1988; Richards et al., 1990). An efficacy of 90% (Lecuyer et al., 1985) and 100% has been reported from naturally infected cattle (Craig and Huey, 1984; Lecuyer et al., 1985; Stansfield et al., 1987). Triclabendazole is also the treatment of choice for treating human fascioliasis (WHO, 2007). In contrast to older flukicides whose activity is limited to adult liver flukes, triclabendazole is effective against all live stages of *Fasciola* flukes in the final host (Keiser et al., 2005). Currently, triclabendazole is not commercially available in Chad and in none of the neighbouring countries (Keiser et al., 2005; Keyyu et al., 2009; Greter et al., 2016). To our knowledge, triclabendazole treatment against fascioliasis in naturally infected cattle in a mobile pastoralist setting has not been determined thus far.

Here, we present results of a single-arm intervention trial of triclabendazole treatment on bovine fascioliasis in naturally infected Chadian cattle in a mobile pastoralist husbandry system. The rationale for treating cattle at the end of the dry season was that cattle would be cleared from infection prior to migrating away from the wetlands of Lake Chad towards semi-arid pasture East of Lake Chad with lowered risk of re-infection during the rainy season (Jean-Richard et al., 2014).

2. Materials and methods

2.1. Study area and local husbandry practices

This study was conducted in three regions: (i) Chari-Baguirmi; (ii) Hadjer-Lamis; and (iii) Lac, situated on the eastern shores of Lake Chad in Chad. The regions are located in the Sahelian ecological zone with borders to Cameroon, Niger and Nigeria in the West. The area is inhabited by fishermen, a sedentary population that predominantly lives of agriculture, and different ethnic groups of mobile pastoralists with large numbers of livestock (Jean-Richard et al., 2015). Participating animals originated from herds owned by one of the four predominant ethnic groups of mobile pastoralists: (i) Arabs; (ii) Buduma; (iii) Fulani; and (iv) Gorane.

The climate consists of a rainy season from June to October, a cool and dry season from November to February and a hot and dry season from March to May. The vegetation cover consists of savannah grassland. In the traditional livestock management system, a variety of Zebu (*Bos indicus)* cattle breeds are raised, among these the Arab Zebu, with a well-developed dewlap and short horns, and the Mbororo (red Fulani) breed, a reddish brown cattle with long, whitish lyre-shaped horns (Flury et al., 2009). The Kouri cattle (*Bos taurus*) is an endemic breed in the Lake Chad area (Quéval et al., 1971). It is highly adapted to the shallow waters and crosses or swims from one island to another (Joshi and Phillips, 1957). Although cattle are kept in grazing systems, husbandry systems practiced by different ethnic groups of mobile pastoralists show specific differences. For example, the Gorane pastoralists breed Arab cattle and can avoid watering animals on surface water due to their excellent well building skills. The Arabs breed Arab cattle and are semi-nomadic. They leave their villages where they use water from wells; when pasture for their livestock gets scarce towards the end of the dry season, they migrate closer to the Lake Chad 's shores. In contrast, the Fulani with their Mbororo cattle and the Buduma with their Kouri cattle live almost exclusively nomadic lifestyle (Loutan and Lamotte, 1984; MERA, 2008). They fully depend on surface water and use pastures on the shores of, and on islands within, Lake Chad.

2.2. Study design, animals and treatment

This study was designed as a single-arm intervention trial to determine the prevalence of *Fasciola* spp. at baseline and 6 months after treatment with triclabendazole in a typical Sahelian mobile pastoralist setting. The timing of the treatment was scheduled in a way that the cattle are treated prior to moving away from the Lake Chad wetlands towards drier areas with a presumably lower infection risk for a period of 5–6 months. In order to simulate mixed husbandry practices and to include all cattle breeds, animals from herds raised by all four groups of pastoralists were included in the study. Participating groups of pastoralists were partly selected randomly and partly through convenience sampling. Within the herds of each group, 25 cattle aged 1 year and above were randomly selected, individually marked with an ear tag and age, sex and body condition were recorded. A faecal sample was collected directly from the rectum of each animal. All selected animals received a single oral dose of triclabendazole (12 mg/kg). For the following 6 months, marked animals were kept together with non-tagged cattle and the pastoralists continued with their normal husbandry practices, except for that they were asked to not sell or slaughter tagged animals and to not administer anthelminthic treatment to marked animals during this period.

2.3. Sample collection and parasitological analyses

The baseline survey was carried out in April and May 2014. The follow-up survey took place from October to December 2014. At baseline and the 6-month treatment follow-up, faecal samples were collected from each animal. Approximately 3 g of faeces was fixed in a vial containing 30 ml of sodium acetate-acetic acid-formalin (SAF) and marked with unique identifiers (IDs) of each animal. Samples were transferred to the parasitology laboratory at the Institute of Parasitology, Vetsuisse Faculty, University of Zurich (Zurich, Switzerland). For detection of *F. gigantica* eggs in SAF-fixed faecal samples, a sedimentation technique was employed. Eggs were enumerated under a microscope by experienced laboratory technicians.