Short communication

Risk analysis of an anthrax outbreak in cattle and humans of Sesheke district of Western Zambia

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A B S T R A C T
An anthrax outbreak occurred in November 2010 in five villages of Sesheke district in Western Zambia. Control measures and data collection was carried out immediately the outbreak was reported. The prevalence of the disease in cattle was estimated at 7.4% (45/609) while the average herd size of infected cattle in affected villages was estimated at 121.8 (95% CI 48.8–194.8). Individual mortality per herd varied between 1.70% (3/179) and 20.25% (6/79). The relative risk of infection of cattle in the five affected villages varied between 0.18 (95% CI 0.4–5.7) and 3.7 (95% CI 1.99–6.68). In humans, the disease only affected three people and was characterized by cutaneous carbuncles. The ratio of infected persons per number of infected carcasses varied between 1:37 and 1:49 in affected villages while the overall ratio of people at risk to the number of carcasses was 42:1 indicating that despite availability of a large number of carcasses, human contact with infected carcasses was low. The findings of this study underline the importance of timely disease control measures in reducing the risk of human infections to anthrax in the face of an outbreak.

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1. Introduction

Anthrax is an infectious zoonotic disease caused by Bacillus anthracis, a spore-forming encapsulated bacteria. It affects all mammals and in cattle, it is characterized by sudden death and oozing of fresh blood from natural orifices. In human, three forms are recognized: the cutaneous form that is also the commonest; gastrointestinal and pulmonary forms (Mock and Fouet, 2001). The disease is important because of its economic impact, zoonotic nature and ability to survive in the environment for a long time making it difficult to eradicate.

In Zambia, anthrax is one of the major threats to livestock and people in the Western part of the country. This area is also endemic of clostridia infections (Munang’andu et al., 1996) suggesting that it is endowed with ecological factors that favor the survival of spore-forming bacteria. The prevalence of anthrax in Western Zambia has previously been reviewed and the role of anthropogenic pressure on the epidemiology of the disease demonstrated (Saimudaala et al., 2006; Munang’andu et al., 2012). In most cases, the information has been obtained through extended retrospective studies, covering large areas at district or regional levels. This has often made it difficult to determine the impact of the disease at a local level. There are very few studies, thus far in Zambia that focus on a single outbreak in a localized area to determine the infection rates at village level and to assess the actual losses due livestock mortality incurred by a household. Early detection of outbreaks and estimation of associated risks would make it easier to distribute resources more effectively.

In the present report, the mortality rate of cattle due to anthrax at herd level was determined as well as the human infection rate per infected carcass at village level for the outbreak that took place in Sesheke district, Western Zambia in 2010.

2. Methods and materials

2.1. Study area and field investigations

The outbreak reported herein was a sudden occurrence of anthrax in the dry months of late October to early November of 2010 in Sesheke district of Western Zambia. Sesheke is predominantly a cattle-rearing area by small scale farmers who use it as the
2.2. Clinical examinations, post mortems and sample collections

2.2.1. Cattle

At each of the affected villages, background information was obtained on the total number of animals in the herd, number infected and control measures taken. The disease in cattle was characterized by sudden death with blood oozing from natural orifices. Specimens collected included swabs of blood. In some cases an ear from a carcass was collected, stored in a sampling bottle and transported to the laboratory on ice. As a general rule, no postmortems were done for fear of contaminating the environment except in cases where carcasses were already opened up by the villagers. Carcasses were incinerated under the supervision of veterinary officials and no meat for human consumption was allowed from infected carcasses.

2.2.2. Humans

All human cases were reported to Mwandi General Hospital where clinical examination of suspected patients was carried out by medical personnel. Patients were examined for fever, abdominal pains, skin lesions and other symptoms suggestive of anthrax infection. Swabs were collected from open wounds and carbuncles for further laboratory analysis.

2.3. Laboratory examination

Both livestock and human samples were examined at Mwandi General Hospital that provided the nearest and quickest diagnostic services for the outbreak. Upon arrival, Giemsa staining was carried out on blood smears to determine the presence of the anthrax bacilli before proceeding with culture, isolation and confirmation of the isolates using standard diagnostic procedures.

2.4. Risk analysis and disease control

Control measures and data collection were carried out immediately the outbreak was reported. To quickly control the disease, background information on the population of cattle in affected villages as well as that of people were monitored. This data was used to estimate the population at risk and also to identify areas with the highest cattle infection rates as the animals were dying. Using existing human population data (CSO, 2010), the number of carcasses per area expected to enter the food chain for human consumption was estimated. High risk areas were allocated more public health personnel, disinfectants and patrol vehicles to ensure public safety and to restrain people from handling or illegally dispersing carcasses.

3. Results

3.1. Field observations and clinical examination

3.1.1. Livestock

Anthrax was reported in five villages in Sesheke district (Fig. 1). Outbreak areas and risk ratios are shown in Fig. 1. The total herd size was 609 in the affected villages and the total mortalities were 45 (Table 1). Clinical signs included sudden death and oozing of...
Table 1
Cattle relative risk of infection and infected human carcass ratio for the outbreak areas in Seshete district, Western Zambia.

<table>
<thead>
<tr>
<th>Vet Camp</th>
<th>Human population</th>
<th>Villages examined</th>
<th>Herd size</th>
<th>Cattle mortality</th>
<th>Herd prevalence</th>
<th>Cattle relative risk of infection</th>
<th>Humans infected</th>
<th>Infected human carcass ratio</th>
<th>Total human carcass ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mwandí</td>
<td>696</td>
<td>Muyombo</td>
<td>79</td>
<td>16</td>
<td>20.25%</td>
<td>3.70 (95% CI 1.99–6.68)</td>
<td>1</td>
<td>1.16</td>
<td>36.6:1</td>
</tr>
<tr>
<td>Bbototo</td>
<td>176</td>
<td></td>
<td>3</td>
<td></td>
<td>1.70%</td>
<td>0.18 (95% CI 0.04–0.57)</td>
<td>1</td>
<td>1</td>
<td>4.5:1</td>
</tr>
<tr>
<td>Kamusa</td>
<td>143</td>
<td></td>
<td>17</td>
<td></td>
<td>11.89%</td>
<td>1.98 (95% CI 1.06–3.63)</td>
<td>0</td>
<td>–</td>
<td>49.0:1</td>
</tr>
<tr>
<td>Simenso</td>
<td>42</td>
<td></td>
<td>5</td>
<td></td>
<td>11.90%</td>
<td>1.69 (95% CI 0.60–4.07)</td>
<td>1</td>
<td>1.5</td>
<td>49.0:1</td>
</tr>
<tr>
<td>Mukela</td>
<td>169</td>
<td></td>
<td>4</td>
<td></td>
<td>2.37%</td>
<td>0.25 (95% CI 0.08–0.72)</td>
<td>0</td>
<td>–</td>
<td>42.4:1</td>
</tr>
<tr>
<td>Totals</td>
<td>1910</td>
<td>5</td>
<td>609</td>
<td>45</td>
<td>7.39%</td>
<td></td>
<td>3</td>
<td>1.15</td>
<td>42.4:1</td>
</tr>
</tbody>
</table>

Fresh blood from natural openings. Of the few animals examined, splenomegaly was the common post mortem finding.

3.1.2. Humans

Of the five affected villages, only three had human cases including two adults (a male and female) and a child below five years old. Clinical signs were characterized by carbuncles on the skin and loss of hair on the head covered by open wounds (Fig. 2).

3.2. Laboratory results

The presence of *B. anthracis* in giemsa-stained smears as well as bacterial cultures from swabs or ear samples were confirmatory of the disease. The bacteria was characterized by chains of bacilli with truncated ends and a ‘bamboo stick’ appearance with a well-defined capsule surrounding the entire chain (not shown).

3.3. Risk analysis

3.3.1. Livestock

The average herd size in the affected village was 121.8% (95% CI 48.8–194.8). Total cattle mortality for all the villages was 7.4% (45/609) while the mean mortality in the affected herds was estimated at 9.0 (95% CI 0.4–17.6) animals. Mortality of cattle at village level varied between 1.70% (3/176) and 20.25% (16/79) as shown in Table 1. As shown in Table 1, the relative risk of infection for cattle varied between 0.18 (95% CI 0.04–0.57) in Bbototo and 3.70 (95% CI 1.99–6.68) in Muyombo, Mwandí.

3.3.2. Humans

The human population at risk was estimated at 1910. Mwandí village had both the highest relative risk of infection in cattle (RR = 3.7; 95% CI 1.99–6.68) and the highest human risk ratio per carcass (37:1). The overall ratio of infected people to infected carcasses was however low (1:15). The overall human risk ratio of contracting anthrax was estimated at one carcass for every 42 people (Table 1) which was adequate to infect a large number of people.

4. Discussion

In Zambia, anthrax is a notifiable disease under Chapter 295 section 9 of the Zambia Public Health Act of the Laws of Zambia. It is therefore mandatory to report all suspected cases to Government Veterinary and Public Health officials as soon as they are noticed. Timely determination of the risk of infection for an outbreak is cardinal for mobilizing adequate resources to stop the spread of the disease. It helps identify the focal area of the outbreak where resources should be allocated first before other places that are less at risk. In the present study, Mwandí had the highest relative risk of infection for cattle (RR = 3.7; 95% CI 1.99–6.68). Coincidentally, the ratio of carcasses that could be consumed by humans and therefore be sources of infection were also high (37:1) meaning that the higher the risk in cattle, the higher it was in humans as well. Hence, timely enforcement of public health control measures such as the burning of infected carcasses, movement restrictions, forbidding the sale or sharing of meat from infected carcasses were effective tools that could be used for risk management in anthrax outbreaks. This probably explains the low overall ratio of infected people to carcasses (1:15) or why in Mwandí only one person was infected despite 16 carcasses being available and in Sankolonga where no-one was infected despite the presence of 17 carcasses.

In previous studies, Combe et al. (2010) reported an outbreak in neighboring Zimbabwe where 15 animals died and 14 were consumed by villagers. Fifty-four of these villagers were enrolled in a study that pointed to several risk factors associated with contracting anthrax from infected carcasses. In another study, Mwenye et al. (1996) reported high infection rates of humans that contracted anthrax from a few infected carcasses during an outbreak in Zimbabwe. In contrast, only three people were infected in the present study despite a high number of infected carcasses (45). Taken together, the findings of the present study demonstrate that reducing contact between infected carcasses and humans is of prime importance in preventing human infections.

Although anthrax is a disease of public health importance, its economic impact at herd level can be devastating as mortalities can be high (Table 1). Similarly, high mortalities have also been previously recorded elsewhere (Schreuder et al., 1996; Shiferaw et al., 2004). Such losses in the poor resource communities of Western Zambia impact negatively on local economies and increase the temptation of selling infected carcasses as a way of reducing losses incurred due to the outbreak. One solution of preventing anthrax outbreaks in these areas that are prone to recurrence is the routine vaccination of livestock as is already the practice. Increased public health awareness campaigns by the government are also envisaged so as to promote active participation of the general public in the control of zoonotic diseases. These should be combined with the setting up of emergency preparedness programs.

![Fig. 2. Human infection of anthrax on the head.](image-url)
essential for the timely control of diseases that impact negatively on the livelihood of resource-poor communities. As an early warning system, it is imperative that all anthrax outbreaks be reported timely to relevant officials to expedite the execution of disease control measures. The grave consequences of the failure to rapidly detect an outbreak and implement disease control measures can be illustrated by the Luangwa valley anthrax outbreak in eastern Zambia where more people were affected with 5 fatalities (Hang’ombe et al., 2012). As emergency preparedness, resources should always be allocated to areas at high risk in order to keep the risk to human at a minimum.

References


