Research Article

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Diagnostic importance of selected Cerebrospinal Fluid parameters listeriosis, coenurosis and oestrosis in sheep

ABSTRACT:
The aim of the present study was to evaluate the diagnostic significance of selected cellular and biochemical parameters in cerebrospinal fluid of sheep with listeriosis, coenurosis and oestrosis. A total of 25 ewes were examined, 10 with listeriosis, 5 with coenurosis, 5 with oestrosis, and 5 healthy. Cerebrospinal fluid (CPS) was collected from each ewe under investigation and examined for cellular and biochemical parameters. Polymorphonuclear cells differed significantly in listeria infected sheep than other infections (p < 0.05). However, a significant variation of total nucleated cell count and mononuclear cell among animal groups (P < 0.05). creatinine kinase, urea, creatinine and glucose ration differed significantly in listeria infected ewes when compared with coenurosis group. Malondialdehyde, superoxide dismutase, and catalase were significantly higher in coenurosis group in comparison with listeriosis group (p < 0.05). However, Reduced glutathione, nitric oxide, Lysozyme and interleukin-1β were significantly decreased (p < 0.5). The results of the present study indicate that analysis of cerebrospinal fluid is important for diagnosis of neurological disorders in sheep.

KEY WORDS:
Listeriosis, Coenurosis, sheep, CSF

INTRODUCTION:
Over and above the natural variation in behavior between breeds and in varying habitats, there exists a wide range of conditions resulting from dysfunction somewhere within the nervous system. Depending on the site and nature of the problem, the animal may be mentally normal, depressed or hyperexcitable, and may exhibit other signs ranging from slight incoordination to total collapse (Hindson and Winter, 2002).

In most ovine neurological diseases, the data collected are often not disease-specific however; the lack of pathognomonic change in serum enzymes, antibody titer or other ante-mortem test may result in a specific diagnosis only for those fatal cases which are submitted for histopathological examination. Age at onset, rate of progression of the condition, husbandry and management practices may provide useful additional information (Scott, 1995). Sheep can be affected with a variety of central nervous system (CNS) diseases, including bacterial, protozoal, and viral infections; toxins; metabolic disturbances; trauma; and neoplasia (Sisó et al., 2006).

In this study, we will use cerebrospinal fluid as a diagnostic tool to differentiate three of the most common ovine diseases in Egypt causing nervous signs and serve as a headache for the veterinarian to reach to the final diagnosis. Listeriosis is an infectious disease caused by Listeria monocytogenes and affecting a wide range of mammals, including ruminants especially sheep with main clinical features of encephalitis, septicemia, abortion, mastitis and gastroenteritis (Brugère-Picoux, 2008). Coenurus cerebralis is the intermediary larval stage of Taenia multiceps and affecting a wide range of mammals, including ruminants especially sheep with main clinical features of encephalitis, septicemia, abortion, mastitis and gastroenteritis (Brugère-Picoux, 2008). Oestrosis is a nasal myiasis of sheep and goats caused by larvae of the fly Oestrus ovis (Linne 1761, Diptera: Oestridae) (Zumpt, 1965). The development of larvae in...
the nasal-sinus cavities can lead to severe nervous signs that together with the irritation caused by the adult fly may result into serious economic losses (Papadopoulos et al., 2006).

In the present study, we will discuss the effect of listeriosis, coenurosis and oestrosis on the cerebrospinal fluid cytology, chemistry, oxidative stress and some immunological parameters aiming to reach a diagnostic criterion for each disease.

MATERIAL AND METHODS:
Animal Description:
A bout twenty-five sheep from different sheep flocks, different localities, and different flock size, of both sexes and different ages were investigated for presence of obvious nervous signs and apparently healthy sheep were collected during the period of investigation and considered as control group for this study (n = 5). Based on competent case history, clinical findings, isolation and identification of Listeria monocytogenes, postmortem examination, and histopathology and CSF analysis, the affected sheep were categorized into three main groups; listeriosis (n = 10), coenurosis (n = 5) and oestrosis (n = 5) groups.

Bacteriological Examination:
For microbiological examination, brain specimens and CSF samples were inoculated in 10 ml of Listeria Enrichment Broth with Listeria Selective Enrichment Supplement (LEB) and incubated at 30°C for 24 h then a loopful from LEB were streaked on PALCAM agar plates at 30°C for 24-48 h. Identification of the recovered isolates were done microscopically and biochemically according to (Bell and Kyriakides, 1998).

Histopathological Examination:
The necropsies were performed within 24 h after death or slaughter of diseased animals. For the histological examination, nasal and CNS tissue samples were selected and fixed in neutral 10% formalin and sections were taken at the level of the nasal septum, turbinates, ethmoidal area and sinuses also, pons, cerebral hemisphere and medulla oblongata were sectioned. Samples were dehydrated, embedded in paraffin wax and 4–5 μm-thick sections were stained with Haematoxilin and Eosin.

Cerebrospinal Fluid Sampling and Cytological Examination:
Cerebrospinal fluid was collected from the lumbosacral space into tubes containing EDTA for cytological evaluation and tubes without anticoagulant for CSF chemistry and bacterial culture. CSF analysis was performed within 1–2 hours from sample collection. Total nucleated cell count (TNCC) was measured with a hemocytometer. Differential cell counts were performed on Wright’s stained smears (Coles, 1986).

Assessment of Cerebrospinal Fluid Chemistry:
Kinetic determination of CK activity was determined spectrophotometrically at 340 nm using ready-made kits provided by ELITech company according to Burts and Ashwood (2001). Glucose was determined by using readymade kits provided by Spinreact according to Young (2001). The ratio of CSF glucose to serum glucose is called glucose ratio. Urea was determined using readymade kits provided by dp International according to Patton and Crouch (1977). Kinetic measurement of creatinine using readymade kits provided by Human, Germany, according to Heny et al. (1974). Uric acid was determined by using kits provided by Spinreact, Spain according to Young (2001). Total protein concentration was determined with a Coomassie brilliant blue spectrophotometric method using readymade kits provided by Spinreact according to Young (2001). quantities estimation of albumin was done by Brom cresol green dye (BCG) colorimetric method, using readymade kits provided by Stanbio laboratory according to Cooper and King (1972). The ratio of CSF albumin to serum albumin is called the albumin quotient and is calculated as follows:

\[
\text{Albumin quotient} = \frac{\text{CSF albumin (mg/dl)}}{\text{Serum albumin (g/dl)}}
\]

Assessment of Cerebrospinal Fluid Oxidative Stress Markers:
MDA, SOD, catalase and reduced GSH were spectrophotometrically assayed (5010, Photometer, BM Co. Germany) using commercial test kits supplied by (Randox Co.UK.) according to the enclosed pamphlet. The CSF nitric oxide was spectrophotometrically assayed using commercial test kits supplied by (Bio-Chain, Inc. USA).

Assessment of Cerebrospinal Fluid Immunological Parameters:
CSF lysozyme was determined by the turbidometric assay using microplate ELISA reader (Bio TEC, ELX800G, USA). The unit of lysozyme presents in CSF (μg/mL) was obtained from a standard curve made with lyophilized hen-egg-white-lysozyme, Sigma (Parry et al., 1965). IL-1β was determined using readymade Rat Interleukin-1 beta (IL-1β) kits provided by Thermo scientific company using microplate ELISA reader (Bio TEC, ELX800G, USA) according to Law (1996). The CSF nitric oxide was assayed spectrophotometrically (5010, Photometer, BM Co. Germany) using commercial test kits (Bio-Chain, Inc. USA).

Statistical Analysis:
Firstly, data was subjected test for normal distribution test. As the data were...
RESULTS:

Clinical findings:

All the affected sheep suffer from general signs which were common in the three investigated groups including: Isolation from the flock, moving aimlessly away from the herd, depression, dullness, listlessness, anorexia, ruminal stasis, hard faeces. Nervous, ocular and respiratory signs.

Bacteriological Examination:

Isolation of *Listeria* from the brain tissue and CSF samples was accomplished on blood agar; recovered colonies appear as a small, smooth, round, glistening, grayish white drop like colonies with a narrow zone of β-haemolysis. Isolation and differentiation of *Listeria monocytogenes* from other *Listeria* species were done on the PALCAM media as a selective enrichment media. Typical colonies recovered were grey-green, 1.5 - 5 mm in diameter, and have black sunken centers due to esculin hydrolysis.

Gram staining of *Listeria monocytogenes* were gram positive rods, present parallel to each other giving palisade appearance. Biochemical identification of *Listeria monocytogenes* was positive reactions with catalase, methyl red–Voges Proskauer (MR–VP) reactions, aesculin hydrolysis, and fermentation of rhamnose, negative reaction for urease, hydrogen sulphide production, indol and xylose.

Histopathological Examination:

Meninges of the affected sheep with listeriosis showed thickening, opacity, congested meningeal blood vessels and cloudiness of CSF with presence of small irregular multifocal, sometimes unilateral whitish areas of discoloration in the brain stem, particularly in pons and medulla oblongata. Brain tissue from coenurosis infected sheep; showed a different size fluid filled bladder varies from 2 to 4 cm in diameter with a thickened cyst wall and containing a clear watery fluid and protoscoleces of the parasite.

Nasal cavity and sinus in oestrosis cases clarified the presence of serous to purulent nasal discharges, hyperemia and thickening of the nasal mucosa besides congested blood vessels and crusts on the outer nasal orifice. Larvae in different stages of life cycle were seen in nasal cavity.

Microscopically, the early lesion of listeriosis appeared as small clusters of mononuclear cells. Later, multiple microabscesses, axonal degeneration and spongiosis were seen besides multiple perivascular lymphocytic cuffing. Leptomeningitis, represented by massive infiltration with macrophages, lymphocytes, plasma cells and few neutrophils, were also seen.

The brain from infected sheep with coenurosis showed thickened pia matter infiltrated with eosinophils, macrophages besides fibroblasts proliferation. The brain parenchyma particularly the cerebral cortex and cerebellum showed migratory tracts represented by replacement of brain tissue by necrotic debris, fibrin and erythrocytes. Later, the migratory tract replaced by granulomatous inflammation. Moreover, the bladder cyst was seen replacing the brain tissue. Some cysts were degenerated and replaced with caseous necrosis and local calcification and surrounded with congested blood vessels, eosinophils and lymphocytes or macrophages and giant cells. The Virchow robin space showed perivascular leukocytic cuffing by lymphocytes, macrophages and eosinophils.

The present histological examination of specimens from nasal cavity of sheep infected with *Oestrus ovis* larvae revealed metaplesia of the lining epithelium, edema and leukocytic infiltration mainly eosinophils and severe congestion of the blood vessels.

Cerebrospinal Fluid Analysis:

Cytological examination of CSF revealed a significant increase in TNCC, polymophonuclear and mononuclear cells in listeriosis group. In coenurosis group, there are a marked increase in TNCC but not statistically significant with a higher elevation in mononuclear cells (Table 1).

Table 1. CSF Cytological and Biochemical Parameters (mean values ± SE) in Clinically Healthy, Listeriosis, Coenurus and Oestrosis Sheep

<table>
<thead>
<tr>
<th>Group</th>
<th>TNCC 10^3/µL</th>
<th>Poly 10^3/µL</th>
<th>Mono 10^3/µL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Contr (n = 5)</td>
<td>0.04 ± 0.002 a</td>
<td>0.02 ± 0.001 a</td>
<td>0.02 ± 0.002 a</td>
</tr>
<tr>
<td>Listeriosis (n = 10)</td>
<td>0.52 ± 0.06 b</td>
<td>0.28 ± 0.034 b</td>
<td>0.25 ± 0.03 b</td>
</tr>
<tr>
<td>Coenurus (n = 5)</td>
<td>0.20 ± 0.003 c</td>
<td>0.07 ± 0.003 c</td>
<td>0.13 ± 0.003 c</td>
</tr>
<tr>
<td>Oestrosis (n = 5)</td>
<td>0.04 ± 0.002 a</td>
<td>0.02 ± 0.002 a</td>
<td>0.02 ± 0.001 a</td>
</tr>
</tbody>
</table>

TNCC = Total nucleated cell count; Poly = Polymophonuclear cells; Mono = Mononuclear cell count.

Creatine Kinase activity show a significant increase in listeriosis and coenurus groups in compare to the control group with a significant increase in listeriosis than coenurus group. Creatinine level shows a significant increase in coenurus group in compare to listeriosis and control group. Listeriosis and coenurus uric acid levels show a significant increase in compare to
control group with a significant elevation in coenurosis than listeriosis group.

Total protein and albumin quotient results show a significant increase in listeriosis and coenurosis groups in compare to the control group with non-significant change between both groups. Albumin values in CSF of listeriosis group show a significant increase to control group and non-significant change to other groups. However, a significant increase in globulin values in coenurosis group to control group and non-significant change to the other compared groups.

There is a significant increase in glucose value in CSF of listeriosis group more than other compared groups. There are non-significant changes in urea and glucose ratio between all compared groups. There are non-significant changes in cytological and biochemical parameters within oestrosis group.

Cerebrospinal Fluid Oxidative Stress Markers:

There is a significant increase of MDA, SOD, and catalase activities in listeriosis and coenurosis groups in compare to control group with a significant elevation in coenurosis group than listeriosis group. Reduced GSH level in CSF of listeriosis and coenurosis groups shows a significant decrease to the control group with a maximum reduction in coenurosis than listeriosis group. There are non-significant changes in oestrosis group to the control group (Table 2).

Table 2. Selected biochemical parameters (mean ± SD) in CSF of sheep affected with listeriosis, Coenuruses, and Oestrosis

<table>
<thead>
<tr>
<th>Group</th>
<th>CK U/L</th>
<th>Cr mg/dl</th>
<th>UA mg/dl</th>
<th>Urea mg/dl</th>
<th>TP g/dl</th>
<th>Alb g/dl</th>
<th>Q</th>
<th>Glob mg/dl</th>
<th>Glucose mg/dl</th>
<th>Glucose Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control (n = 5)</td>
<td>12 a</td>
<td>0.65 a</td>
<td>0.13 a</td>
<td>37.50 a</td>
<td>2.07 a</td>
<td>0.15 a</td>
<td>35.99</td>
<td>1.92 a</td>
<td>35.67 a</td>
<td>0.53 ab</td>
</tr>
<tr>
<td></td>
<td>± 0.58</td>
<td>± 0.03 a</td>
<td>± 0.01 a</td>
<td>± 0.76</td>
<td>± 0.05 a</td>
<td>± 0.003 a</td>
<td>± 0.68</td>
<td>± 0.05 a</td>
<td>± 2.33 a</td>
<td>± 0.04</td>
</tr>
<tr>
<td>Listeriosis (n = 10)</td>
<td>19.94 b</td>
<td>0.70 a</td>
<td>0.23 b</td>
<td>44.89 b</td>
<td>2.43 b</td>
<td>0.57 b</td>
<td>46.57 b</td>
<td>1.86 b</td>
<td>45.06 b</td>
<td>0.61 ab</td>
</tr>
<tr>
<td></td>
<td>± 0.74</td>
<td>± 0.03</td>
<td>± 0.01</td>
<td>± 2.45</td>
<td>± 0.03</td>
<td>± 0.08 a</td>
<td>± 2.13</td>
<td>± 0.07</td>
<td>± 2.35 a</td>
<td>± 0.04</td>
</tr>
<tr>
<td>Coenuruses (n = 5)</td>
<td>16.50 c</td>
<td>0.83 b</td>
<td>0.38 a</td>
<td>47.13 c±2</td>
<td>2.57 c</td>
<td>0.18 a</td>
<td>53.10 c</td>
<td>2.39 b</td>
<td>35.38 a</td>
<td>0.63 b</td>
</tr>
<tr>
<td></td>
<td>± 0.57</td>
<td>± 0.04</td>
<td>± 0.02</td>
<td>3.00</td>
<td>± 0.15 c</td>
<td>±0.004 c</td>
<td>±1.50</td>
<td>±0.15</td>
<td>±2.00 a</td>
<td>±0.10</td>
</tr>
<tr>
<td>Oestrosis (n = 5)</td>
<td>12.60 a</td>
<td>0.64 a</td>
<td>0.12 a</td>
<td>38.60 a</td>
<td>1.99 a</td>
<td>0.14 a</td>
<td>33.38</td>
<td>1.85 a</td>
<td>38.00 ab</td>
<td>0.40 a</td>
</tr>
<tr>
<td></td>
<td>± 0.51</td>
<td>± 0.05</td>
<td>± 0.01</td>
<td>± 1.08</td>
<td>± 0.05</td>
<td>± 0.002 a</td>
<td>± 0.84</td>
<td>± 0.05</td>
<td>±1.14 a</td>
<td>± 0.02</td>
</tr>
</tbody>
</table>

CK = Creatine phosphokinase; Cr = Creatinine; UA = Uric acid; Urea = Urea; TP = Total protein; Alb = Albumin; Q = Albumin Quotient; Glob = Globulin.

Cerebrospinal Fluid Immunological Parameters:

Nitric oxide value in CSF revealed a significant increase in listeriosis group to the control group and, significantly increased than the coenurosis group. There is a significant decrease in NO level in CSF of coenurosis group to the control group. Lysozyme value in CSF shows a significant increase in listeriosis group in compare to control group. IL-1β value in CSF shows a marked increase in listeriosis group more than other compared groups. There is a non-significant change in oestrosis group (Table 3).

Table 3. CSF Oxidative Stress, Antioxidant and Immunological Parameters (mean values ± SE) in Clinically Healthy, Listeriosis, Coenuruses and Oestrosis Sheep

<table>
<thead>
<tr>
<th>Groups</th>
<th>MDA nmol/ml</th>
<th>SOD U/ml</th>
<th>GSH mg/dl</th>
<th>Catalase U/L</th>
<th>NO µmol/l</th>
<th>Lysozyme µg/ml</th>
<th>IL-1β pg/ml</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control (n = 5)</td>
<td>0.79 ± 0.04 a</td>
<td>154 ± 1.27 a</td>
<td>3.01 ± 0.06 a</td>
<td>107.31 ± 2.60 a</td>
<td>15.87 ± 0.24 a</td>
<td>0.91 ± 0.01 a</td>
<td>43.12 ± 0.82 a</td>
</tr>
<tr>
<td>Listeriosis (n = 10)</td>
<td>1.42 ± 0.08 b</td>
<td>216.63 ± 4.42 b</td>
<td>1.28 ± 0.09 b</td>
<td>126.82 ± 2.82 b</td>
<td>20.60 ± 0.66 b</td>
<td>1.02 ± 0.02 b</td>
<td>52.50 ± 0.70 b</td>
</tr>
<tr>
<td>Coenuruses (n = 5)</td>
<td>1.79 ± 0.06 c</td>
<td>237.27 ± 2.30 c</td>
<td>0.82 ± 0.07 c</td>
<td>138.61 ± 3.75 c</td>
<td>13.22 ± 0.36 c</td>
<td>0.95 ± 0.004 a</td>
<td>43.96 ± 0.82 a</td>
</tr>
<tr>
<td>Oestrosis (n = 5)</td>
<td>0.82 ± 0.07 a</td>
<td>151.74 ± 1.28 a</td>
<td>3.08 ± 0.06 a</td>
<td>102.36 ± 2.67 a</td>
<td>15.86 ± 0.16 a</td>
<td>0.93 ± 0.01 a</td>
<td>42.76 ± 0.87 a</td>
</tr>
</tbody>
</table>

MDA = Malondialdehyde; SOD = Superoxide dismutase; GSH = Reduced glutathione; CAT = Catalase, NO = Nitric oxide; Lyso = Lysozyme; IL-1β = Interleukin-1β.

DISCUSSION:

The present observed clinical signs in listeriosis depends mainly on the affected nucleus in the brain; Trigeminal (CN V), facial nerve (CN VII) and glossopharyngeal (CN IX) (CN IV), (CN VI) and (CN VIII) deficits (Al-Dughaym et al., 2001; Kumar et al., 2007; Brugère-Picoux, 2008). The clinical signs observed in sheep affected with coenurosis revealed a great variance which occurs in accordance to the site of the coenurosis cysts from one cerebral hemispheres, median fissure, cerebellum, and ventricles (Scott, 2000; Sharma and Chauhan, 2006; Christodouloupolos et al., 2008). The clinical signs appeared with oestrosis investigated sheep are due to the presence of the larvae in the nasal passage with increase in the intensity of signs due to the movement of the larvae towards the nasal sinus and up to the paranasal and frontal sinuses which agree
with Caracappa et al. (2000), Alcaide et al. (2005).

Isolation and differentiation of Listeria monocytogenes from other Listeria species were done on blood agar and PALCAM media and identified microscopically and biochemically. The results obtained were similar to (Al-Dughaym et al., 2001; Kumar et al., 2007).

CSF analysis is a general index of neurological health and often provides evidence of the presence of disease. Additionally, the type and degree of CSF abnormality seem to be related as much to the location of disease as to the cause or the severity of lesion (Kaneko et al., 2008). Cytological examination of CSF from cases with encephalitic listeriosis shows a marked elevation in the TNCC with a marked increase in the polymorphonuclear and mononuclear cells with variance in their predominance from case to another (Green and Smith, 1992; Dalton et al., 1997; Brugère-Picoux, 2008). In coenurosis group; our results show a marked but not statistically significant increase in the TNCC with mononuclear cells predominating in most of cases which go parallel with Oruç and Uslu (2006).

Biochemical analysis of CSF clarifies a significant elevation in the activity of CK enzyme in listeriosis (Panczewicz, 1996; Kepa et al., 2007) and coenurosis Barichello et al. (2009) with a marked increase in listeriosis sheep to coenurosis group which indicate the severity of the clinical status and are helpful as a prognostic marker in purulent bacterial meningitis. Uric acid level in CSF shows a significant elevation in listeriosis (Rodríguez-Núñez et al., 2003; Bowman et al., 2010) and coenurosis (Altintas et al., 1997; Rodriguez et al., 2008) with an obvious elevation in coenurosis which could be attributed to the antioxidant role of uric acid and, indicative for alteration in neuronal energy metabolism. Also, a marked increase in the level of CSF creatinine were seen which may be attributed to the defect in blood brain barrier and reflects the dehydration state of the affected sheep.

Our CSF protein analysis from cases with listerial meningoencephalitis revealed a considerable increase in the CSF protein concentration which was contributed by a significant increase in albumin (Scott, 1995; Dalton et al., 1997; Kumar et al., 2007; Brugère-Picoux, 2008; Stokol et al., 2009). There is a significant increase in the level of albumin and albumin quotient in CSF which are indicative for defect in the integrity of the blood brain barrier (Scott, 2004; Di Terlizzi and Platt, 2009).

Also, our results in coenurosis cases show a marked elevation in the total proteins and globulin which may be attributed to the intrathecal production of immunoglobulin (Altintas et al., 1997; Rodríguez et al., 2008). There is a marked elevation in albumin quotient value which indicate defect in the integrity of the blood brain barriers (Scott, 1995 & 2004). Rodríguez et al. (2008) classified cases with neurocysticercosis to normal CSF, moderate and severe inflammatory process according to the increase in the total cell count and protein level in CSF.

The excess generation of reactive oxygen species (ROS) in damaged cells leads to lipid peroxidation of cell membranes, and to the oxidative damage of DNA and proteins involved in many pathophysiological processes (Gilgun-Sherki et al., 2001). The present results show a significant elevation in the level of MDA, SOD and catalase activities in CSF of listeriosis cases which agree with Christen et al. (2001) and Candelario-Jalil et al. (2001). Also, there is a marked elevation in these parameters in CSF of coenurosis cases which go parallel with Rodríguez et al. (2008) and Gilgun-Sherki et al. (2001). Reduced GSH value in our results shows a significant reduction in their level in CSF of listeriosis and coenurosis cases with marked decrease in coenurosis cases which indicate the exhaustion of this antioxidant in the removal of the produced free radical from tissue damage (Candelario-Jalil et al., 2001; Christen et al., 2001).

The immunological parameters in our results shows a significant increase in the value of nitric oxide in CSF from cases of encephalitic listeriosis which agree with Pfister et al. (2002). The increase in NO are attributed mainly to: Normal brain cells, including neurons, constitutively express inducible NO synthase (iNOS) and neuronal (nNOS), and the expressions of these molecules are increased in Listeria monocytogenes infections (Shin et al., 2000). Meanwhile, a significant reduction in NO level in CSF from coenurosis group was observed which reflects the immunosuppressant effect of neurocysticercosis and extensive tissue damage of brain parenchyma with subsequent bad prognosis. Lysozyme value in listeriosis investigated group revealed a marked elevation in CSF which go parallel with Hälgren et al. (1982) and Ribeiro et al. (1992) which produced from the increased granular and mononuclear cells in the CSF in bacterial meningitis.

IL-1β has been shown to be a mediator of meningeal inflammation in bacterial meningitis correspondingly; our results show a significant increase in the level of IL-1β in CSF from cases with ovine meningoencephalitis. The same results were observed by Akalin et al. (1994) as they reported a significantly elevated level of IL-1β in the CSF of patient with bacterial meningitis than those patients with viral and tuberculous
meningitis. Correspondingly, there were a higher sensitivity in TNF-α and IL-1β values in CSF to differentiate bacterial meningitis from aseptic meningitis (Kleine et al., 2003).

In conclusion, cerebrospinal fluid has marked changes in sheep with listeriosis and coeneurosis. However, Oestrus ovis had less effects. cellular, biochemical and immunological analysis may be of clinical value for narrowing the differential diagnosis of neurological diseases in sheep.

REFERENCES:


