Epidemiology of cattle respiratory infection in Gezira State, Sudan: Serological evidence of adenovirus 3 infection

Nada E. M¹; Intisar K. S²; Selma B.E³; Ali Y. H²

¹Veterinary Research Laboratory, P. O. Box 555, Wad Medani, Gezira State, Sudan.
²Virology Dep. Veterinary Research Institute, P. O. Box 8067, Khartoum, Sudan.
³Molecular Biology Dep. Veterinary Research Institute, P. O. Box 8067, Khartoum, Sudan.

Abstract

In this study, the epidemiology of cattle respiratory infection in Gezira State and the prevalence of BAV-3 were studied. Collected data about the reported condemned lungs due to pneumonia in slaughter houses in Gezira State during 2005-2009 was statistically analyzed. A total of 22953 (6.4%) lungs were condemned during 2005-2009, the highest percentage of condemnation was seen in autumn (36%) then summer (35%). Most of the reported cases were during April and September (11%). There was significant difference between seasons (P=0.000). The reported cattle cases diagnosed as having pneumonia in Wad Medani Veterinary Teaching Hospital in Gezira State during 2005-2009 were 209 out of 875 animals brought to the clinics (23.9%). There was no significant difference between seasons in pneumonia cases (P=0.967). Out of 287 sera samples tested by indirect ELISA for BAV-3 antibodies, 263 (91.6%) were found positive. There was a significant difference between age groups (P=0.001) but there was no significant difference between different breeds (P=0.839), sex (P=0.088) and regions (P=0.839). In calves showing respiratory signs, BAV-3 antigen was detected in 16 (36.4%) of nasal swabs while BAV-3 antibodies were detected in 35 (79.5%) of serum samples. It was concluded that respiratory infection in cattle is widely distributed in Gezira State. It is thought to be a major cause of economic loss in the cattle industry and BAV-3 is a common viral infection in large cattle herds.

Keywords: Adenovirus antibodies, ELISA, Cattle, Sudan.

Introduction

Respiratory diseases are one of the most important health problems and economic losses for the cattle industry (Sakhaee et al., 2009). Bovine respiratory syncytial virus
(BRS), parainfluenza-3 virus (PI-3), infectious bovine rhinotracheitis (IBR), bovine herpes virus-1(BHV-1), bovine viral diarrhea virus (BVD), bovine corona virus (BCV) and adenoviruses had been described as important primary role in the pathogenesis of respiratory tract diseases in cattle (Peters et al., 2004) (Hagglund, 2005).

Bovine adenovirus type 1 and type 3 (BAdV-1 and BAdV-3) are important respiratory pathogens and form acute or subacute viral diseases in cattle characterized by pyrexia, nasoocular discharge and pneumonia (Akca et al., 2004). BAdV-3 was first isolated in England during studies on the viral etiology of respiratory infection of cattle (Darbyshire et al., 1965). This virus was later reported to have a pathogenic effect on respiratory tract of cattle and induce tumors in new born hamsters.

The viral infection has a worldwide distribution, and common among cattle population especially in the respiratory system infection cases, these infections that are mostly subclinical can easily cause to clinical infections depending upon malnutrition, improper environmental conditions and other stress factors (Duman et al., 2009)

In Sudan, Intisar et al (2010) studied the incidence of adenovirus type 3 in camels and reported the first detection of adenovirus type 3 antigen and antibodies. Since the detection and isolation of adenoviruses from calf with pneumonia and enteritis in Khartoum reported by Eisa (1973), no work to investigate the epidemiology of respiratory infection in cattle and the role of adenoviruses in this infection was published. This study is intended to elucidate the epidemiology of respiratory infection in cattle in Gezira State at central Sudan and to explore the role of adenovirus in causation of respiratory infection.

Materials and methods
Retrospective study
Data about the incidence of bovine respiratory infection as well as the condemnation of lungs in the slaughter houses due to pneumonia during 2005-2009 in Gezira State were collected from the annual records of Animal Wealth General Directorate and Wad Medani Teaching Veterinary Hospital. Collected data were statistically analyzed using SPSS software program.

Sample collection
A total of 287 sera were collected randomly from cattle at different localities in Gezira state which were El-biboth (42), Atra (26), Komur El-Galeein (45), Maringan
Samples were collected from cattle showing respiratory signs as well as healthy ones at different ages, sex and breed (Table1). In addition, 44 nasal swabs were collected from calves showing respiratory signs. All samples were transported to the Central Veterinary Research laboratory on ice box and were kept at \(-20^\circ\)C till tested.

**Table (1):** Distribution of collected cattle sera for the detection of antibodies to adenovirus 3 at Gezira State, Sudan.

<table>
<thead>
<tr>
<th>Breed</th>
<th>Calves</th>
<th>Adults</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Male</td>
<td>Female</td>
<td>Male</td>
</tr>
<tr>
<td>Local</td>
<td>26</td>
<td>21</td>
<td>3</td>
</tr>
<tr>
<td>Cross</td>
<td>8</td>
<td>40</td>
<td>1</td>
</tr>
<tr>
<td>Total</td>
<td>34</td>
<td>61</td>
<td>4</td>
</tr>
</tbody>
</table>

Detection of BAV-3 antibodies using indirect ELISA.

Commercial indirect ELISA kits (Bio-X Diagnostics, Jemelle, Belgium) were used to determine the existence of antibodies against BAV-3. ELISA was applied as instructed by the manufacturer. The results of BAV-3 antibodies detection by indirect ELISA were statistically analyzed using SPSS version 11.5.

**Sandwich ELISA for BAV-3 antigen detection**

ELISA kits for detection of BAV-3 antigen in nasal swabs (Bio-X Diagnostics, Jemelle, Belgium) were used. All collected samples were tested for BAV-3 antigen, the test was conducted according to the manufacturer instructions.

**Results**

**Epidemiology of cattle respiratory infection in Gezira State**

During 2005-2009, a total of 22953 (6.4%) lungs were condemned due to pneumonia in the slaughter houses, the highest percentage of condemnation was seen in autumn (36%) then summer (35%) and winter (29%) (Fig.1a). Monthly distribution of condemned lungs was noticed, most of the reported cases were during April and September (11%) (Fig.1b). The reported cattle cases diagnosed as having pneumonia in veterinary clinics in Gezira State during 2005-2009 were 209 out of 875 animals brought to the clinic (23.9%), the highest percentage was in summer (38%), then winter (32%) and autumn (30%) (Fig.2a). The highest incidence was reported in March (12%) then August (10%) (Fig.2b). Condemned lungs due to pneumonia showed a significant difference between seasons on different years (p= 0.000).
Meanwhile no significant difference in pneumonia cases was observed between seasons on different years (p= 0.967) (Figure 3, 4).

**Figure (1a):** Seasonal distribution of condemned cattle lungs due to pneumonia in Gezira State during 2005-2009.

**Figure (1b):** Monthly distribution of condemned cattle lungs due to pneumonia in Gezira State during 2005-2009.
Figure (2a): Seasonal distribution of cattle pneumonia in Gezira State during 2005-2009.

Figure (2b): Monthly distribution of cattle pneumonia in Gezira State during 2005-2009

Figure (3): Condemnation of cattle lungs due to pneumonia (2005-2009) in Gezira State.
Figure (4):- Reported cases of cattle pneumonia in Veterinary Clinics in Gezira State from 2005-2009.

BAV-3 antibodies detection using indirect ELISA
Out of 287 sera samples tested for BAV-3 antibodies, 236 (91.6%) were found positive. Positive results were observed in sera collected from all areas with variable prevalence rate ranged between 80-100% (Table 2), variable titers of antibodies were detected; the highest was 2+ (46.5%) then 3+ (30.7 %), and 1+ (14.6 %).

BAV-3 antigen detection using sandwich ELISA
Antigen of BAV-3 was detected in 16 (36.4%) of nasal swabs; as observed for antibodies, BAV-3 antigen was detected in samples collected from all tested areas, it ranged between 14-50% (Table 3).

Association of BAV-3 antigen and antibodies in pneumonic calves
Nasal swabs and sera collected from 44 pneumonic calves were tested for BAV-3 antigen and antibodies using ELISA. Out of tested samples 16 (36.4%) tested positive for BAV-3 antigen while 35 (79.5%) of the sera from the same animals showed antibodies against BAV-3 (Table 4).

Table (2):- BAV-3 antibodies detection in cattle sera collected from different areas in Gezira state in Sudan tested by indirect ELISA.

<table>
<thead>
<tr>
<th>Area</th>
<th>Number of tested serum sample</th>
<th>Positive</th>
<th>% +ve</th>
</tr>
</thead>
<tbody>
<tr>
<td>El-bihoth</td>
<td>42</td>
<td>36</td>
<td>85.7</td>
</tr>
<tr>
<td>Atra</td>
<td>26</td>
<td>26</td>
<td>100</td>
</tr>
<tr>
<td>Komur El-Galeein</td>
<td>45</td>
<td>45</td>
<td>100</td>
</tr>
</tbody>
</table>

Nada et al., IJAVMS, Vol. 9, Issue 6, 2015:289-299
Table (3) Detection of BAV-3 antigen in nasal swabs of calves tested by sandwich ELISA.

<table>
<thead>
<tr>
<th>Area</th>
<th>Number of nasal swabs tested</th>
<th>Positive</th>
<th>% +ve</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wad El-Nor</td>
<td>7</td>
<td>1</td>
<td>14.3</td>
</tr>
<tr>
<td>Krkoj</td>
<td>12</td>
<td>5</td>
<td>41.7</td>
</tr>
<tr>
<td>Wad – Himaydan</td>
<td>10</td>
<td>4</td>
<td>40</td>
</tr>
<tr>
<td>El-Rai</td>
<td>9</td>
<td>3</td>
<td>33.3</td>
</tr>
<tr>
<td>Wad-Elmhi</td>
<td>6</td>
<td>3</td>
<td>50</td>
</tr>
<tr>
<td>Total number</td>
<td>44</td>
<td>16</td>
<td>36.4</td>
</tr>
</tbody>
</table>

Table (4) - BAV-3 antigen detection in nasal swabs and antibodies against the virus detected in serum samples of the same animals (calves) tested by ELISA.

<table>
<thead>
<tr>
<th>Specimens</th>
<th>Total number</th>
<th>Positive</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nasal swabs (Ag)</td>
<td>44</td>
<td>16</td>
<td>36.4</td>
</tr>
<tr>
<td>Serum samples (Ab)</td>
<td>44</td>
<td>35</td>
<td>79.5</td>
</tr>
</tbody>
</table>

Discussion

In this study, the epidemiology of cattle respiratory infection in Gezira State during 2005-2009 was investigated. The results revealed that the highest incidence of pneumonia in Veterinary Clinics was in March then August and the highest figures of pneumonic lungs condemned in slaughter houses was in April then September (summer and autumn seasons in Sudan) this could be attributed to the fact that respiratory defenses of cattle can be impaired by environmental conditions. This is in line with the previous reports stating that immunosuppressive stress is induced by factors such as dehydration, low or high temperatures, beside that, dust particles may

Nada et al., IJAVMS, Vol. 9, Issue 6, 2015:289-299
additionally serve as irritants and predispose for respiratory disease (Callan and Garry, 2002, Valarcher and Hagglund, 2006).

Seasonal distribution of cattle pneumonia showed that the highest incidence was in summer then winter and autumn and the highest condemnations of lungs were seen in autumn then summer and winter. This was highly expected as previously suggested that during dry season, the dusty dry wind increase irritation of the respiratory tract, preparing the ground for microbial infection and the condition may be aggravated by stress due to lack of feed or inadequate feed (Raji et al., 2000). Similar observation was reported (Al-Tarazi and Daghall, 1997) where incidence of pneumonia recorded at the beginning of rains may be due to chilling and the resultant rapid fall in temperature predisposes the respiratory tract to infection.

The present study showed that there was statistically significant difference between seasons with regards to condemned lungs due to pneumonia in slaughter houses (p = 0.000), meanwhile there was no significant difference between seasons for pneumonia cases in Veterinary Clinics (p = 0.967), this is mainly due to the low number of pneumonia cases reported to the veterinary clinics as the owners most probably do not care to report the case, they just use antibiotics directly. For that data collected from the slaughter houses can nearly to reflect the actual situation of respiratory infection as well as other infections.

Serological data suggested that bovine adenoviruses are wide spread all over the world and may be causally related to some outbreaks of respiratory disease in cattle (Alkan, 1998). Surveys on the presence of antibodies in the serum of cattle indicated that infection is wide spread but rarely leads to overt disease (Jones et al., 1997).

The results of the present study revealed that the seroprevalence of BAV-3 was 91.6 %, these results were similar to those reported by Sakhaee et al (2009), who detected antibodies against BAV-3 in all herds tested (100 %) and serologic evidence in United States indicated high prevalence of BAV-3 in cattle. Hartel et al (2004) detected BAV-3 antibodies in 15/18 (83%) cattle herds in Finland, Semra et al (2007) determined antibodies in (81.38 %) of unvaccinated cattle using serum neutralization (SN) test.

In this study, the detected seroprevalence of BAV-3 was considered far higher than that detected by Eisa and Elamin (1973) who detected BAV in 2.8% of cattle sera obtained from different provinces in Sudan tested by AGID. This indicated the
wide spread of the virus beside the highly sensitive technique (Indirect ELISA) used in this study. The same technique was used by Intisar et al (2010), who detected adenovirus type 3 antibodies in 90% of camel sera collected from different areas in Sudan.

Highest percentage of positivity observed in the present study was 2+ (46.5%) then 3+ (30.7 %), and 1+ (14.6 %), the high titer of antibodies reflects that exposure to this agent is common in these regions, and detected antibodies in investigated apparently healthy cattle indicated that, adenovirus infection is common, and could be frequently symptomless, this agreed with Mattson (1973) and (Duman et al., 2009). The significant difference between adult and young animals in antibody titer may indicate multiple previous infections in adult ones.

The highest prevalence of BAV -3 antigen in nasal swabs collected from pneumonic calves could indicate that the virus was the causing agent of the pneumonia, as it was detected during the acute stage of the disease, this is in line with the observation about the existing of the virus in nasal secretion (Kahrs, 2001).

Since the work done by Eisa (1973) this is the first study to prove the wide spread of BAV-3 in Gezira State and its association with respiratory infection in cattle. Detailed study to investigate the magnitude of this virus and its role in causation of respiratory infections in different areas of Sudan is highly recommended.

References


