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With1 table and 4 figures in the text.

Concurrent Infection of *Schistosoma bovis* and *Fasciola gigantica* in a dairy cattle in Khartoum State, Sudan

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ملخص البحث

تصف هذه الدراسة التغيرات المرضيه للأنسجه وبعض معالم الدم فى أبقار محليه و مهجنه مع ابقار فريزيان مصابه اصابة طبيعيه ومتزامنه بطفيل المنشقه البقريه (*Schistosoma bovis*) وطفيلى المتورقه العملاقه (*Fasciola gigantica*) فى مشروع سوبا غرب الزراعى المروى. تمثلت العلامات المرضيه فى الإجهاد والهزال الشديد، اسهال مدمم، خشونة الشعر مع تدنى فى إنتاج اللبن. أوضحت الصفات التشريحيه شحوب الذبيحة، استسقاء ، صغر حجم الكبد مع تغير لونها الى الاخضرالمسود، ازدياد حجم المراره و إحتقان الامعاء .عند الفحص المجهرى للانسجه لوحظ وجود التهاب وفرط تنسج مزمن فى المراره مع متلازمة كبدية مزمنة. كما تبين فقر في الدم تمثل فى تدنى تركيز خضاب الدم (Hb%) وحجم كريات الدم المتراصه (PCV).

Summary

The present study describes the pathological and haematological changes of natural concurrent infection of *Schistosoma bovis* and *Fasciola gigantica* in cattle at Soba west Irrigated Agricultural Scheme, Khartoum State. Affected animals were local zebu dairy cattle and their cross bred lines with the Holstein-Friesians. Both sexes were affected. They manifested malaise, emaciation, rough coat, haemorrhagic diarrhoaea and a decline in milk production. The most prominent macroscopic features were pale carcasses, ascitis, green to black and small size livers, distended-gall bladder and congested intestines. Microscopically, chronic hyperplastic chollangitis associated with chronic hepatic syndrome were noticed. Anaemia represented by a declined haemoglobin concentration (Hb%) and a fall in PCV were encountered.

Introduction

Bovine schistosomosis and fasciolosis caused by *Schistosoma bovis* (*S. bovis*) and *Fasciola gigantica* (*F. gigantica*), respectively, are economically important diseases in the tropics (Leather *et al*, 1982; Solusby, 1982) and both parasites invade the liver. The liver flukes, *Fasciola* spp., inhabit the bile ducts and are responsible for widespread mortalities in sheep, cattle and wild animals (Roberts, 1968), whereas *S. bovis* is widely distributed among domestic animals in many African and Mediterranean countries (Solusby, 1982).

In the Sudan, *S. bovis* is common in cattle, sheep and goats but rarely encountered in camels and other farm animals (Eisa *et al*., 1979; Majid *et al*, 1980). The extent of severity of liver damage caused by both parasites was described by many authors (Sinclair, 1960; Dawes, 1961; Sewell, 1966). Heterologous infections of schistosomes and other related trematodes in various animal species are frequently reported (Ross, 1966; Boray, 1969; Anderson *et al*, 1975; Hillyer, 1981; Sirag, 1981). Mixed **i**nfection with both *S. bovis* and *F. gigantica* were studied in goats (Goreish *et al*, 1995), pigs (Ross *et al*, 1967), mice (Pelly and Hillyer, 1978; Christensen *et al*, 1978; Hillyer, 1981) and in calves (Sirag, 1981). Sequential cross-resistance due to this infection has been demonstrated in goats (Goreish *et al*, 1995).

This investigation reports on a natural cocurrent infection of *S.bovis and F. gigantica* in local and cross-bred dairy cattle raised at Soba West Irrigated Agricultural Scheme in Khartoum State, with special reference to clinico-pathological findings.

Materials and Methods

Case history:

A concurrent natural infection of *S. bovis* and *F. gigantica* was diagnosed in a cattle dairy farm at Soba West Irrigated Agricultural Scheme in Khartoum State. Affected animals were local dairy zebu cattle and their cross bred-lines with Holstein-Friesians.

Fourty one out of sixty adult cattle (morbidity rate of 68.33%) exhibited haemorrhagic diarrhoea, emaciation, rough coat and rectal temperatures ranging from 39-41ºC. Out of the affected animals, 16 of them died (mortality rate of 40.46%)

Parasitological examination:

Faecal samples were collected per rectum from each animal and divided into two portions. 10% formalin was added to one portion and was examined by the sedimentation method, whereas the other part was kept as formalin-free for examination by the floatation method.

Haematology:

Blood smears were made from the ear vein, dried, fixed in methanol and stained with Giemsa. Likewise, blood in EDTA was collected from the jugular vein and complete haemogram was done according to Schalm *et al* (1975).

Histopathology:

Two affected adult cows suffering from schistosomosis and fasciolosis were slaughtered and necropsied. Portions of liver, kidney, lung,

spleen, lymph nodes, pancreas, brain, intestine and gall-bladder were fixed in 10% formalin, embedded in paraffin wax, sectioned at 6 µm thick sections and stained with haematoxylin and eosin (H&E).

Results

Clinical signs:

The predominant clinical signs were loss of condition, inappetance, emaciation, rough coat and bloody diarrhoea. Anaemia was characterized by a decline in heamoglobin concentration (Hb%) and red blood cells (RBCs) count; a parallel fall in PVC (Table 1) was evident in all affected animals. Eosinophilia was apparent in 6 animals infected with both parasites. Other white blood cells did not deviate appreciably from the normal range in most of the infected cases.

Parasitological findings:

The results of faecal examinations showed that 25 out of 60 adult cattle (41.6%) were infected with both *S. bovis* and *F.gigantica*. Only a single infection with *F. gigantica* (1.6%) was encountered.

Pathological findings:

The most visible macroscopic features were emaciated carcasses, small hard liver and ascitis with large amount of yellowish fluid; The bile ducts were filled with *F. gigantica;* 95 adult liver flukes were recovered from one animal. The gall-bladder was distended with bile. Numerous schistosomes were observed wondering on the ventral surface of the liver and inside the mesenteric artery. Moreover, the intestines were congested.

Microscopically, the most striking findings were observed in the liver, lymph nodes and intestines. Changes in the liver included infiltration of lymphocytes, which occasionally formed lymphoid follicles, a few eosinophil aggregates proliferation of fibrous tissue in the portal tract and presence of *Schistosoma* ova. *S. bovis* ova were observed in the portal vein and free in the portal tract (Fig. 1). Occasionally, cellular infiltration and fibrotic proliferation tended to encircle the hepatic lobule resulting in pseudolobulation. In addition, haemosidrin and black pigments were seen in the kupffer´s cells and peri-portal area. The common bile duct presented adenomatous proliferation and infiltration of lymphocytes around the *S. bovis* ova in the lamina propria and free in the microvilli (Fig. 2). Sections of *F. gigantica* were evident in the lumen of the bile ducts. The gall-bladder Showed infiltration of lymphoid cells in the lamina propria and submucosa.

Complete haemogram of local zebu dairy cattle and their cross lines with Holstein-Fresian concurrently infected with *Schistosoma bovis* and *Fasciola gigantica*

Animal No.	Hb in gm	PCV %	WBCs X10³µL	RBCs X10⁶ µL	Lymph	Mono	Neutro	Eosin	Results of faecal Examination results
YL	4.9	14	5250	3.6	ND	ND	ND	7	Schisto+Fasciola
4453	7.7	24	5500	5.9	53	3	44	-	-
4463F	7.7	25	7450	5.5	61	2	33	4	-
53F	3.2	18	4800	3.7	23	6	65	6	Schisto+Fasciola
39F	3.8	12	3900	7.2	ND	ND	ND	ND	Schisto+Fasciola
4472	3.5	11	-	5.8	23	9	64	4	Schisto+Fasciola
3261	4.2	13	13100	4.0	31	7	57	5	Schisto+Fasciola
15F	3.5	11	8800	2.9	48	4	42	6	Schisto+Fasciola
40F	4.2	12	4150	3.7	47	6	42	5	Schisto+Fasciola
26F	7.7	22	5450	9.5	48	2	50	0	-
24F	6.2	18	5400	10.2	62	6	32	0	-
3260	5.3	17	2700	1.4	48	4	45	3	Schisto+Fasciola
50L	4.9	14	3700	1.2	ND	ND	ND	7	Schisto+Fasciola
19F	5.3	16	5750	5.4	56	5	36	3	Schisto+Fasciola
4468F	3.8	13	4300	9	43	0	51	6	Schisto+Fasciola
4457F	5.9	19	4400	4.7	49	0	46	5	Schisto+Fasciola
25F	5.9	19	6700	12.6	56	4	40	0	-
ZL	5.9	18	5300	1.7	ND	ND	ND	ND	-
47F	4.5	14	3000	3.4	56	3	37	4	Schisto+Fasciola
32L	4.2	14	3150	8.5	54	2	38	6	Schisto+Fasciola
X	3.5	11	3400	7.1	47	4	47	2	Schisto+Fasciola
71L	7.0	23	7000	7.7	ND	ND	ND	ND	-
58F	4.9	14	4050	11.4	ND	ND	ND	ND	-
41F	5.9	19	3750	6.4	38	3	53	6	Schisto+Fasciola
4459L	4.9	15	4050	1.5	54	6	40	0	-

lymph= lymphocyte; Mono= monocyte; Neutro= neutrophil; Eosin= eosinophil; Baso=baso

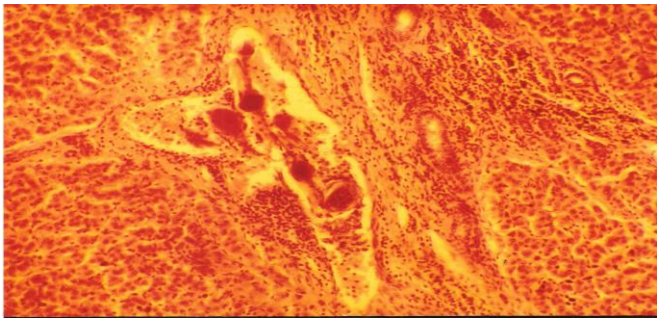

Fig 1: Liver; ***S. bovis*** **ova in the portal vein and the portal tract. Cellular exudation and fibrotic proliferation. (H & E X100).**

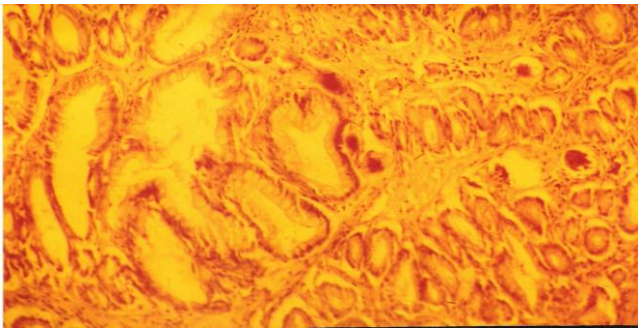

Fig 2: **Bile duct adenomatous proliferation and infiltration of lymphocytes around *S. bovis* ova in the lamina propria and free in the microvilli (H&E X100).**

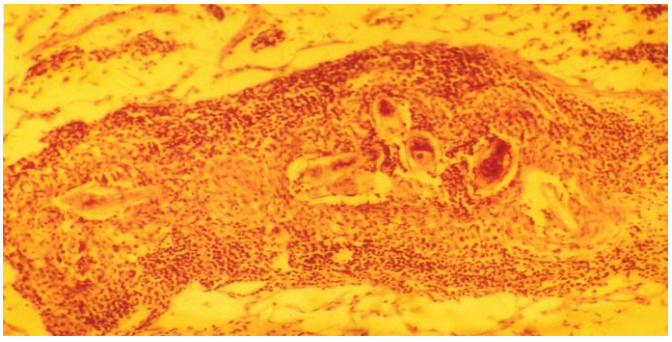

Fig 3: Lymph node, *S. bovis* ova surrounded by a granulomatous reaction of epithelioid, lymphoid cells and mass eosinophils aggregates (H&E X100).

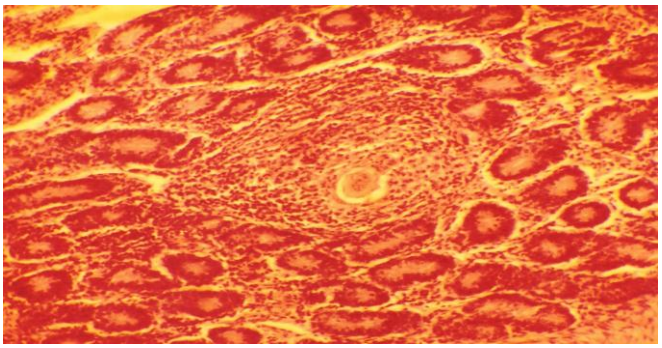

Fig 4: Intestine, Epithelioid granuloma concomitant with lymphocytic and mass eosinophils aggregates exudate (H&E X100).

The hepatic and mesenteric lymph nodes showed follicular hyperplasia. *S. bovis* ova were observed free in the trabecullae and blood vessels within the medulla. These ova were surrounded by a granulomatous reaction of epithelioid, lymphoid cells and aggregates of eosinophils (Fig.3). Parasitized blood vessels showed phlebitis with intimal proliferation and presence of adult males and females of *S. bovis*. *S. bovis* ova were detected in all the layers of the small intestine. Cellular granuloma predominantly composed of epithelioid cells, lymphocytes and eosinophils (Fig. 4) were seen in the submucosa, muscularis mucosa and serosa. Haemorrhage and lymphocytic cellular reaction were seen in the villi.

Discussion

The pathological changes described in the present investigation on concurrent infection of *S. bovis and F. gigantica* in local dairy zebu cattle and their cross bred lines with the Holstein-Friesians were comparable to those recorded previously for each parasite separately (Soulsby, 1982).

Experimental *S. bovis* infections followed by a sequential infection of *F. gigantica* in various animal species confer cross-resistance to *S. bovis* in cattle (Ross, 1966; Boray, 1969; Christensen *et al*, 1978). Cross-resistance between *S. mansoni* and *F.hepatica* is egg-dependent (Christensen *et al*, 1978) and cross infection with 1000 *S. bovis* cercaria induced resistance to heterologous challenge with *F. gigantica* in goats (Goreish *et al.*, 1995). This resistance was deduced from the reduced number of liver flukes encountered in the bile ducts. In the current investigation, 95 adult *F. gigantica* were recovered from the bile ducts of one liver; this is much lower than the finding of Sewell (1966) who detected

300-500 liver flukes per animal in old cattle with chronic fasciolosis. However, Goreish *et al* (1995) indicated that large dose of 1000 cercaria of *S. bovis* are needed to induce partial protection against *F. gigantica* and that sensitization with a small dose (500 cercaria of *S. bovis*) is not sufficient. Christensen *et al*, (1978) proved a substantial cross-resistance between *F. gigantica* and *S. mansoni*.

The cross-resistance demonstrated in laboratory models and field trials is presumably due to *schistosoma* ova granuloma that induces physical barriers to the migration into the liver parenchyma by Fasciola species (Ericksen and Flagstad, 1974). Hepatic fibrosis caused by schistosomes involvement was previously described (Ross, 1966; Boray, 1969; Nansen, 1972; Ericksen and Flagstad, 1974; Pelly and Hillyer, 1978). It may be suggested that the extensive hepatic fibrosis encountered in pigs is responsible for the innate resistance to *F. hepatica* infecton. However, it remains to be demonstrated whether this resistance has an influence on disease prevalence or severity under field condition (Sirag, 1981). Further Histopathological studies are warranted to elucidate the possible involvement of this non-immunological mechanism.

There is a marked increase in prevalence rate of *S. bovis* and *F. gigantica* infection with the increase in water conservation, construction of dams or with irrigation and increase in the animal population density (Majid *et al*, 1980; Solusby, 1982). This man-made changes are conducive for the presence of intermediate hosts of both *F. gigantica* and *S. bovis*.

In the present study, it is possible that cattle were firstly infected with *S. bovis* followed by sequential infection of *F.gigantica;* a situation led to the formation of a physical barrier by S*chistosoma* ova granuloma to the migration of juvenile stages *F. gigantica* into the liver parenchyma. Our results conform well with Sirag (1981) who believed that the problem is multi-factorial involving both humoral and cellular immunity. Further immunological studies on simultaneous or sequential infection of *S. bovis* and *F. gigantica* infections are warranted to elucidate this condition.

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