

OEDEMATOUS SKIN DISEASE IN BUFFALOES (DIAGNOSIS AND TREATMENT)

GOHAR, H. M*.; SENNA, N. A.*; ABD-ELAZIZ, M. A. and FARGHALI, H.A****

* Dept. of Surgery, Anesthesiology and Radiology, Faculty of Vet. Med.,
Cairo Uni.

**Dept. of Microbiology, Faculty of Vet. Med. , Cairo Uni

Received: 1. 9. 2007

Accepted: 2. 10. 2007

SUMMARY

Skin lesions in affected buffaloes were either closed (166 cases) or open (81 cases). Forms of closed lesions (non-suppurative) included regional oedema (96), subcutaneous nodules (60) and granulating overgrowth (10). According to duration of the disease open lesions (suppurative) were acute (47), sub-acute (19) or chronic (15).

Animals treated with combination of systemic anti-inflammatory, anthelmintic drugs and antibiotics showed the highest response. It was concluded that the use of broad spectrum anthelmintic (like ivermectine or levamisole) in combination with antibiotic and anti-inflammatory drugs can increase the response to treatment by improving unspecific immunity; the effect of the exotoxins of *C. pseudotuberculosis*

indicates that further researches for production of toxoid are essential for controlling the disease.

INTRODUCTION

The world population of buffaloes is considered to be 180 million (11% of the world's cattle) but their health and welfare have not been seriously researched until relatively recently, primarily because they have had little importance in western agriculture and are restricted mainly to less developed countries. Water buffalo is valued in many parts of tropical Asia, North Africa, Europe and South America as draught animals and provider of milk, meat and hides. There are basically two types of water buffalo (Encarta 1999). In Egypt, the demand for buffalo meat is higher than beef meat, primarily because most consumers perceive it to have less intramuscular fat than lean meat.

Oedematous skin disease (OSD) is one of the

most important endemic skin diseases of buffaloes in Egypt, which appeared as an outbreak in most provinces of lower Egypt (Abu-Zaid, 2001 and Amal, 2002). The disease results in serious economic losses, however, it is not fatal. It causes marked losses in animal production in addition to costs of treatment (Hamoda, 1996).

The authors designed the present work to study the clinical picture of the disease and to suggest some trials for medicinal and surgical approaches recommended for its treatment.

MATERIAL AND METHODS

The material along the present study comprised 247 buffaloes with tentative diagnosis of Oedem-

atous skin disease. These cases were of different ages and of both sexes (156 female and 91 male buffalo). The study was conducted over a period of five years. The examined cases were collected from Giza, El-Monofeya, El-Sharkeya, El-Behera and El-Fayoum provinces and were diagnosed during two weeks interval visits in those provinces. A full history of each case was obtained using a previously designed sheet. It included age, sex and general health conditions of the animal, special examination of the lesion and treatment trials. Each animal was subjected to thorough clinical examination with special emphasis to the superficial lymph nodes particularly those related to the affected region (Fig 1) and the condition of the coat (nature and distribution of the skin lesions). Blood samples were taken on EDTA from thirty

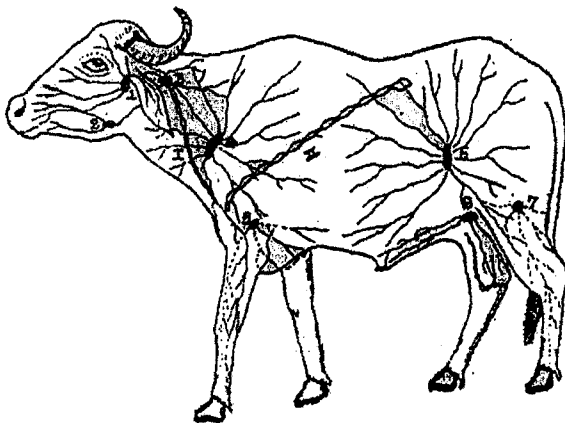


Fig.(1): Schematic Diagram of a buffalo showing superficial lymph nodes and their respective draining areas (1) Parotid, (2) Mandibular, (3) Atlantal, (4) Prescapular, (5) Axillary, (6) Prefemoral, (7) Popliteal, (8) Superficial inguinal lymph nodes.

- I. Tracheal lymph duct.
- II. Thoracic duct.

diseased and thirty apparently healthy buffaloes for estimating the values of packed cell volume, (PCV) haemoglobin (Hb), erythrocytic count (RBCs) (Kelly, 1984) and total and differential leucocytic count (Schalm, 1975) were carried out. Serum biochemical assay including serum total proteins, aspartate aminotransferase (AST), alanine aminotransferase (ALT), alkaline phosphatase (AP), and serum urea nitrogen were estimated using reagents-kits.

Trials for either medicinal or surgical treatment were carried out and had been followed up post handling. An affected buffalo was randomly located in one of the four used treatment regimen. They were surgical approach + antibiotic, antibiotic only, antibiotic + anti-inflammatory and antibiotic+ anti-inflammatory+ anti-parasitic.

Forty-one animals were treated using the first regimen. They were surgically treated and injected with systemic antibiotics. The surgical interference was performed under tranquilization with Xylazine (Rompun) ^{R(1)} 0.1mg/kg body weight intramuscularly and/or local or regional analgesia according to its site with lignocaine hydrochloride 2 % solution (Xylocaine) ^{R(2)}. The combined used antibiotics were penicillin-streptomycin (Streptopencid) ^{R(3)} (18 cases) with a dose of 25.000 i.u. and 10 mg/kg body weight respectively, oxytetracycline (Panterramycin) ^{R(4)} (14 cases) with a dose of 15 mg/kg body weight and gentamycin sulphate (Gentamycin 10% injection)

^{R(5)} (9 cases) with a dose of 4 mg/kg body weight. The antibiotic used for each treatment continued for 7-10 days. Daily dressing of the lesions with povidone iodine solution (Betadine) ^{R(6)} was performed.

The second group (39 buffaloes) was treated with systemic antibiotic only depending upon the result of sensitivity test. The used systemic antibiotics were penicillin-streptomycin (15 cases), oxytetracycline (11 cases) and gentamycin (12 cases).

The third group (44 buffaloes) was treated with systemic antibiotic and anti-inflammatory. The anti-inflammatory drugs used in group III were phenylbutazone (Arthridine) ^{R(7)} in a dose of 20-30 ml slowly intravenous for first two days the dose was decreased to 20 ml then 10 ml and dexamethazon (Dexamethazon) ^{R(8)} 1 ml per 10 kg body weight injected intramuscularly for five days. The treated buffaloes in group III were divided to six subgroups according to the used antibiotic. They were penicillin-streptomycin and phenylbutazone (11), penicillin-streptomycin and dexamethazon (5), oxytetracycline and phenylbutazone (9), oxytetracycline and dexamethazon(8), gentamycin and phenylbutazone(5) and gentamycin and dexamethazon(6).

The forth group comprised 123 buffaloes and were treated with systemic antibiotic, anti-inflammatory and anti-parasitic drugs. The anti-

parasitic drugs used in this group were ivermectin (Ivomec) ^{R(9)} 200 ug/kg body weight once subcutaneously and levamezol (Levamezol) ^{R(10)} 2.5 mg/kg body weight one dose subcutaneously daily for 3 successive days. The injected treatment regimen were penicillin-streptomycin, phenylbutazone and ivermectin (15), penicillin-streptomycin, dexamethazon and ivermectin (10), penicillin-streptomycin, phenylbutazone and levamezol (8) , penicillin-streptomycin, dexamethazon and levamezol (11) , ten cases oxytetracy-

cline, phenylbutazone and ivermectin, oxytetracycline, dexamethazon and ivermectin (9) , oxytetracycline, phenylbutazone and levamezol (12) , oxytetracycline, dexamethazon and levamezol (9) , gentamycin, phenylbutazone and ivermectin (9) , gentamycin, dexamethazon and ivermectin (11) . gentamycin, phenylbutazone and levamezol (11) and gentamycin, dexamethazon and levamezol (9).

Table 1:- Used chemicals and drugs

⁽¹⁾ Rompun 2 % solution ^R :	Bayer, Leverkusen, Germany.
⁽²⁾ Xylocaine 2 % solution ^R :	Asefoc, Belgium
⁽³⁾ Streptopencid vial ^R :	CID Co., Egypt.
⁽⁴⁾ Panterramycin solution ^R :	Pfizer, Egypt.
⁽⁵⁾ Garavet 50 vial ^R :	Nile Co., Egypt.
⁽⁶⁾ Betadine skin solution ^R :	Nile Co., Egypt.
⁽⁷⁾ Arthridine ^R :	Virbac laboratories, France.
⁽⁸⁾ Dexamethazon ^R :	Adwia, Egypt.
⁽⁹⁾ Ivomec ^R :	MSD AGVET.
⁽¹⁰⁾ Levamezol ^R :	Adwia, Egypt.

RESULTS

Clinical examination revealed that all cases except one showed normal body temperature, respiratory rate, pulse rate, mucous membranes and rumen motility, i.e. no constitutional symptoms.

In the present study, the skin lesions in affected buffaloes were either closed (166 cases) or open (81 cases). Cases with closed lesions (non-suppurative) showed three forms including regional oedema (96) (Fig 2,3), subcutaneous nodules (60) (Fig 4) and granulating overgrowth (10) (Fig. 5). According to duration of the disease open lesions (suppurative) were acute (47), sub-acute (19) or chronic (15).

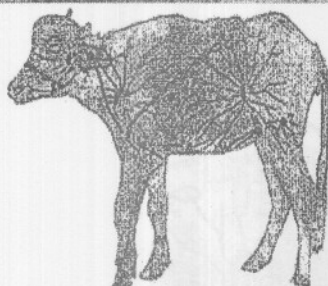
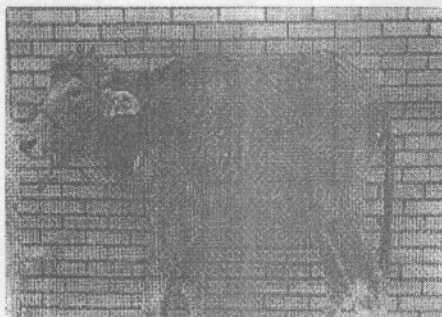


Fig 2:-A) shows a 6 months male water buffalo showing diffuse oedema at the left fore limb

B) Schematic Diagram of the same case showing the superficial lymph nodes and their respective draining areas

(1) Parotid, (2) Mandibular, (3) Atlantal, (4) Prescapular, (5) Axillary, (6) Prefemoral, (7) Popliteal, (8) Superficial inguinal lymph nodes.

I. Tracheal Lymph duct. II. Thoracic duct.

Fig 3:-A) shows 3 years female water buffalo showing oedema at the breast.

B) Schematic Diagram of the same case showing the superficial lymph nodes and their respective draining areas

(1) Parotid, (2) Mandibular, (3) Atlantal, (4) Prescapular, (5) Axillary lymph nodes.

I. Tracheal Lymph duct.

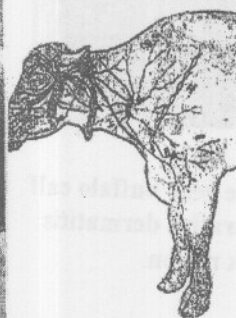
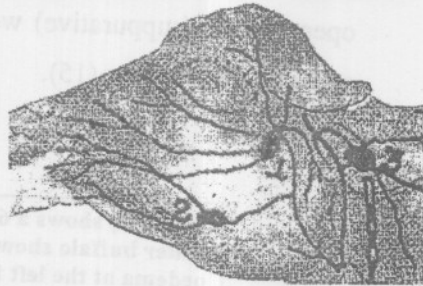




Fig 4:-A) 2 years female water buffalo showing subcutaneous nodules at the left cheek.

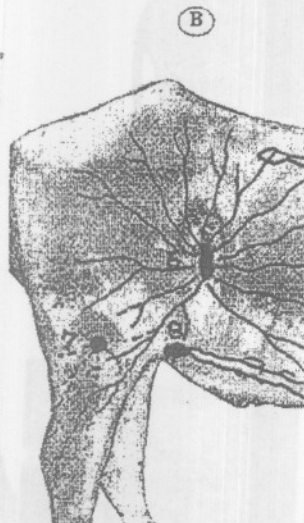


B) Schematic Diagram of the same case showing the superficial lymph nodes and their respective draining areas

(1) Parotid, (2) Mandibular lymph nodes.



Fig 5:-A) One year buffalo calf showing ulcerative dermatitis at right flank region.



B) Schematic Diagram of the same case showing the superficial lymph nodes and their respective draining areas :- (6) Prefemoral, (7) Popliteal, (8) superficial inguinal lymph nodes.

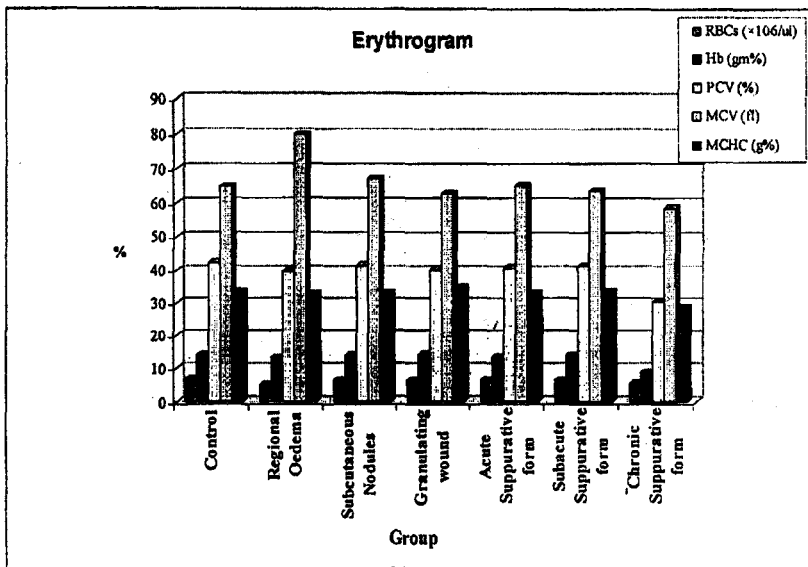


Fig (6): Erythrogram of the blood of 30 apparently healthy and 30 diseased Buffaloes

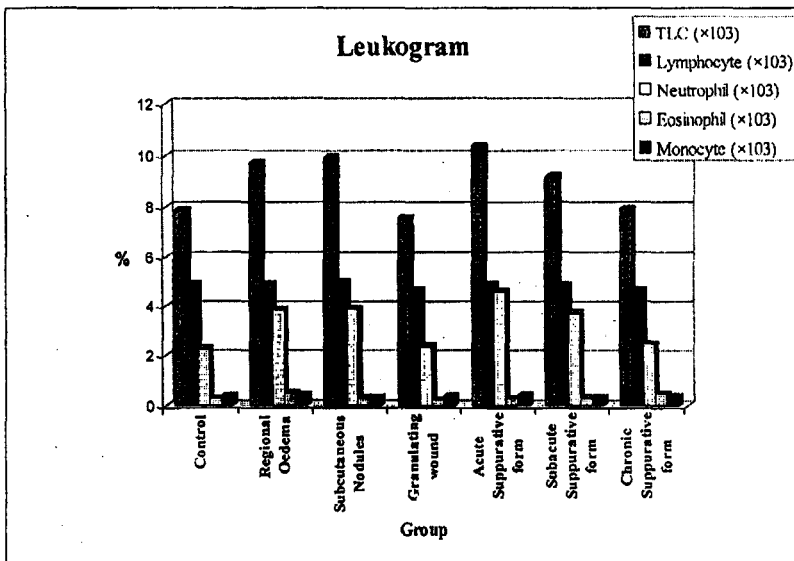


Fig (7): Leukogram of the blood of 30 apparently healthy and 30 diseased buffaloes:

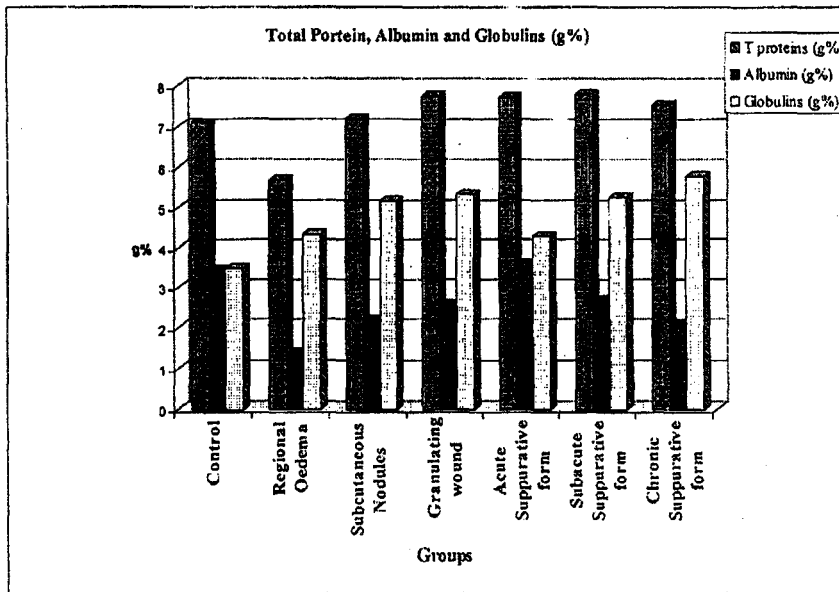


Fig (8): Total protein, albumin and globulins of the blood of 30 apparently healthy and 30 diseased buffaloes:

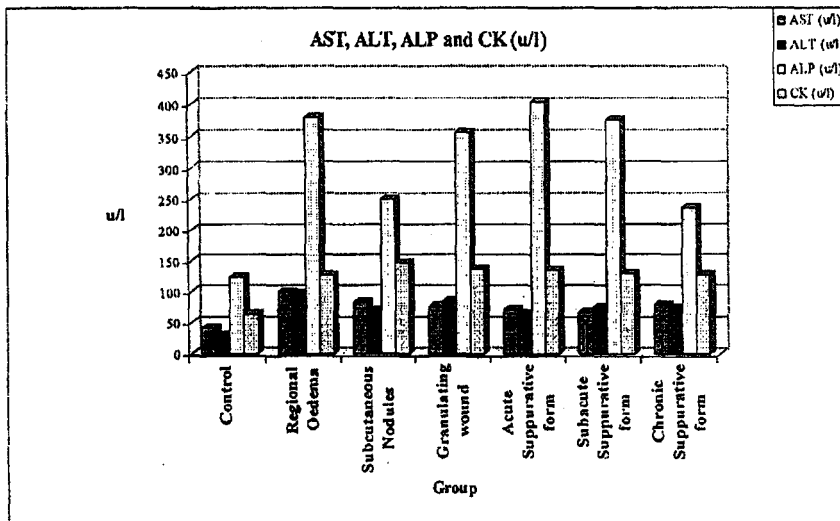


Fig (9): AST, ALT, ALP and CK of the blood of 30 apparently healthy and 30 diseased buffaloes:

Examination of drainage lymph nodes of the affected regions showed that the most commonly affected one was axillary (36.8%) then followed by pre-scapular (28.0%), pre-femoral (17.0%), popliteal (8.9%), superficial inguinal (6.1%), mandibular (2.0%) and parotid (1.2%) lymph nodes. Atlantal lymph node not affected in any recorded .

As shown in Fig 6 the Erythrogram revealed that buffaloes suffering from regional oedema showed significant decrease in total erythrocyte count and significant increase in MCV. Moreover, buffaloes suffering from chronic suppurative form showed significant decrease in total erythrocyte count, Haemoglobin, PCV, MCV and MCHC..

Regarding Leukogram, buffaloes suffering from regional oedema, acute suppurative, subcutaneous nodules and sub-acute suppurative forms showed significant increase in total leukocyte count and neutrophils. Affected buffaloes suffering from regional oedema and chronic suppurative

forms showed significant increase in eosinophils. (Fig7).

The results of blood biochemistry declared that albumin and A:G ratio were mainly low in all forms of the disease especially in regional oedema. Globulins, AST, ALT, ALP and CK were high in all forms of the disease. Urea was high in subcutaneous nodules, granulating overgrowth and chronic suppurative forms and low in regional oedema, acute and sub acute suppurative forms (Fig 8, 9).

The highest therapeutic response in treated buffalo groups was achieved in animals treated with penicillin-streptomycin combination (72.2%) penicillin-streptomycin combination (37.5%). penicillin-streptomycin in combination with phenylbutazon (63.4%) and penicillin-streptomycin in combination with dexamethazon and ivermectine or with tetracycline, dexamethazon and ivermectine (100%) in the four treated groups respectively (Table 2).

Table (2): The results of treatment trials using different regimens:

Group	Treatment regimen	Number of used buffaloes	Number of successfully treated buffaloes	% from the treated cases
Group I	Penicillin-streptomycin	41	19	46.3%
Group II	Penicillin-streptomycin + phenylbutazon	39	9	23.1%
Group III	Penicillin-streptomycin + dexamethazon + ivermectine	44	24	54.5%
Group IV	Penicillin-streptomycin + tetracycline + dexamethazon + ivermectine	123	98	79.7%
Total		247	150	60.7%

DISCUSSION

In spite that the signs of the disease were recorded mainly in buffaloes, few authors reported them in cows (Fouad et al., 1974; Esmat, 1984; Fouad et al., 1984; Barakat, et al., 1985; Abd El-galil et al., 1986; Zaghawa and El-Gharib, 1996; Khalel et al., 1995 and Hamoda, 1996). However, in the present study, all diagnosed cases were in buffaloes.

The information recorded from the examination sheet showed that the age of the affected animals, in the present work, was between 6 to 48 months. Such results are very close to those recorded by Amal (2002). The disease was recorded in number of females almost twice that of males. However, Ibrahim et al. (1983) diagnosed it only in female buffaloes.

Regarding the clinical signs, all recorded cases (except one) showed normal general health parameters (body temperature, respiratory rate, pulse rate, mucous membranes and rumenal motility), a result that might indicate that the disease is more or less a localized condition affecting a particular region of the body. The disease showed two main forms, closed and open lesions. The closed lesions were represented as regional oedema, subcutaneous nodules or granulating overgrowth. The open lesions were either acute, subacute or chronic suppurative forms. Zaghawa and El-Gharib (1996) and Zaki (1999) described the

clinical picture of the disease as closed non-suppurative and open suppurative lesions. The same forms were detected similarly throughout this study. The most commonly involved lymph nodes in fore and hind limbs were the axillary (36.8%) and prefemoral (17.0%). In the ventral abdomen and head and neck they were superficial inguinal (6.1%) and mandibular (2.0%).

In the present study, antibiotic sensitivity test was performed on 58 isolates and showed that *C. ovis* was sensitive to all used antibiotic discs in different degrees and highly sensitive to Penicillin and Ampicillin followed by Chloramphenicol, Tetracycline, Gentamycin, Erythromycin, Neomycin, Streptomycin, Becitracin and Sulphamethoxazole. The results were nearly similar to those recorded by Mostafa (1984) although he found that all *C. ovis* isolates were resistant to streptomycin. On the other hand, Garg, et al. (1985) reported strains of *C. pseudotuberculosis* that were strongly resistant to penicillin but susceptible to neomycin. Ibrahim et al. (1983) found that Kanamycine and Gentamycine were the proper antibiotics to be used. However, Hamoda (1996) found that cephalothin was the most effective antibiotic followed by kanamycin, oxytetracycline, nitrofurane, fluemaquine, pencillin, ampicilin, chloramphenicol and streptomycin. Those results were more or less similar to those recorded by Fouad et al. (1974), Biberstein and Zee (1990), Songer (1991) and Ali and Zaitoun (1999).

From the results of erythrogram, buffaloes suffering from regional oedema showed macrocytic hypochromic anemia. Moreover, buffaloes suffering from chronic suppurative form showed hypocytic hypochromic anemia. The results which are nearly similar to those recorded by Hassan et al. (1983) and Ibrahim et al. (1983) who found that total erythrocytic count, packed cell volume and haemoglobin concentration tended to decrease after the first week postinfection.

In cases suffering from regional oedema, anemia may be due to the enzymatic effect of *C. pseudotuberculosis* and Fasciola species infestation (Radostits et al., 1994). While in cases suffering from chronic suppurative form, it may be due to the long standing enzymatic effect of *C. pseudotuberculosis*.

As a sequel of bacterial infection, leukogram, buffaloes suffering from regional oedema, acute suppurative, subcutaneous nodules and sub-acute suppurative forms showed significant increase in total leukocytic count and neutrophils (Ibrahim et al., 1983 and Hassan et al., 1983). In the present study, cases suffering from regional oedema and chronic suppurative forms showed significant increase in eosinophils and probably due to parasitic infestation.

In the present study, the results of blood biochemistry declared that albumin was mainly low in all forms of the disease especially in regional

oedema. A result that agrees with those of Agag (1983), Zaghawa and El-Gharib (1996) and Amal and Thabet (1998). Amal and Thabet (1998) supposed that the most probable explanation of the low level of total protein and albumin might be due to the escape of albumin in the oedematous fluid. Moreover, it might be due to disturbance of protein metabolism caused by the effect of exotoxine of *C. pseudotuberculosis* on liver as well as effect of fascioliasis in cases of regional oedema. On the other side, globulins were high in all forms of the disease reflecting immune response of the body against *C. pseudotuberculosis* infection by formation of immunoglobulin (Agag, 1983; Abdel Salam et al., 1995 and Amal and Thabet, 1998). However, Radostits et al. (1994) noted that fascioliasis in cattle and buffaloes is usually associated with anemia, eosinophilia and severe hypoalbuminemia. They added that the critical test in an outbreak of gastrointestinal helminthiasis is the response to treatment.

AST and ALT were high in all forms of the disease. In the present study and other studies carried out by Agag (1983), Ibrahim et al. (1983), Hassan et al. (1983), Khater et al. (1983), Zaghawa and El-Gharib (1996) and Amal and Thabet (1998). Hassan et al. (1983) incriminated infection in such result as it causes hepatic disturbance. The decrease of the mentioned parameters may be attributed to the severe degenerative changes in the liver produced by *C. pseudotuberculosis* toxin as recorded by Khater et al.

(1983) and Hassan (1988).

ALP and CK levels were high in all forms and this may be due to excessive tissue destruction a result which agrees with Ibrahim et al. (1983) and Zaghawa and El-Gharib (1996). Urea level was high in long standing forms of the disease (subcutaneous nodules, granulating wounds and chronic suppurative forms). Such result that should be related to the effect of exotoxins of *C.pseudotuberculosis* and precipitation of antigen-antibody complex on the kidney (Selim 2001). However, that effect was less in acute and subacute forms of the disease (regional oedema, acute and subacute suppurative forms). These results are nearly similar to those recorded by Hassan et al. (1983) and Zaghawa and El-Gharib (1996). Hassan et al. (1983) attributed the malfunction of the liver and kidney to an exotoxins produced by *C. pseudotuberculosis*.

Regarding treatment trials using four different regimens, the number of treated buffaloes was 41, 39, 44 and 123. The last group, treated by combination of systemic anti-inflammatory, anthelmintic and antibiotics showed the highest response (79.7%) and the second group treated by systemic antibiotics only showed the lowest therapeutic response (23.1%).

The first group of buffaloes (41 cases) were treated surgically in combination with three antibiotics (penicillin-streptomycin combination, tetra-

cycline and gentamycin). The highest therapeutic response was achieved in buffaloes treated with penicillin-streptomycin combination (72.2%) followed by tetracycline (35.7%) and gentamycin (11.1%). Fouad et al. (1984), Mostafa (1984) used successfully penicillin in high dosage in combination with surgical interference. Hamoda (1996) used systemic oxytetracyclines after surgical interference and he recorded good results.

Ibrahm et al. (1983), Shpigel et al. (1993), Abou-Zaid and Hammam (1994) and Nawal et al. (1995) reported that field treatment of animals with closed lesions using systemic gentamycine for five days or surgical treatment with the antibiotic locally and systemically for ten days gave good improvement.

In the present study, 39 buffaloes (group II) were treated with systemic antibiotics (penicillin-streptomycin, 16 cases; oxytetracycline, 11 cases and gentamycin, 12 cases). The highest response was met with those treated with penicillin-streptomycin combination (37.5%). Such results indicated that the systemic treatment with antibiotic was not sufficient enough to treat the disease.

Buffaloes in group III (44 cases) were treated with combination of anti-inflammatory (phynylbutazon or dexamethazon) with the same three systemic antibiotics. The highest therapeutic response was in animals treated with penicillin-streptomycin in combination with phynylbutazon

(63.4%). Selim (2001) suggested that such used antibiotic removes *C. pseudotuberculosis* from tissues thus preventing the persistent source of PLD. He added that an anti-inflammatory drug inhibits oedema and other inflammatory signs.

Affected buffaloes in group IV (123 cases) were treated with a combination of anti-inflammatory (phenylbutazon or dexamethazon), anthelmintic (ivermectine or levamisole) with one of the same three systemic antibiotics. The highest medical response was noted in buffaloes treated with penicillin-streptomycin in combination with dexamethazon and ivermectine (100%) and those treated with tetracycline, dexamethazon and ivermectine (100%). On the other hand, Hamoda (1996) found that there was no obvious variation in the duration of clinical improvement between groups treated by oxytetracycline and levamisole or that treated by oxytetracycline alone.

Soliman et al. (1963) and Fouad et al. (1974) stated that the use of anti-filarial drugs and systemic antibiotics were helpful in the treatment of such conditions. While Mostafa (1984) used Foudain (Stipophen) and only two animals out of 12 showed good recovery.

REFERENCES

- Abd-El-Galil, Y., Ammar, M.I., Yousef, F. H. and Kenawy, A. (1986): Clinical and bacteriological studies of oedematous skin disease in buffaloes and camels in Sharkia Governorate. *Zag. Vet. J.* (1), 268-277.
- Abou-Zaid, A.A (2001): *Corynebacterium pseudotuberculosis* in buffaloes and sheep. *Vet. Med. J.*, Giza. 49, (3):435-450.
- Abou-Zaid, A.A and Hammam, H.M. (1994): Studies on some skin affections in cattle. 2-ulcerative lymphangitis. 6th Sci. Cong. Fac. Vet. Med. Assiut, Egypt.
- Ali, H.S and Zaaitoun, A.M. (1999): Studies on cutaneous suppurative lymphangitis in buffaloes at Assiut Governorate-Egypt. *Assiut Vet. Med. J.* 41, 208-218.
- Agag, B.I.A. (1983): Some causes of unthriftiness in Egyptian lambs and their combat. Ph.D. Thesis. Fac. Vet. Med. Zagazig Univ.
- Amal, M.R.E. (2002): Studies on *Corynebacterium pseudotuberculosis* infection in buffaloes. Ph.D Thesis, Fac. of Vet. Med., Cairo University.
- Amal, R. T. and Thabet, K.Y. (1998): Some biochemical studies on serum of calves affected with oedematous skin disease. *J. Egyptian Vet. Med. Ass.* 58, No. 3:461-472.
- Barakat, A.A., Osman, R.M., Afifi, E.A., Gad, A.S. and Shouman, M.T. (1985): Occurrence of bovine oedematous skin disease in different provinces. *J. Egypt. Vet. Med. Ass.* 44, 225-231.
- Biberstein, E.L. and Zee, Y.C. (1990): Review of Veterinary Microbiology. Backwell Scientific Publications, Inc., U.S.A.
- Encarta (1999): Microsoft Encarta Encyclopedia '99 CD-ROM. Microsoft Corporation, United States.
- Esmat, M.M. (1984): Studies on the so called oedematous skin disease. M.V.Sc. Thesis, Fac. Vet. Med. Zagazig Uni.

- Fouad, K., Saleh, M., Khamis, Y., Shouman, T. and Fahmy, L.S. (1974): Further investigation on so called oedematous skin disease of buffaloes and cattle. In: Egyptian Vet. Med. Assoc. (eds), Proc. 10th Arab. Ann. Vet. Congress, Cairo.
- Fouad, K., Misk, N.A. and Kassem, M. (1984): Studies on certain skin affections among ruminants. Assiut Vet. Med. J., 11, (22): 183-187.
- Garg, D.N., Nain, S.P.S. and Chandiramani, N.K. (1985): Isolation and characterization of *Corynebacterium ovis* from sheep and goats. Indian Vet. J. 62:805-808.
- Hamoda, F.K. (1996): Some studies on oedematous skin disease. J. Egypt. Vet. Med. Ass. 56, 213-231.
- Hassan, M.S., El-Allawy, T.A. and Paghib, M.P. (1983): Clinical and laboratory investigation in cattle and buffaloes experimentally infected with toxigenic strain of *Corynebacterium pseudotuberculosis*. Assiut Vet. Med. J. Vol. 11, No. 21, 1983.
- Ibrahim, M.S., Awad, Y.L., Elbalkemy, E.A. and Shoban, I.A. (1983): Some studies on the so called oedematous skin disease in buffaloes. Zag. Vet. J., Zagazig Univ., Egypt. 4, 35-50.
- Songer JG (1991): *Corynebacterium pseudotuberculosis*: in vitro susceptibility to 39 antimicrobial agents. Vet Microbiol. 1991 Apr; 27(2):145-50.
- Kelly, W.R. (1984): Veterinary Clinical Diagnosis. 2nd Ed., Bailliere Tindal, London.
- Khalel, Nawal, G., Seddek, S.R. and Nashed, S.M. (1995): Studies on ulcerative lymphangitis in buffaloes in Assiut. Assiut Vet. Med. J., 33, 65, 93-99.
- Khater, A.R., Deeb, S., Salem, H., Bayoumi, A.H. and Taha, M.M. (1983): Studies on experimental infection with *C. ovis*. 2: Pathological changes in cattle. Assiut Vet. Med. J. 10, 85-89.
- Radostits, O.M., Blood, D.C. and Gay (1994): Veterinary Medicine (8th Ed.). The English Language Book Society and Bailliere Tindall, London: 363-365.
- Mostafa, M.E. (1984): Studies on the so-called oedematous skin disease. M.D. Thesis, Zag. University, Egypt.
- Nawal, G. Khalel, Seddek, S.R. and Nashed, S.M. (1995): Studies on ulcerative lymphangitis in buffaloes in Assiut. Assiut Vet. Med. J., 33, 93-99.
- Schalm, O.W. (1975): Veterinary Haematology. 4th Ed. Lea and Fibger, Philadelphia.
- Selim, S.A. (2001): Review Oedematous skin disease of buffalo in Egypt. J. Vet. Med. B 48, 241-258.
- Shpigel, N.Y., Eland, D., Yeruham, I., Winkler, M. and Saran, A. (1993): An outbreak of *Corynebacterium pseudotuberculosis* infection in an Israeli herd. Vet. Rec., 133:39-44.
- Soliman, K.N., Agamy, F.I. and Sayour, E.M. (1963): Ulcerative lymphangitis in buffaloes and cattle in Egypt. Oedematous skin disease in buffaloes. Egyptian Vet. Med. Assoc. (eds), Proc. 4th Arab. Vet. Cong. Cairo.
- Zaghawa, A.A and El-Gharib, S.A. (1996): An outbreak of oedematous skin disease in Alexandria during 1994: Clinical investigation and assessment of epidemiological parameters. 7th Sci. Cong. 17-19 Nov, 1996, Fac. Vet. Med., Assiut, Egypt. 617-636.
- Zaki, E.R. (1999): Bacteriological studies on oedematous skin disease in buffaloes at El-Minia Governorate. 5th Sci. Cong., Egyptian Society for Cattle Disease, 20-30 Nov. Assiut, Egypt Pp. 201-204.