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SOME STUDIES ON PARASITIC LIVER INFESTATIONS OF CAMELS IN EGYPT

(With 2 Tables and 6 Figures)

By

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بعض الدراسات على إصابات الكبد الطفيلية في الجمال في مصر

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لإجراء هذه الدراسة على طفيليات الكبد في الجمال ، تم فحص ٥٠٠٠ جمل من سلخانة القاهرة في الفترة من مارس ١٩٩٤ إلى إبريل ١٩٩٥ ، حيث وجد أن ١,٣٪ من هذه الحيوانات مصابة بطفيليات الكبد هذا وقد تم تشخيص الأطوار الطفيلية: الفاشيولا، الأكياس المائية لتينيا الضبع، الأكياس المائية لتينيا الكلاب والحوصلات القنزبية في ١٤٪ ، ٢٦٪ ، ٠,٢٪ و ٨٨٪ من الحيوانات المفحوصة على الترتيب. هذا وقد شخصت نيدان الفاشيولا هيياتيكا لأول مرة في كبد الجمال في مصر، كما ظهر من هذه الدراسة أن الأكياس المائية لتينيا الكلاب نادرة الوجود في كبد الجمال. ويمكن إستنتاج أن طفيليات الكبد في الجمال قليلة الحدوث عامة إلا أن أهميتها تظهر باعتبار أن الجمال المصابة بها سوف تكون حاملة للعدوى، وناقلة لها إلى الحيوانات الأخرى. ويوصى الباحثون بضرورة نشر الثقافة الصحية بين مربى وقادى الجمال حتى يتم التخلص من الجمال الميتة، بطريقة صحية، أثناء تربيتها أو أثناء رحلتها الطويلة إلى مصر، كما يوصون بأهمية عمل إستقصاءات وبائية لبيان إنتشار هذه الطفيليات في الجمال، تكون متبوعة بعلاج المصاب منها، حيث أن مربى الجمال غالباً ما يهملون هذا الأجراء الهام.

SUMMARY

For studying the parasitic infestations of camel's liver, 5000 camels were examined during the period extending from March 1994 to April 1995. Out of the 5000 examined camels, 65 cases (1.3%) showed parasitic infestations in their livers. *Fasciola* spp, *Cysticercus dromedarii*, *C. tenuicollis* and hydatid

cysts were the recovered parasitic stages in incidences of 0.14% , 0.26%, 0.02% and 0.88% , respectively. Both *F. gigantica* and *F. hepatica* were recorded in all of the infested cases with *Fasciola* spp., which was considered as the first record of *F. hepatica* in camels in Egypt. *C. tenuicollis* proved to be an accidental infestation for camels. It was concluded that camel, may act as a carrier for the parasitic liver infestations and indirectly transmitting them to other animals. The authors recommend the application of the hygienic culture, among camel breeders and leaders, for the proper disposal of dead carcasses, and the application of epizootological surveys, followed by medicinal treatment of the infested cases, as camel breeders usually neglect these measures.

Key words: Camels - Liver - Parasites - Egypt

INTRODUCTION

Annually, about 89000 camels are slaughtered and consumed as meat in Egypt (Meat Hygiene Dept., Ministry of Agriculture, Egypt, 1991). Liver affections in meat producing animals, including camels, represent a loss of our national income, either through the condemnation of the affected livers, or their effect on the animal's growth and its meat production.

The parasitological infestations of camel's liver, were studied by many authors in Egypt (El-Afifi, 1962, Selim *et al.*, 1970, EL-Atabany, 1982, Mahmoud *et al.*, 1989, Tantawy, 1992 and Lotfi, 1994).

This study was designed to explore the character of the parasitological infestations and their pathological alterations in camel's liver, in a comprehensive picture.

MATERIALS and METHODS

(A) Animals

During the period, extending from March 1994 to April 1995, an investigation was performed, at the main Cairo abattoir, on 5000 camel carcasses, of both sexes. Their ages ranged from 9 months to 2.5 years old.

(B) Samples

Careful postmortem examination, was carried out on the livers of slaughtered camels. The liver's capsule was examined grossly and many incisions were made through the whole hepatic tissue. Liver specimens which

showed either parasitological infestations or pathological lesions, were collected.

(C) Techniques

1. The collected *Fasciola* worms were processed and mounted according to the Technical Bulletin no. 18 (1979) and were identified according to Yamaguti (1961), Dunn (1978) Georgi (1980) and Soulsby (1982).

Collected cysticerci and hydatid cysts were described grossly for the size, shape, dimensions and the nature of their contents (normal, caseated or calcified). The fertility of the hydatid cysts was judged by the presence of scolices, and the cysts which did not show scolices, were described as sterile cysts (Soulsby, 1982).

The viability of cysts were judged by decystation (separation of cysts from their connective tissue capsule) and cyst's evagination in an alkaline detergent (0.1% aqueous solution) of, pH9 and were incubated at 40°C. The cysts which evaginate within maximum 12 hours, were considered as viable cysts and cysts which did not evaginate within this time, were judged as unviable cysts (EL-Nawawy, 1969).

The collected cysticerci and hydatid cysts were processed and mounted according to Mary and Günther (1982) and were identified according to Yamaguti (1961), El-Nawawy (1969), EL-Mossalami and EL-Nawawy (1971), Soulsby (1982) and Zidan (1983).

The collected liver tissue specimens were fixed in 10% neutral buffered formol saline, for at least 24 hours and were routinely processed, paraffin embedded specimens were sectioned at 4-6 thickness, for further histopathological examinations.

The sections were stained with Hematoxylin & Eosin, Prussian blue and Mucicarmin stains according to Bancroft *et al.* (1994).

RESULTS

(A) Recovered genera

The examined livers of camels in this study showed that they were infested with the following parasitic stages : *Fasciola hepatica* , *F. gigantica* (family fasciolidae), *Cysticercus dromedarii*, *C. tenuicollis* (Larval stages of *Taenia hyanea* and *T. hydatigena*, respectively) and hydatid cyst (larval stage of *Echinococcus Spp.*), of family Taenidae.

Out of the 5000 examined cases, 65 cases (1.3%) proved to be affected with parasitic infestations, in their livers.

Fascioliasis

Out of the 5000 examined camels, 7 (0.14%) were infested with *Fasciola* spp. Both *F. hepatica* and *F. gigantica* were present in all of them (Fig 1.A, Table I).

Macroscopic pathology:

The infested livers were dark brown in colour, hard and tough in consistency. The affected bile ducts were thickened, tortuous and protruded above the liver surface. On cut section; it revealed presence of inspissated bile and sometimes accompanied by a gritting sound.

Microscopic pathology

There was increased fibrous connective tissue proliferation within the portal triads, interlobular connective tissue and inbetween the hepatocytes (pericellular). The proliferated fibrous connective tissue in the portal triads assumed a concentric arrangement around the small bile ducts and portal blood vessels, accompanied by heavy infiltration of inflammatory cells mostly histiocytes, lymphocytes, plasma cells and eosinophiles (Fig 6.A). The large and medium sized bile ducts revealed a variety of changes emphasized by hyperplasia of the ductal epithelium with the formation of papillomatus protrusions (Fig 6.B) and large number of the newly formed bile ducts which was arranged in an adenoid pattern simulating adenoma. The proliferated fibrous tissue inbetween the newly formed bile ducts appeared to be infiltrated with a large number of inflammatory cells. The ductal epithelium of the main and medium sized bile ducts showed dystrophic calcification. Sometimes, the biliary epithelial cells of the newly formed bile ducts showed metaplastic changes to goblet cells, which were confirmed by using Mucicarmin stain.

The portal blood vessels showed thickening of the portal veins by fibrous connective tissue proliferation and medial hypertrophy of the portal branch of the hepatic arteries.

In two cases, mature *Fasciola* worms were detected within the lumen of the affected bile ducts (Fig 4.A).

Cysticercosis

Cysticercus dromedarii was recorded in 13 cases (0.26%) and *C. tenuicollis* was detected in one case only (0.02%) out of the 5000 examined cases (Fig 2.A&B, tables I & II). The recovered *C. dromedarii* were superficially located on the liver surface. They were spherical in shape and ranged from 2 to 3 mm in diameter. The recovered *C. tenuicollis* was

spherical in shape and was 1 cm in diameter. It was attached to the liver surface with a distinct long neck (Figure 2.A.b , tables I & II).

* **Macroscopic Pathology**

- In case of *Cysticercus dromedarii*, the viable cysts were characterized by possessing a transparent cyst wall filled with colourless clear fluid, through which milky white spots 1-3 mm in diameter were seen.
- The shape of all these cysticerci were spherical and ranged from 2-5 mm in diameter and embedded within the hepatic parenchyma. These cysticerci occurred either single or multiple. The rest of the hepatic tissue revealed presence of multiple greyish areas 1 mm in diameter on the capsular surface.

One liver was found infested with *Cysticercus tenuicollis*. The cyst was transparent greyish white in colour and attached to the surface of the liver by a long neck, it measured about 1.5 cm in diameter and no gross reaction was detected at the point of attachment to the liver surface.

* **Microscopic pathology**

- In case of viable cysts, they were surrounded by fibrous connective tissue capsule infiltrated with inflammatory cells mostly lymphocytes, histiocytes and plasma cells (Fig 5.A&B). The hepatic cells adjacent to the cysts suffered from pressure atrophy, while other hepatocytes revealed vacuolar and granular proteinous dystrophy.
- In case of dead or degenerated cysts, either caseated or calcified, the necrotic remnants of the cysts were surrounded by a thick fibrous connective tissue capsule which showed heavy infiltrations by lymphocytes, histiocytes, few plasma cells, RBCs, and infrequently multinucleated giant cells.
- In all cases, at the vicinity of the cysts, there were small golden brown minute granules, irregular in shape, variable in size and occurred either free or engulfed by phagocytic cells. These granules were identified as hemosiderin pigment.

In case of *Cysticercus tenuicollis* the infested liver showed variable degenerative changes manifested by vacuolar and granular dystrophy.

Hydatidosis

Hydatid cysts were recorded in 44 cases (0.88%) out of the 5000 examined cases (Fig 3.A, tables I&II). Most of the cysts were of 2-4 cm in diameter, but it reached the size of 10 cm in some cases. While 6.8% of the hydatid cysts were fertile, 36.4% of them were sterile (Table II).

*** Macroscopic pathology**

The surface of the liver was studded by single or multiple cysts either superficially or embedded in the hepatic parenchyma. The cysts varied from 3 mm to more than 5cm in diameter. The cysts were either oval or spherical with variable shapes and dimensions. In case of viable cysts, most of them were greyish white in colour, soft in consistency, on cut section a clear or turbid fluid either white or pale yellowish in colour was oozed. In case of fertile cysts, the inner layer of the cyst exhibited a velvet-like appearance corresponded to the presence of scolices and brood capsules.

In case of degenerated or dead cysts in early stages, some of them were surrounded by a thick capsule which had gelatinous contents, meanwhile the older cysts were tough resembling cartilage, or they were hard or calcified.

*** Microscopic pathology**

In case of viable cysts, there were inflammatory cellular infiltrations around the lamellated wall of the cysts consisting of histiocytes, lymphocytes, plasma cells and eosinophils and intermingled with scattered fibroblast cells (Fig. 3.B).

In case of degenerated or dead cysts the fibrous connective tissue capsule of the cysts was surrounded by inflammatory cell infiltrations mostly histiocytes, lymphocytes and few plasma cells.

In case of caseated cysts, the fibrous capsule enclosed homogenous eosinophilic material while in calcified cysts, it enclosed basophilic structureless masses.

DISCUSSION

Fascioliasis

The low incidence of fascioliasis in camels which was recorded in this study (0.14%), is in agreement with that of Farrah, 1993 (0.18%) in Sharkia (Egypt) and Nafie et al (1992) in North of Sinai (1.3%). This low incidence of camel fascioliasis in Egypt had been related, by Soliman (1962) to the type of grazing system by camels. The authors disagreed with this opinion, as the low incidences which were recorded in this study and in Soliman's study were obtained mostly from Sudanese camels, slaughtered at Cairo abattoir. Those camels were grazing the wild grasses in the marshy lands in Sudan. Also, the low incidence which was recorded by Nafie et al (1992), was in North of Sinai, in camels which were grazing wild desert plants. The

authors agree with the opinion of Selim et al. (1970), who attributed this low incidence of fascioliasis in camels, to the rich connective tissue in camel's liver, which hinders the penetrative action of the migrating larvae of *Fasciola* spp. in the liver.

Higher incidence of fascioliasis was recorded by Mahmoud et al., 1989 (12%) in camels in Assiut. The authors think that Mahmoud's result is fairly higher than the actual incidence, as the researchers in that work depended upon the histopathological lesions alone for identifying the parasite. These lesions could be done by other causative agents, in addition, they did not depend on the confirmative parasitological examinations, which insure the parasitism. The authors recorded *F. gigantica* in all of the infested cases with fascioliasis in this study, which was in agreement with the findings of Nagaty (1942), Soliman (1960 b), Selim et al., (1970) in Egypt and EL-Bihari (1986) in Saudi Arabia.

The authors also recorded *F. hepatica* in all of the infested cases with fascioliasis in this study, which disagreed with the findings of all the previous Egyptian workers, who never recorded this species in the examined camels.

It is worthy to notice that EL-Azazy and Schillhorn (1983) stated that there were no records of *F. hepatica* in the native Egyptian animals up to that date. From the other side of view, this result was in agreement with those of Cross (1917) in India and EL-Bihari (1986), in Saudi Arabia, who recorded *F. hepatica* in camels. *F. hepatica* was recorded in Egypt in sheep, goat and cattle by El-Refaii (1969) in the New Vally, and Selim et al. (1970) recorded *F. hepatica* in the imported cattle and sheep. This is the first time, in this study, to record *F. hepatica* from camels in Egypt.

The macroscopical pictures in all of the infested cases proved that infestation was in a late chronic stage. These pictures were previously described in camel's liver infested with fascioliasis by Mahmoud et al., (1989), Fahmy & EL-Attar (1990) and Farrah (1993). The presence of chronic inflammatory changes and absence of new migratory tracts in all of *Fasciola* infested camel's livers, may be attributed to the excessive amount of fibrous tissue normally existing in camel's liver. This was act as an obstacle to the migrating larvae and provide an evidence of discontinuation of infection, which may play a role in the natural resistance to the infestation (Mahmoud et al., 1989 and Fahmy and EL-Attar 1990).

The histopathological changes detected in all *Fasciola* infested livers were previously mentioned by Mahmoud et al., (1989) and Fahmy and EL-Attar (1990), in camel's liver and by Shehata (1954), Selim et al. (1970),

Motwally and Sami (1982) and Swarup and Pachaur (1987) in the liver of cattle and by Ross *et al.*, (1967) and EL-Mahdy (1975) in the liver of sheep.

In two affected cases, the ductal epithelium revealed necrosis and desquamation of the lining epithelial cells, dystrophic calcification and presence of mature worms within its lumina.

Degeneration and necrosis of the ductal epithelium of the intra-hepatic bile ducts may be due to the effect of toxic products elaborated by *Fasciola* worms (Mahmoud *et al.*, 1989).

The presence of mature worms within the lumen of the intra-hepatic bile ducts brings about a continuous irritation and lead to hyperplastic proliferations which was emphasized by papillomatus projections and formation of large number of the newly formed bile ducts (Shehata, 1954 and EL-Mahdy 1975).

One of the most important changes in the ductal epithelium of the newly formed bile ducts which assumed an adenoid pattern, is the presence of multiple vacuoles of variable sizes which stained red with Mucicarmin stain. The presence of these vacuoles indicates that the ductal epithelium underwent metaplastic changes to goblet cells and its cytoplasm was loaded with mucinous secretions. These changes were coincided with the findings of EL-Mahdy (1975), who reported the presence of catarrhal cholangitis in sheep liver infested with fascioliasis.

Proliferation of the fibrous tissue within the wall of the portal veins, which resulted in vein occlusion and in turn reduce portal blood supply, and increase of intra-hepatic resistance as the result of massive fibrosis was compensated by arterial medial hypertrophy. (TDC, 1974).

Cysticercosis

The incidence of *C. dromedarii* in the examined livers in this study (0.26%), was higher than that recorded by EL-Nawawy, (1969) (0.1%) in Egypt, which indicated that camel cysticercosis is of increasing incidence. This could be attributed to the enlargement of camel's importation to Egypt through the last two decads.

From the other side of view, this incidence of camel cysticercosis in Egypt, is fairly lower than that recorded by Pellegrini, 1945 (23%) in the livers of Somali camels. This could be attributed to the scarcity of the definitive host (*Hyaena hyaena*) in Egypt, in comparison to Somalia (Hoogstral, 1964).

Of the procured cysticerci in this study, 30.8% were viable, which is nearly in agreement with EL-Nawawy (1969) (50%). Only one case was

found to be infested with *C. tenuicollis* in this study (0.02%), which is in agreement with EL-Afifi, 1962 (0.2%) and Farrah, 1993 (0.012%). It was clear from these records, that *C. tenuicollis* in camels is an accidental infestation.

Our study revealed that the affected cases with viable cysts had a transparent cyst wall with a milky white spot in the center (scolex). The degenerated cysts, either caseated or calcified appeared to be surrounded by thick fibrous capsule and had cheesy contents in caseated cysts, or hard and showing gritting sound on cut section in calcified cysts. These findings were quite similar to those reported by EL-Nawawy (1969), EL-Sergany *et al.*, (1970), EL-Mossalami and EL-Nawawy (1971) and EL-Atabany (1982).

The histopathological features detected in case of viable cysts were completely different from those observed in case of dead or degenerated cysts. In case of dead cysts, it was surrounded by a thick fibrous connective tissue capsule and the hepatic tissue revealed an extensive intercellular and interlobular fibrous connective tissue proliferation. These changes may be due to the fact that the cysticerci after their death act as a foreign body and resulted in changes which may be related to their toxic effect and the increased pressure upon the surrounding tissue (EL-Nawawy, 1969 and EL-Sergany *et al.*, (1970).

The presence of minute golden brown Prussian blue positive hemosiderin pigment, either free or engulfed by the phagocytic cells in one case, may be attributed to the excess hemolytic activity caused by bacterial infection (Monlux and Monlux, 1972 and Jones and Hunt, 1983).

Hydatidosis

The incidence of liver hydatidosis in this study (0.88%) was lower than that recorded by Ahmed (1991) and by Lotfi *et al.*, (1994) in Assiut Governorate, Upper Egypt (3.06% and 4.65%, respectively), which could be attributed to the high availability of the definitive host (carnivores) in such places. From the other side, it was higher than that recorded in earlier works by EL-Garhy and Selim (1957) (0.31%) and Sedik *et al.* (1976) (0.35%) in Egypt.

We can conclude that the incidence of hydatidosis in camel's livers is increasing through the last four decades. This may be attributed to the flourishing of camel meat consumption by the Egyptian people, and consequently the flourishing of camel's importation to Egypt.

The histopathological pictures detected in the liver infested with viable hydatid cysts consisted of infiltration by inflammatory cells around the

outer lamellated layer of the cyst. These findings were greatly similar to those observed by EL-Garhy and Selim (1957), Afshar *et al.*, (1971) and Hamdy *et al.*, (1984).

In case of caseated and calcified cysts, the thick fibrous capsule of the cyst appeared to be enclosing the necrotic remnants of the cyst. Around the capsule, there was an intense tissue reaction composed of mononuclear cellular infiltration, beside the presence of few eosinophils, a result which was in accordance to those described by Gutierrez (1990).

Many of the imported camels to Egypt, from the neighbouring African countries, fall dead, during their exhaustive long journey from there to Egypt, and their carcasses are left exposed to carnivores in the desert, which enhance the spread of the disease. This attract our attention for the necessity of applying the hygienic culture among camel leaders and breeders for proper hygienic disposal of dead camels by burrying or burning, to reduce such infestation.

Generally, the parasitic infestations of the liver of camels appear to be of low incidences, but at the same time, camels appear to be very important carriers for such infestations, transmitting them to other animals in the field. Hence, it is very important to make field surveys on camels, followed by medicinal treatment , as camel breeders mostly neglect such measures.

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Table I
Incidence of various parasitological infestations in the livers of camels (related to the 5000 examined cases).

	<i>Fasciola</i> spp	Cysticerci		Hydatid cyst	Total
		<i>C. dromedarii</i>	<i>C. tenuicollis</i>		
No	7	13	1	44	65
%	0.14%	0.26%	0.02%	0.88%	1.3%

Table II
Classification of the infested cases with larval stages of family Taenidae according to its condition.

	Fertile		Sterile		Caseated		Calcified		Total	
	No	%	No	%	No	%	No	%	No	No
	<i>C. dromedarii</i>	4	30.8%			4	30.8%	5	38.4%	
<i>C. tenuicollis</i>	1	100%			0	0%	0	0%		1
Hydatid Cyst	3	6.8%	16	36.4%	13	29.5%	12	27.3%		44

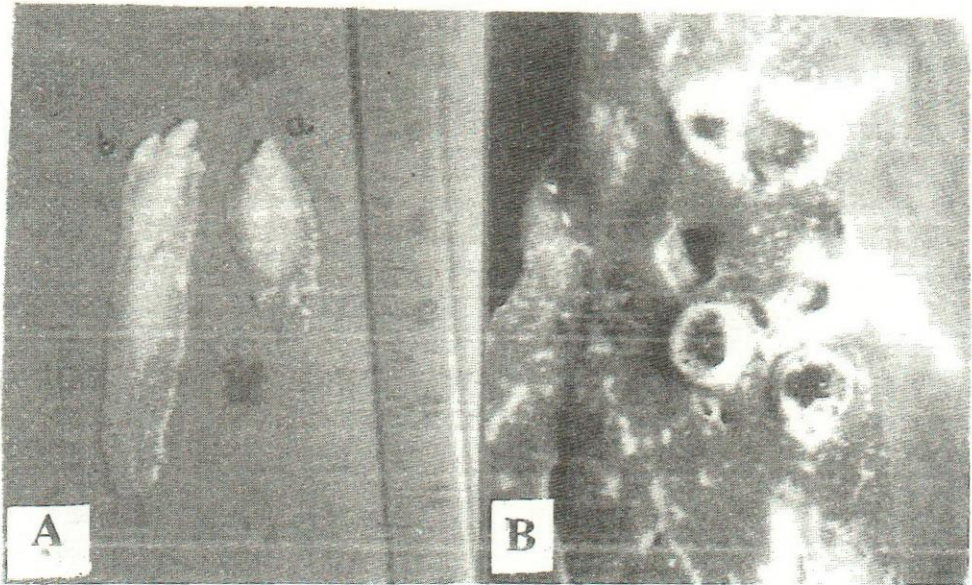


Fig. 1:

A: Adult *Fasciola hepatica* (a) and *F. gigantica* (b)
B: Cut surface of liver of camel infested with fascioliasis.

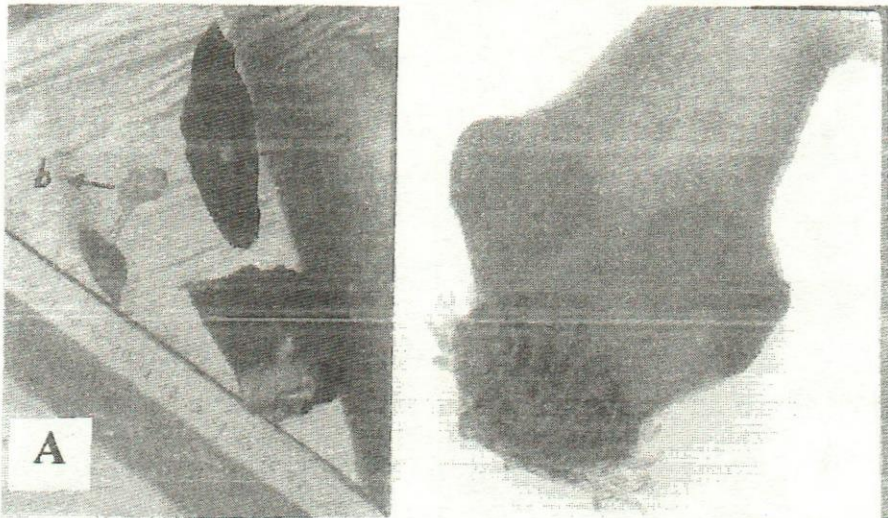


Fig. 2:

A: Liver of camel infested with (a) *Cysticercus dromedarii* and
(b) *C. tenuicollis*.
B: Evaginated scolex of *C. dromedarii* (x 60)

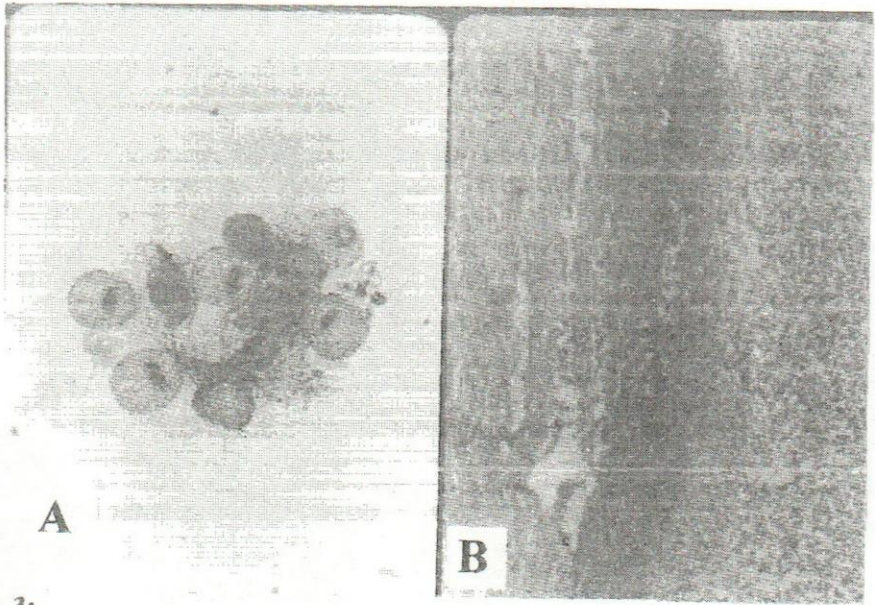


Fig. 3:

A: Hydatid sand. (X 100)

B: Portion of a viable hydatid cyst, illustrating inflammatory cell infiltrations around the outer lamellated layer of the cyst (H & E x 100).

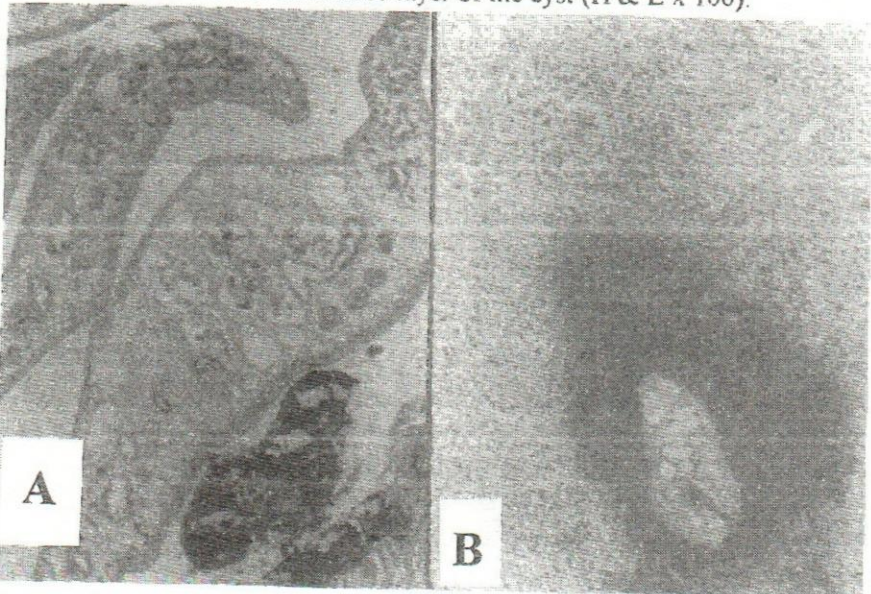


Fig. 4:

A: Showing mature *Fasciola* worms, within the lumen of the main bile duct. (H & E . x 250).

B: Showing a body of migrating larva, within the core of the granuloma, surrounded by eosinophilic necrotic zone and heavy aggregations of inflammatory cells. (H & E. x 100).

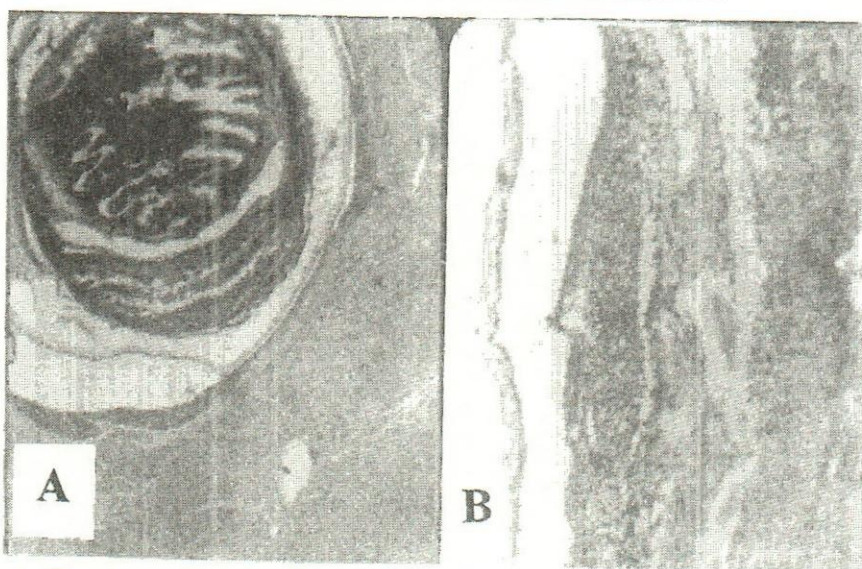


Fig 5:

- A: Showing a viable *Cysticercus dromedarii* in camel's liver, the cyst was surrounded by thin fibrous c. t. capsule, with inflammatory reaction. (H & E X 32).
- B: Showing a portion of viable *C. dromedarii* with the intact bladder wall(top), and the fibrous capsule revealed heavy infiltration with inflammatory cells, and the adjacent atrophied hepatocytes (bottom). H&E x 100.

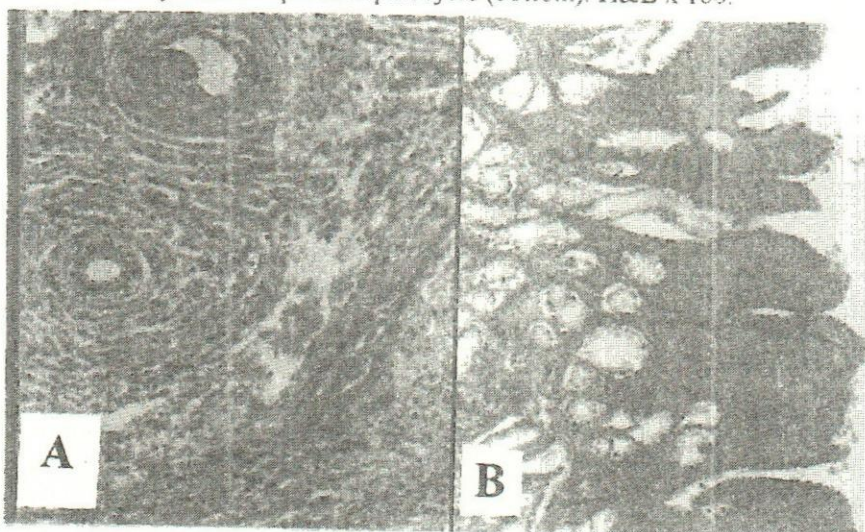


Fig. 6:

- A: Showing fibrous c.t. proliferation within the portal triads, with concentric arrangement around small bile ducts and portal blood vessels, infiltrated with inflammatory cells (H&E x 250).
- B: Illustrating papillomatous protrusions of the hyperplastic epithelial lining of the intrahepatic bile ducts, with the formation of newly formed bile ducts. (H & E x 100).

