TEMPORAL AND GEOGRAPHICAL DISTRIBUTION OF ANIMAL ANTHRAX IN TAMIL NADU STATE, INDIA

L. Gunaseelan1, R. Rishikesavan2, T. Adarsh1, R. Baskar3 E. Hamilton4 and J.B. Kaneene4

ABSTRACT

Anthrax is an endemic disease in the southern state of Tamil Nadu, India. A total of 619 anthrax outbreaks in cattle were documented over 15 years in 28 of the 30 districts from April 1991 to March 2006 with peaks between 1993 and 1995 and between 2001 and 2005. Multiple logistic regressions were used to assess the association between the three effector variables. Population of cattle per district (as per the 2004 livestock census), percent of villages with alkaline soil, and presence of a tannery were used to estimate the odds of experiencing greater than 25 anthrax outbreaks from 1991 to 2006. There were no statistically significant interactions between any of the effector variables. The only variable with statistical significance was the percent of villages with alkaline soil per district. The likelihood of greater than 25 outbreaks from 1991-2006 in districts with greater than 11.85 percent villages with alkaline soil is 12.505 (1.133, 138.024) times the odds of greater than 25 outbreaks in districts with 11.85 percent or less villages with alkaline soil, when controlling for the presence of a tannery and the number of cattle per district. The presence of a tannery or number of cattle per district did not show a statistically significant association with having greater than 25 outbreaks of Anthrax from 1991 to 2006.

Keywords: Anthrax, Cattle, Alkaline soil, Tanneries, Outbreaks

INTRODUCTION

Anthrax is basically an animal disease that has a long-recorded history in India, which means that it has been occurring in domestic cattle for hundreds of years. During all this time, it has not been credited with any serious disease of epidemic proportions in humans, although stray cases are reported amongst people working closely with cattle or sheep (Kumar et al., 2000, pp.204--246).

The incidence of anthrax in animals and in man throughout India is not known accurately due to the fact that a large number of cases go unreported and only a fraction of human cases receive medical attention in a hospital (Lalitha and Kumar, 1996).

In India, which has the largest population of livestock in the world, the disease is still endemic (Bhat et al., 1989, pp.8--11). However comprehensive reports of the disease distribution in animals are

1. Professor and Head, Department of Veterinary Public Health and Epidemiology, Madras Veterinary College, Chennai 600 007, India;
2. Assistant Professor, KVK,Namakkal
3. Directorate of Veterinary Services, Government of Tamil Nadu, India
4. Center for Comparative Epidemiology, Michigan State University, East Lansing, Michigan, United States
Corresponding Author: L. Gunaseelan: Email: hodvphmvc@tanuvas.org.in

Tamilnadu J. Veterinary & Animal Sciences 7 (6) 277-284, November - December, 2011
limited. This paper attempts to analyze the distribution of the animal anthrax in Tamil Nadu state over 15 years.

MATERIALS AND METHODS

A retrospective study of the records of anthrax documented in all 31 districts of Tamil Nadu state over the past 15 years was reviewed. Information regarding the outbreaks each year was extracted from the reports submitted by field veterinarians from around the districts and used for this study reported here. The variables, which were considered in relation to the outbreaks, were the presence of tannery, the population of cattle and the proportion of villages with alkaline soil in the districts which had outbreaks.

Statistical Methods

Analysis of these variables was performed using SAS 9.1.3. Continuous variables were assessed using 'proc univariate'. The quartiles produced from this procedure assisted in creating categories for each continuous variable. The median was used as the break point for creating categories for the number of cattle and percent of villages with alkaline soil, per district. The 75th percentile was used as the break point for creating categories for the outcome variable, number of anthrax outbreaks from 1991 to 2006.

Multiple logistic regression was used to analyze the effect of the presence of a tannery, number of cattle, and percent of villages with alkaline soil, per district on having 25 or more anthrax outbreaks from 1991 to 2006. Interactions between all three effector variables were assessed and found to not be statistically significant.

RESULTS

A total of 619 anthrax outbreaks were documented over 15 years in 29 of the 31 districts from April 1991 to March 2006, majority of them being in cattle. Though the outbreaks were throughout the 15 years, there were two peaks of occurrence between 1993 and 1995 and another between 2001 and 2005 (Figure 1) with a little over 50 outbreaks during this period and coming down to 17 outbreaks at the end of the study period in 2005-2006.

In the state of Tamil Nadu there are 577 leather tanneries (CLRI, 1990) and most of the tanneries (firms that process leather and skins) are concentrated in a handful of locations in the districts of the Cauvery and Palar river basins (Kennedy, 1999, pp.1673--1691). The following districts fall either partially or wholly under Cauvery basin: Dharmapuri, Salem, Nilgiris, Namakal, Erode, Coimbatore, Dindugul, Karur, Tiruchirapalli, Pudukottai, Perambalur, Ariyalur, Thanjavur, Thiruvarur and Nagapattinam, while only Vellore, Thiruvannamali and Kancheepuram districts are in the Palar river basin (Table 1). The districts, which had a steady report of anthrax outbreaks are depicted graphically and geographically (Figures 2 & 3). The highest number of outbreaks (213) was observed in the three northern districts in all the 15 years.

The state of Tamil Nadu is made up of 31 districts. The districts of Ramanatha puram and Chennai had no reported outbreaks and because Ariyalur was recently created, it was excluded from this analysis due to limited information. Of the remaining 28 districts, the population of cattle per district, as per the 2004 livestock census (Statistical Hand Book, 2008), percent of villages with alkaline soil, and presence of a tannery were used to estimate the odds of experiencing greater than 25 anthrax outbreaks from 1991 to 2006. The number of outbreaks experienced in each district from 1991 to 2006 ranged from 0 to 141 (median = 14.5); the number of cattle per district ranged from 3,973 to 824,136 (median = 295,065); the percent of villages with alkaline soil ranged from 0 to 47 percent (median = 11.85 percent); and 53 percent of districts had a tannery (N = 16), (Table 2). As mentioned in the methods, the median or 75th quartile was used to
determine the break points applied to these continuous variables in order to achieve binomial distributions.

Multiple logistic regression was used to assess the association between the three effector variables and the occurrence of greater than 25 outbreaks of anthrax from 1991 to 2006. Modeling revealed that there were not statistically significant interactions between any of the effector variables. The only variable with statistical significance was the percent of villages with alkaline soil per district (Table 3). The likelihood of greater than 25 outbreaks from 1991-2006 in districts with greater than 11.85 percent villages with alkaline soil is 12.505 (1.133, 138.024) times the odds of greater than 25 outbreaks in districts with 11.85 percent or less villages with alkaline soil, when controlling for the presence of a tannery and the number of cattle per district. The presence of a tannery or number of cattle per district did not show a statistically significant association with having greater than 25 outbreaks of anthrax from 1991 to 2006.

DISCUSSION

Anthrax has had an overpowering presence in the state of Tamil Nadu over the years and should necessarily have a negative impact not only on the economy of livestock rearing but also on public health. Outbreaks are almost evenly distributed over the years with a small decrease in incidence between 1996 and 2001 (Figure 1). This is possibly a result of intensive vaccination protocols, which is evidenced to play an important role in reduction of outbreaks. However the increase again after 2001 (Figure 1) cannot be attributed to any specific reason but can be assumed that concentrated attention is drawn only when outbreak numbers are above 40 and vaccinations are implemented. This hypothesis needs to be explored further.

Vaccination is an important tool in the prevention of anthrax and as seen in this study a reduction is attributed only to this prophylactic strategy, (Kumar et al., 2000, pp.240--246). Though the principal actions taken to contain outbreaks in a Canadian experience was carcass disposal, burning of the bush, vaccination and treatment, in order to avert a future outbreak, annual revaccination against anthrax was recommended for all susceptible animals in the outbreak area for at least the next three years (Chelsea et al., 2008, pp.235-237). In the outbreak areas of Tamil Nadu, a similar plan of action would assist in containing outbreaks and an annual repeat of the schedules for three continuous years would greatly help in reducing the soil survival of the spores in any given area as has been suggested by Crowther and Gambles (1983) in their observations in Cyprus.

The presence of these outbreaks to a larger extent in some districts of the State like Vellore and Tiruvannamalai (Figures 2 & 3) are an indication of interplay of certain environmental and human factors that are likely to trigger anthrax outbreaks like the free range system of rearing, relatively poor awareness of the disease and its implication in general, the presence of leather tanneries and the soil chemistry of certain geographical regions of the state.

This paper attempts to analyze the interplay of these above variables in relation to the endemicity of anthrax in the state. One of the most interesting facts of which can be related to the presence of anthrax in a specific geographic zone is the concept of “incubator areas” for anthrax which is determined by the an alkaline soil pH and dry periods which provides the microenvironment for spore survival and an increased exposure to susceptible hosts to infective doses of spores (Van Ness, 1971, pp.1303--1307). As seen in this study the number of outbreaks in the Cauvery basin, which comprise of 14 districts, was 179 during the 15 years and 1,218 villages in these districts had alkaline pH of soil. It is however interesting to note that in the Palar river basin, which has only three districts, had a higher
number of outbreaks (213) and the total number of villages in these districts with a higher soil pH was 1,041. This indicative of the presence of an alkaline soil chemistry which assists in the survival of spores and hence being an "incubator area" for anthrax.

Dragon and Rennie (1995) had proposed anthrax outbreaks during dry periods interspersed with rain. The latter results in water collection and subsequent runoffs or evaporation in dry weather, which either concentrates the spores or disperses them. Sufficient moisture is experienced in Tamil Nadu for only three to four months in a year with dry periods predominating (Kulandaivelu and Jayachandran, 1994). This explains the presence of the diseases in many parts of the state though the monthly distribution of anthrax is not presented here. The interaction of the environment is a major contributor for the endemicity.

The anthropogenic factors that could contribute to the disease is the absence of proper identification of the disease process, improper carcass disposal procedures, a fool-proof reporting system and a strategic vaccination protocol. It can be concluded that this study would increase the awareness for a continued and strengthened surveillance system for anthrax particularly in areas of greater incidence which also needs to include vaccination, the importance of ante-mortem examination before slaughter, continuing education to acquaint with reporting procedures and effective outreach programs for animal owners and livestock enterprises.

REFERENCES


Kennedy, L., 1999. Cooperating for Survival: Tannery Pollution and Joint Action in the Palar Valley (India), World Development, 27(9), 1673-1691


Lalitha, M.K. and Kumar, A., 1996. Anthrax-A continuing problem in southern India, Indian Journal of Medical Microbiology, 14, 63–72


Table 1

Number and Percent of Anthrax Outbreaks in Animals of the Palar and Cauvery Basins, 1991-2006

<table>
<thead>
<tr>
<th>District</th>
<th>Anthrax Outbreaks</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Number</td>
</tr>
<tr>
<td><strong>Palar Basin</strong></td>
<td></td>
</tr>
<tr>
<td>Vellore</td>
<td>141</td>
</tr>
<tr>
<td>Thiruvannamalai</td>
<td>52</td>
</tr>
<tr>
<td>Kancheepuram</td>
<td>20</td>
</tr>
<tr>
<td><strong>Cauvery Basin</strong></td>
<td></td>
</tr>
<tr>
<td>Ariyalur</td>
<td>3</td>
</tr>
<tr>
<td>Coimbatore</td>
<td>25</td>
</tr>
<tr>
<td>Dharmapuri</td>
<td>3</td>
</tr>
<tr>
<td>Dindugal</td>
<td>35</td>
</tr>
<tr>
<td>Kanur</td>
<td>2</td>
</tr>
<tr>
<td>Nagapattinam</td>
<td>9</td>
</tr>
<tr>
<td>Namakkal</td>
<td>5</td>
</tr>
<tr>
<td>Perambalur</td>
<td>7</td>
</tr>
<tr>
<td>Pudukottai</td>
<td>6</td>
</tr>
<tr>
<td>Salem</td>
<td>24</td>
</tr>
<tr>
<td>Thanjavur</td>
<td>20</td>
</tr>
<tr>
<td>Nilgris</td>
<td>1</td>
</tr>
<tr>
<td>Thiruvarur</td>
<td>9</td>
</tr>
<tr>
<td>Thiruchirapalli</td>
<td>30</td>
</tr>
</tbody>
</table>

*Data Source:* Compilation of documented anthrax occurring in all districts of Tamil Nadu
Table 2
Distribution and Frequencies of Variables from 30 Districts, India

<table>
<thead>
<tr>
<th>Variable</th>
<th>Ranges</th>
<th>Median</th>
<th>Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>min</td>
<td>max</td>
<td></td>
</tr>
<tr>
<td>Number of Anthrax outbreaks from 1991 to 2006</td>
<td>0</td>
<td>141</td>
<td>14.5</td>
</tr>
<tr>
<td>Number of Cattle</td>
<td>3,973</td>
<td>824,136</td>
<td>295,065.50</td>
</tr>
<tr>
<td>Percent of Villages with Alkaline Soil</td>
<td>0</td>
<td>47</td>
<td>11.85</td>
</tr>
<tr>
<td>Presence of a Tannery</td>
<td>16</td>
<td>53%</td>
<td></td>
</tr>
</tbody>
</table>

a The Ariyalur district was removed from analysis because it is newly formed accurate information on number of cattle was not available.

Data Sources:


d Districts with alkaline soil: Government of Tamilnadu, Department of Agriculture, Chennai 600 005

e Report on the Capacity Utilization and Scope for Modernization in Indian Tanning Industry, 1990 (Central Leather Research Institute (CLRI), Adyar, Chennai)

Table 3
Odds Ratio for Effect of Experiencing Greater than 25 Outbreaks per District from 1991 to 2006

a The Ariyalur district was removed from analysis because it is newly formed accurate information on number of cattle was not available.

Binomial Categorization:

b Present v Not Present

c < 295,065 cattle v 295,065 cattle

d <11.85 percent v 11.85 percent
Temporal.....

Figure 1

Anthrax Outbreaks by year in the State of Tamil Nadu, 1991-2006
Figure 2

Anthrax Outbreaks by District, in the State of Tamil Nadu, 1991-2006