INTRODUCTION

Mechanical ileus in cattle is most frequently caused by a partial or complete mesenteric torsion or an intussusception (Iselin et al., 1987). In rarer cases, intestines are trapped into internal or external hernias, or by embryonic or acquired remnants (Deprez et al., 2006; Pardon et al., 2009; Ruf-Ritz et al., 2013). In contrast to other species, intestinal obstruction is less common in cattle. Obstruction by blood clots in hemorrhagic bowel disease and, less frequently, obstruction by a trichobezoar or fytobezoar have been documented in the literature (Abutarbush and Rastosis, 1994; Iselin et al., 1997). In puppies, piglets and foals, massive ascarid infections have been reported to completely obstruct the small intestine (Cribb et al., 2006; Willard, 2009; Zimmerman et al., 2012). In cattle, ascarid infestations by Toxocara vitulorum are endemic in regions with a tropical and subtropical climate (Roberts, 1993). In these countries, severe infections are no exception, in contrast to countries with a more temperate climate, such as Belgium (Goossens et al., 2007; Borgsteede et al., 2012). This case report describes a case of intestinal obstruction by T. vitulorum in a heavily infected Belgian blue calf.
CASE DESCRIPTION

In February 2014, a one-month-old Belgian blue bull calf of 56 kilograms was referred to the animal hospital of the Faculty of Veterinary Medicine (UGhent) on suspicion of intussusception. The calf was housed in a box with three dams and two calves, and had been suffering from diarrhea for already one week. During the last two days, it had lost appetite and showed colic symptoms such as kicking to the abdomen.

Condition and vital signs of the calf were normal, apart from moderately congested mucosae. On auscultation of the left side, no ruminal sounds were audible. On the right side, fluid-splashing and ping sounds were present. Both right abdominal quadrants were dilated and painful upon palpation.

Transcutaneous ultrasound of the right abdomen with a 5.4 MHz probe (Mylab 25 Gold, Esaote, Belgium) showed contractile small intestines, partly with a thickened intestinal wall. In the right dorsal quadrant, a dilated cecum with gas content could be visualized. No abnormalities were detected in the thorax. Based on the obvious colic signs and the thickened intestinal wall, a tentative diagnosis of mechanical ileus was made and an explorative laparotomy was performed.

The calf was sedated with xylazine (0.2 mg/kg IM, Xyl-M 2%, VMD, Belgium) and induced with ketamine (2.2 mg/kg IM, Anesketin, Eurovet, Belgium). Anesthesia was maintained by injection of ketamine (2.2 mg/kg IM, Anesketin, Eurovet, Belgium). After opening the abdominal cavity, a moderate cecal and abomasal distension was detected. Gas was aspirated from the cecum and abomasum. From duodenum to mid-jejunum, a severe infestation with worm-like structures could be visualized through the intestinal wall (Figure 1). The intestinal wall was locally thickened. At the punctum maximum of an apparent obstruction, a 2 cm antimesenterial incision was made. The intestinal lumen was completely obstructed by adult worms. These worms were identified based on macroscopic appearance, host species and age as *T. vitulorum* (Figure 1). The final diagnosis was an intestinal obstruction caused by *T. vitulorum*. After partially removing the adult worms, the intestine was closed in two layers with synthetic absorbable gluconate (Monosyn 4/0®, B. Braun Medical,

![Image](A)

![Image](B)

![Image](C)

![Image](D)

Figure 1. Macroscopic appearance of adult *T. vitulorum* (A and B) in a one-month-old Belgian blue calf. Worms can already be palpated and visualized through the intestinal wall (C). Enterotomy showed that the lumen was completely obstructed (D).
Belgium) using an inverted suture pattern (Cushing). The abdominal cavity was closed continuously with synthetic absorbable polyglycolic acid (Surgicryl®, SMI, Belgium).

To confirm the final diagnosis, feces from the patient was examined for worm eggs by sedimentation flotation. At the same time, the two other calves and three cows (including the dam of the case calf) were sampled. In Table 1, the results of the first fecal examinations are shown. Only in the case calf, *T. vitulorum* eggs (with a very high count) could be found.

After surgery, a blood sample was taken to determine the hematocrit and base excess. The hematocrit was 48% (25-35), the base excess -8 meq/L (-5 – 5). For this reason, a hypertonic alkalizing perfusion was applied (40g bicarbonate in 1L sodium chloride). Both values normalized to 30% and -2.1 meq/L, respectively. Fluid therapy was continued with an isotonic polyionic infusion.

The calf was given a single dose of doramectin (0.2 mg/kg SC, Dectomax®, Eli Lilly, Belgium) to eliminate the worms that were not removed surgically, and pain relief was obtained with flunixin meglumine (2.2 mg/kg IV, Emdofluxin 50®, Emdoka, Belgium). For five consecutive days, procaine penicillin G and neomycin (0.05 mg/kg IM, Neopen®, MSD, Belgium) were injected. The second and third days after surgery, additionally, erythromycin (Erythrocine 200®, Ceva vet, the Netherlands) was administered intramuscularly at a prokinetic dose of 8.8 mg/kg. After five days, the calf could be discharged from the clinic. The owner was advised to deworm the other animals on the farm with a macrocyclic lactone and to disinfect the stable. Two months later, the animal was still in good condition and no new cases had occurred. Fecal samples of the same animals (three calves, three dams), taken three months after admission of the clinical case, were all negative for strongylides, ascarids, *Giardia duodenalis* and coccidiosis (Table 2). At that time, the farmer had not dewormed his animals yet.

### DISCUSSION

*T. vitulorum* is a roundworm, belonging to the phylum Nematoda, class Secernentea, order Ascaridida and the family of Toxocaridae. Within the genus *Toxocara*, there are three species: *T. vitulorum*, *T. cati* and *T. canis* (Roberts, 1993). Other well-known species within this order are *Parascaris equorum*, *Ascaris suum* and *Oxyuris equi*.

*T. vitulorum* is widespread, but the prevalence is strongly related to climatic conditions. In countries with a hot and humid climate, such as the (sub)tropics, the prevalence is significantly higher than in countries with a cold and dry climate (Roberts, 1993; Aydin et al., 2006; Borgsteede et al., 2012; Murray et al., 2012; Rast et al., 2013). In Table 3, an overview of prevalence studies on *T. vitulorum* in different countries is provided. Also in Belgium

<table>
<thead>
<tr>
<th>Animal</th>
<th>Strongyles (EPG)</th>
<th>Eimeria spp. (OPG)</th>
<th>Giardia[a]</th>
<th>T. vitulorum (EPG)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Calf 1</td>
<td>0</td>
<td>0</td>
<td>+</td>
<td>57.500</td>
</tr>
<tr>
<td>Calf 2</td>
<td>7.650</td>
<td>0</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>Calf 3</td>
<td>0</td>
<td>0</td>
<td>+</td>
<td></td>
</tr>
<tr>
<td>Cow 1</td>
<td>0</td>
<td>0</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>Cow 2</td>
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<td>0</td>
<td>-</td>
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<td>Cow 3</td>
<td>100</td>
<td>0</td>
<td>-</td>
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</tbody>
</table>

[a] McMaster method

<table>
<thead>
<tr>
<th>Animal</th>
<th>Strongyles (EPG)</th>
<th>Eimeria spp. (OPG)</th>
<th>Giardia[a]</th>
<th>Ascarids (EPG)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Calf 1</td>
<td>0</td>
<td>0</td>
<td>-</td>
<td>0</td>
</tr>
<tr>
<td>Calf 2</td>
<td>0</td>
<td>0</td>
<td>-</td>
<td>0</td>
</tr>
<tr>
<td>Calf 3</td>
<td>0</td>
<td>0</td>
<td>-</td>
<td>0</td>
</tr>
<tr>
<td>Cow 1</td>
<td>0</td>
<td>0</td>
<td>-</td>
<td>0</td>
</tr>
<tr>
<td>Cow 2</td>
<td>0</td>
<td>0</td>
<td>-</td>
<td>0</td>
</tr>
<tr>
<td>Cow 3</td>
<td>0</td>
<td>0</td>
<td>-</td>
<td>0</td>
</tr>
</tbody>
</table>

[a] McMaster method

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**Table 1. Results of the first fecal examination of the animals.**

**Table 2. Results of the second fecal examination of the animals.**
larvae remain present in an inactive state (hypobiosis) (Roberts, 1990). After this tissue migration, the larvae migrate through the portal vein to the liver. A small part is found in the mesenteric lymph nodes or the lungs (Roberts, 1993). After hatching, the larvae penetrate the intestinal wall. The largest part of the larvae start migrating to the udder. The exact stimuli for this migration are not yet completely understood (Murray et al., 2012). In male hosts, infection appears to be dead ending. The cycle only continues in pregnant hosts (Murray et al., 2012).

Approximately eight days before parturition, the larvae start migrating to the udder. The larvae reach the adult stage in the duodenum (Roberts, 1993). The larvae are mainly excreted in the milk during the first eleven days after parturition with a peak at days two and three (Roberts et al., 1990), but larvae can be found in the milk of the dam up to three to four weeks after giving birth (Taylor et al., 2007). The larval stages may be present in the tissues of the dam for years and can potentially infect calves over one to three consecutive parturitions (Rast et al., 2013). Lactogenic infection is the only evidenced route of infection.

The larvae reach the adult stage in the duodenum of the calf when it is ten to twelve days old (Warren, 1971). Approximately 22.8 ± 1.8 days after oral ingestion, eggs can be found in the feces (prepatent period) (Roberts, 1993). Peak excretion occurs at five to seven weeks of age and can last until the age of two to four months. During this patent period, approximately 110,000 eggs are excreted by one parasite every day. Overall, this can add up to 70 million eggs per calf, which leads to very high egg counts in the diagnosis (Roberts, 1990). In the present case, only one calf had a positive result on fecal examination. Most likely, the other two calves did experience an infection, but with no or minor clinical symptoms. At the time of the first fecal examination, the patent period had already passed and eggs were no longer excreted.

Infection in adult cattle causes no visible clinical signs in contrast to infection in newborn calves (Roberts, 1990). The symptoms in calves are mainly related to the number of adult worms in the small intestine. Whereas moderate infection only causes

and in its neighboring countries with a moderate climate (Germany, Italy, the Netherlands), cases have been reported, albeit at low frequency (Goossens et al., 2007; Borgsteede et al., 2012; Dorchies, 2010). In the south of France, the parasite is believed to be endemic (Dorchies, 2010). To date, the parasite has been found in water buffalo (Bubalus bubalis), zebu (Bos indicus), cattle (Bos taurus), Bali cattle (Bos sondaicus), bison (Bison spp.) and sheep (Ovis aries) (Matoff and Vassilev, 1959; Khan et al., 2010). However, experimental infections in sheep have been found to be unsuccessful (Warren, 1970; Mozgovoi et al., 2007; Borgsteede et al., 2012; Dorchies, 2010). To date, the parasite has been found in water buffalo (Bubalus bubalis), zebu (Bos indicus), cattle (Bos taurus), Bali cattle (Bos sondaicus), bison (Bison spp.) and sheep (Ovis aries) (Matoff and Vassilev, 1959; Khan et al., 2010). However, experimental infections in sheep have been found to be unsuccessful (Warren, 1970; Mozgovoi et al., 2007; Borgsteede et al., 2012; Dorchies, 2010). Therefore, the most important host species are water buffalo and cattle (Roberts, 1993).

*T. vitulorum* has a direct lifecycle. Excreted eggs are round, measure 70 to 100 μm and develop into a first stage larva in about seven days under optimal circumstances (28 to 30°C) (Roberts, 1993) (Figures 2 and 3). Below 12°C, no development occurs, but eggs can survive for several months (Enyenihi, 1972; Thienpont and De Keyser, 1981; Anwar and Chaudhry, 1984; Roberts, 1989). A minimum humidity of 80% is required for survival and of 90% for development (Enyenihi, 1969). The eggs are sensitive to heat and dehydration (Roberts, 1989). Within the egg, the larva molts two times. Two or three days after the last molding, hence, under optimal circumstances, nine to ten days after excretion, the larva reaches its infective stadium (Roberts, 1993). After being swallowed by a mammalian host, the larva actively hatches. In experimental conditions, this has already occurred five to six hours after oral intake (Mozgovoi and Shikhov, 1971; Roberts, 1993). After hatching, the larvae penetrate the intestinal wall. The largest part migrates through the portal vein to the liver. A small part is found in the mesenteric lymph nodes or the lungs (Roberts, 1990). After this tissue migration, the larvae remain present in an inactive state (hypobiosis) in different organs (Abo-Shehada and Herbert, 1984; Murray et al., 2012). In male hosts, infection appears to be dead ending. The cycle only continues in pregnant hosts (Murray et al., 2012).

### Table 3. Prevalence of *T. vitulorum* in different countries.

<table>
<thead>
<tr>
<th>Year</th>
<th>Country/Place</th>
<th>Species</th>
<th>Study</th>
<th>Number of animals</th>
<th>% infected</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>2000</td>
<td>Hai Boi (Vietnam)</td>
<td>Cattle</td>
<td>Randomized</td>
<td>74</td>
<td>36</td>
<td>Holland et al. (2000)</td>
</tr>
<tr>
<td>2002</td>
<td>Guadeloupe</td>
<td>Cattle</td>
<td>Not randomized</td>
<td>247</td>
<td>77</td>
<td>Mahieu en Naves (2008)</td>
</tr>
<tr>
<td>2003</td>
<td>Belgium</td>
<td>American Bison</td>
<td>Not randomized</td>
<td>82</td>
<td>61</td>
<td>Goossens et al. (2007)</td>
</tr>
<tr>
<td>2003</td>
<td>Bamako (Mali)</td>
<td>Cattle</td>
<td>Randomized</td>
<td>490</td>
<td>7.6</td>
<td>Wymann et al. (2008)</td>
</tr>
<tr>
<td>2004</td>
<td>Tournod (Ivory coast)</td>
<td>Cattle</td>
<td>Randomized</td>
<td>144</td>
<td>12</td>
<td>Knopf et al. (2004)</td>
</tr>
<tr>
<td>2004</td>
<td>Hakkari (Turkey)</td>
<td>Cattle</td>
<td>Randomized</td>
<td>718</td>
<td>29</td>
<td>Aydin et al. (2006)</td>
</tr>
<tr>
<td>2006</td>
<td>Van (Turkey)</td>
<td>Cattle</td>
<td>Not randomized</td>
<td>231</td>
<td>17.7</td>
<td>Göz et al. (2006)</td>
</tr>
<tr>
<td>2006</td>
<td>Florida</td>
<td>Cattle</td>
<td>Not randomized</td>
<td>105</td>
<td>17.6</td>
<td>Davila et al. (2010)</td>
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<tr>
<td>2008</td>
<td>Punjab (India)</td>
<td>Cattle</td>
<td>Randomized</td>
<td>1582</td>
<td>8.5</td>
<td>Jyoti et al. (2013)</td>
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<tr>
<td>2008</td>
<td>Multan (Pakistan)</td>
<td>Water buffalo</td>
<td>Randomized</td>
<td>282</td>
<td>63.8</td>
<td>Raza et al. (2013)</td>
</tr>
<tr>
<td>2008</td>
<td>Multan (Pakistan)</td>
<td>Cattle</td>
<td>Randomized</td>
<td>144</td>
<td>37.5</td>
<td>Raza et al. (2013)</td>
</tr>
<tr>
<td>2009</td>
<td>Laos</td>
<td>Water buffalo</td>
<td>Randomized</td>
<td>329</td>
<td>25.5</td>
<td>Rast et al. (2013)</td>
</tr>
<tr>
<td>2009</td>
<td>Laos</td>
<td>Cattle</td>
<td>Randomized</td>
<td>566</td>
<td>20.9</td>
<td>Rast et al. (2013)</td>
</tr>
<tr>
<td>2010</td>
<td>Erzurum (Turkey)</td>
<td>Cattle</td>
<td>Randomized</td>
<td>508</td>
<td>22.2</td>
<td>Avcioğlu en Balkaya (2011b)</td>
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<td>2011</td>
<td>Serbia</td>
<td>Cattle</td>
<td>Randomized</td>
<td>600</td>
<td>35</td>
<td>Kulišić et al. (2012)</td>
</tr>
<tr>
<td>2012</td>
<td>Hyderabad (Pakistan)</td>
<td>Cattle</td>
<td>Randomized</td>
<td>1000</td>
<td>8</td>
<td>Mirani et al. (2012)</td>
</tr>
</tbody>
</table>
diarrhea, heavy infection can cause anorexia, constipation, dehydration, steatorrhea, abdominal pain and as evidenced in this case, even obstruction (Srivastava, 1963; Enyenih, 1969; Srivastava and Sharma, 1981; Sukhapensa, 1981; Thienpont and De Keyser, 1981). In other animal species, obstructions caused by ascarids have been described previously. For example *P. equorum* can cause obstruction in foals, *T. canis* in puppies and *A. suum* in piglets (Cribb et al., 2006; Willard, 2009; Zimmerman et al., 2012). Without treatment, the prevalence may reach 100% in calves, with mortality rates up to 80% as a result of weakening and dehydration (Roberts, 1993). If calves survive, they develop a strong immunity and adult worms are expelled (Hansen and Perry, 1994).

After diagnosis by fecal examination, treatment can be adjusted. Routine deworming of calves at an age of three months has no effect on the prevalence of *T. vitulorum* because the peak egg excretion has already passed (Goossens et al., 2007). Adult parasites in the intestine of a calf are susceptible to most anthelmintics, although Hassanain and Degheidy (1990) described a reduced susceptibility to ivermectin. Intestinal larvae are most susceptible to levamisole or pyrantel (Davila et al., 2010). Larval stages in maternal hosts are only susceptible to levamisole, but Starke-Buzetti (2006) described a 38% survival rate after thirteen consecutive days of treatment (Roberts, 1992; Starke-Buzetti, 2006). A single administration of levamisole at the age of ten days killed the adult and immature intestinal worms and prevented recontamination of the environment (Roberts, 1993).

Based on the direct life cycle of *T. vitulorum*, there are several ways to prevent infection. Routine treatment with levamisole at the age of ten to twelve days prevents a patent infection and therefore prevents recontamination of the environment (Roberts, 1993).

Since lactogenic infection is the only route of infection, it is also possible to prevent infection by feeding calves with milk replacer.

Rajapakse et al. (1994a) described an immune response in adult water buffaloes with the production of antibodies in serum and colostrum after oral ingestion of infective eggs. High numbers of antibodies in the dam’s colostrum and the serum of the calf were associated with low egg excretion in the feces. Antibodies would protect the dam against the migration of larvae to the udder (Rajapakse et al., 1994a; Starke-Buzetti et al., 2001). This was confirmed by a study with antibodies of water buffaloes in mice (Rajapakse et al., 1994b). However, despite a high level of antibodies in the serum of the calf, this did not prevent patent infection (Starke-Buzetti et al., 2001; De Souza et al., 2004). Further research into the exact immune response and potential immunization methods is required.

Another way of preventing infection with *T. vitulorum* is hygiene. The feces of the calves should be removed daily to prevent oro-fecal transmission to other adult cattle (Avcioğlu and Balkaya, 2011a). Eggs in the environment are highly resistant against chemical cleaning. They can be destroyed by direct exposure to sunlight, by boiling water or by immersion in 3% hydrogen peroxide for fifteen minutes. However, feces act as protection for the eggs; so these disinfection methods appear to be insufficient (Anonymous, 2005). A completely reliable cleaning and disinfection method does not yet exist. Another possibility would be composting infected feces. Provided that the composting process works sufficiently, temperatures in compost can reach up to 70°C with a relative humidity of 50%. As stated, eggs do not survive in heat and need a minimum relative humidity of 80%.

Concerning the importance of *T. vitulorum* for human health, it should be stated that *T. canis* is a well-known zoonosis, which can cause ocular or visceral larva migrans, especially in infants (Glickman and Shofer, 1987). It is unknown whether this is also the case for *T. vitulorum*. In tropic regions, many children are infected by *Toxocara* spp., but it is unclear whether this only involves *T. canis*, or whether other species are important as well and whether they can induce clinical symptoms or not.

**CONCLUSION**

This case report demonstrates that *T. vitulorum* is present in cattle in Belgium. Moreover, in succession of reports in horses, pigs and dogs, this paper shows that intestinal obstruction by ascarids can also occur in calves. Practitioners should realize that besides levamisole, no common anthelmintic is active against the immature stages of the worm. Preventive measures are general hygiene to prevent the oro-fecal infection route, and feeding milk replacer instead.

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**Figure 3. Microscopic appearance of eggs of *T. vitulorum* in feces of a one-month-old Belgian blue calf with intestinal obstruction.**
of cow’s milk to break the infectious cycle. In practice, on infected herds, systematically treating calves aged 10-12 days with levamisole is likely the most straightforward approach to prevent clinical disease in calves and environmental contamination.

REFERENCES


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**Te koop**

Modern uitgeruste middelgrote gemengde praktijk in Zeeuw-Vlaanderen met uitstekend rendement. Nadruk op gezelschapsdieren.

Landelijk gelegen.

Praktijkpand te koop, tevens mogelijkheid tot koop riante woning.

**MEER INFORMATIE:**

wiro.westerwoudt@dixfortuin.nl