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Pathological studies on *Campylobacter jejuni* and C. coli isolated from diarrheic camel - calves

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SUMMARY

A total of 200 internal organs (intestine, liver, spleen and mesenteric lymph node) were collected from slaughtered camel-calves aged 14-18 months at slaughtered houses in Cairo and Giza; diarrheic camel-calves (150) and apparently healthy camel-calves (50). All samples were investigated bacteriologically to detected *Campylobacter* species. The positive samples were examined histopathalogically. The results of bacteriological studies were recovered, 37 (20%) were positive for the infection with *C. jejuni* and *C. coli*, while 10 (5%) were positive for the apparent healthy cases. The isolation rate of *C. jejuni* in the diarrheic calves was (15.33%) and (14%) from apparently healthy cases, while the rates of isolated *C. coli* were 7(4.66%) and 3(6%) respectively. No isolation can be detected for both microorganisms in the mesenteric lymph node, meanwhile, the higher rate of *C. jejuni* and *C. coli* isolate was from the intestine 18(30%), 5(8.33%), then 7(23.33%), 2(6.66%) from the liver of diarrheic and apparently healthy cases. The isolate rate of *C. jejuni* was 5(16.66%), 2(20%) from the spleen of diarrheic and apparently healthy calves. The histopathalogical examination revealed cryptitis, destruction and degeneration of intestinal covering in the cases which affected with *C. coli*. Necrosis of intestinal glands, surfac3 erosion and proliferation of cryptal enterocytes with the presence of bacteria in the apical destructed cells at the tip of epithelial covering were detected from *C. jejuni* affected cases, while a marked hyperplasia of enterocytes, resulting in distortion of normal architecture of tightly packed proliferating enterocytes were noticed in *C. jejuni* and *C. coli* infected cases. The liver revealed hepatic necrosis with inflammatory cell aggregations,

also the spleen showed a pronounced follicular depletion with necrosis in the cases which suffered a mixed infection of both bacteria. Finally, this study indicated that camel-calves are reservoir of human infection with Campylobacter infection. This study can provide a basis for the development of specific needs of public health inspection involved in protecting and promoting food safety.

INTRODUCTION

The camel plays vital socio-economic roles and supports millions of people in the dry and arid zones of Asia and Africa. The role of the camel as a domestic animal is under going fundamental changes, problems associated with lack of knowledge due to insufficient research in the past. Camels numbers are believed to have increased to 11.9 thousand, camels annually produce about 3218, 538, 95 and 14 thousand tons of milk, meat, hides and fiber respectively (Badran et al., 2008). In Egypt, during the last few years, the consumption of camel's meat showed observable increase; this might be due to the need for more sources of animal proteins. The Arabian camels are nowadays getting more attention as multipurpose animals (Sobhy et al., 2003). *Campylobacter* infection is a zoonotic disease, observed in most parts of the world. The disease is caused by *C.jejuni* or less commonly *C. coli*. It is estimated to cause 5-14% diarrhea world wide (Ekdahl and Andersson, 2004). *Campylobacter* infection has emerged to most important bacterial cause of gastrointestinal infection and had been established as one of the bacterial agents that cause economic losses in farm animal which frequently contaminate raw milk and non chlorinated water which are usually the source of infection in human (F.D.A. , 2002 and C.D.C., 2006). The available literatures concerning isolation of *C.jejuni* from camel carcasses in scantly, so the incidence of the organism and its histopathalogic feature are needed (Wilson, 1991). Animals (variety of poultry, cattle, sheep, swine, dogs, cats and rodents) are the major reservoir for *Campylobacter* species, especially sheep which can become persistently infected and continue to shed bacteria in the feces (Blaser, 1995).The clinical symptoms in calves include a thick, mucoid diarrhea with occasionally flecks of blood either or without fever. The symptoms generally last 3-7 days but some animals may have intermittent diarrhea for weeks and occasionally for months (Drake, et al., 1981; Anon, 1997 and Blaser, 2003). *Campylobacter* species were isolated from the intestinal tracts of many species of domestic animals. It had been incriminated as an etiological agent of febrile enteritis with

diarrhea in these animals (95% of infections are due to *C. jejuni* or *C. coli*) (Allos, 2001 and Butzler, 2004). The histopathaligical findings in the intestinal tract were varied from edema with acute to chronic inflammatory alterations and cryptitis (Colgan, et al., 1998). Focci of lymphocytic aggregations and neutrophilic infiltration presents in liver in association with follicular spleenic depletion (Kumar, et al., 1982; Skirrow, 1994 and Surawicz, etal., 1994). *C. jejuni* is a curved Gram-negative, motile, obligate intracellular bacterium that can not be grown on artificial media and the infection with *C. jejuni* and *C. coli* in most of domesticated animals and human show a characteristic feature of prolife rate enteritis (Aiello and Mays, 1998; Willoughby et al., 1999). McGavin and Zachary (2004) reported that C. jejuni infection cause a surface erosions and proliferation of cryptal enterocytes with the presence of comma –shaped and S-shaped bacteria in the apical cytoplasm of affected cells, so the diagnosis of campylobacter infection depend on this characteristic histopathological findings in the intestinal crypt epithelial cytoplasm. *Campylobacter jejuni* is a curved, Gram negative, motile, obligate intracellular bacteria that can not be grown on artificial media and the infection with *C. jejuni* and *C. coli* in most of domesticated animals and human show a characteristic feature of a proliferative enteritis (Aiello and Mays, 1998; Willoughby et al., 1999). This study was focused for an in-depth investigation of *Campylobacter* species in the diarrheic camel-calves in the slaughtered camels by incidence of isolation and identification of *Campylobacter* species as well as to study the pathological alterations in the internal organs due to the infection with this microorganism and to show the important role of the infected animals as a source of spreading the disease through the cohabitation with the susceptible animals.

MATERIALS AND METHODS

1. Sampling:-

A total 200 samples were collected from internal organs (Intestine, liver, spleen and mesenteric lymph node) of freshly slaughtered camel-calves from slaughtered houses in Cairo and Giza as follows (150 samples of diarrheic camel-calves in addition to 50 samples of apparently healthy camel-calves). All samples were taken from camel-calves of both sexes ranging in age from 14 – 18 months old (Table, 1). The specimens were collected and immersed in 10% formol saline (the intestinal portions were tied at their ends and injected with suitable amount of the formol saline (10%) in their lumen for rapid fixation of mucosa). Fixed specimens were dehydrated in different grades

of alcohol, cleared in xylol, embedded in paraffin, sectioned at 3 – 5 u thickness and finally stained with hematoxylin and eosin (Bancroft and Stevens, 1990).

Table 1: Type and number of samples collected from the examined slaughtered camel - calves.

Type of samples	Diarrheic camel-calves	apparently healthy camel-calves	Total
Intestine	60	20	80
Liver	30	10	40
Spleen	30	10	40
Mesenteric lymph node	30	10	40
Total	150	50	200

2. Isolation and Identification:-

Samples were cultured in thioglycolate medium at 37°C under microaerophilic conditions (5% O2, 10% CO2 and 85% N2). All samples were examined after 24 hrs under phase contrast microscope for characteristic *Campylobacter* motility (Ledergerber et al., 2003). The positive samples for *C jejuni* and *C. coli* were filtrated through 0.45 mm millipore filter. The filtrate was cultured on the brain heart infusion agar plate with 10% defibrinated sheep R.B.Cs with *Campylobacter* selective supplement and incubated at 37°C for 48hrs in microaerophilic condition. The suspended colonies were identified biochemically as shown in Table (1) according to Acha, et al., (2004).

3. Histopathaligical examination:

The specimens were collected and injected in 10% formol saline (the intestinal portions were tied at their ends and injected with suitable amount of the formal saline (10%) in their lumen for rapid fixation of mucosa). Fixed specimens were dehydrated in different grades of alcohol, cleared in xylol, embedded in paraffin, sectioned at 3-5 U thickness and finally with hematoxylin and eosin (Bancroft & Stevens, 1990).

RESULTS

Thirty seven (24.7%) out of 150 samples of diarrheic camel calves were positive for the infection with *C.jejuni* and *C. coli*, while 10

(20%) out of 50 samples of apparent healthy camel calves were positive. The isolation rates of *C. jejuni* from the diarrheic slaughtered camel-calves was 30 (20%) while the rate was 7(14%) from the apparent healthy slaughtered camel calves. The isolation rates of *C.coli* was 7 (4.7%) from the diarrheic slaughtered camel-calves while from the apparent healthy ones was 3 (6%). No isolation of *C. jejuni* and *C. coli* can be detected in the mesenteric lymph nodes. Also no isolation was detected for *C. coli* in the spleen of the diarrheic and apparently healthy calves. The mentained isolation rates of *C. jejuni* and *C. coli* in the internal organs of diarrheic and apparent healthy slaughtered camel calves were respectively mentioned in (Table 2). The results of biochemical tests of *C. jejuni* and *C. coli* isolated from the internal organs of diarrheic and apparent healthy camel calves has been illustrated in Table (3).

Table (2): The incidence of *C. jejuni* and *C. coli* among the examined camel calves' samples.

Type of samples	Apparently healthy					Diseased					Total	
	Number of examined samples	*C.jejuni*		*C.coli*		Number of examined samples	*C.jejuni*		*C.coli*		No of +ve	%
		No	%	No	%		No	%	No	%		
Intestine	60	18	30	5	8.33	20	3	15	2	10	28	35
Liver	30	7	23.33	2	6.7	10	2	20	1	10	12	30
Spleen	30	5	16.7	-	-	10	2	20	-	-	7	17.5
Mesentric lymph node	30	-	-	-	-	10	-	-	-	-	-	-
Total	150	30	20	7	4.7	50	7	14	3	6	47	23.5

No. : Positive number
% : was calculated according to number of examined samples

Table 3: Characteristics of *C. jejuni* and *C. coli* isolated from the examined camel calves.

Test isolate	Oxidase reduction	Catalase reduction	Motility	H2S production	Growth in 1% glycine	Growth in 3.5% NaCl	Heat tolerance To 42°C	Sod. Hippurate hydrolysis
C. jejuni	+ve	+ve	+ve	+ve	+ve	-ve	+ve	+ve
C. coli	+ve	+ve	+ve	+ve	+ve	-ve	+ve	-ve

+ve: positive -ve: negative

The results of histopathaligical examination were illustrated in figures (1-6):

As shown in fig.1 *Campylobacter jejuni* was detected in the contents after scrabing the tips of the covering epithelium of the intestine of infected camel calf and stained with Modified Zeil Nelson stain, the microorganism appeared as spiral, S-shape and comma shape under the phase contrast microscope as shown in (Fig.1)

1- The intestine appeared flaccid, congested and some areas of erosions were noticed.

Microscopically: Destruction and necrosis of some intestinal glands .Wide dilatation of the lymphatics in most of the intestinal villi in association with huge inflammatory cells infiltration (mainly neutrophils, mononuclear cells and plasma cells).Surface erosions and proliferation of cryptal enterocytes (proliferative enteritis) with the presence of bacteria in the apical destructed cells at the tip of epithelial covering were showed in *C. jejuni* infected cases. (fig.2)

Edema and cryptitis with intense infiltration of mononuclear inflammatory cells and neutrophils with destruction and desquamation of epithelial cells covering the superficial surfaces of the intestinal villi. Degeneration of some intestinal glands were also seen in *C. coli* infected cases. (fig. 3).

Marked hyperplasia of enterocytes, resulting in distortion of normal architecture (collision necrosis) of tightly packed proliferating enterocytes with degeneration of most intestinal glands and focal aggregations of inflammatory cells mainly neutrophils, macrophages and plasma cells were noticed in *C. jejuni* and *C. coli* infected cases. (fig. 4).

2-Liver: - showed focci of hepatic necrosis and inflammatory cells aggregations mainly neutrophils and plasma cells were noticed at the portal area in *C. jujeni* and *C. coli* infected cases. (fig. 5).

3-Spleen: - showed a pronounced depletion of the lymphocytes with degeneration of the spleenic follicls and areas of necrosis were noticed in *C. jujeni* infected cases. (fig. 6).

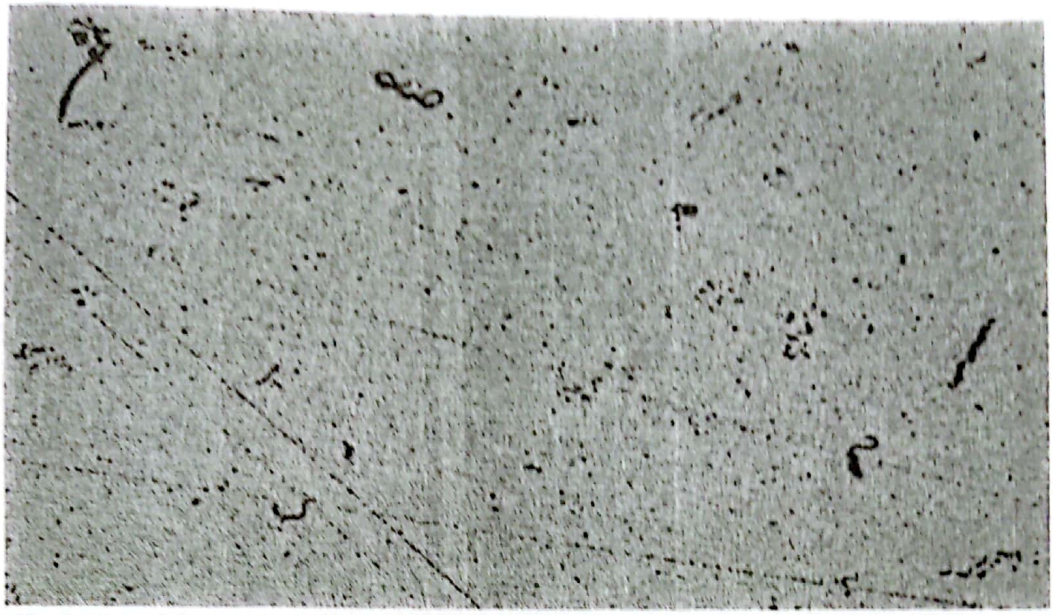

Fig. 1: *Campylobacter jejuni* which was isolated from the contents and the tips of the crypt of the intestine of infected camel calf, stained with Modified Ziel Nelson stain showing spiral, comma and S-shaped under the phase contrast microscope (X400).

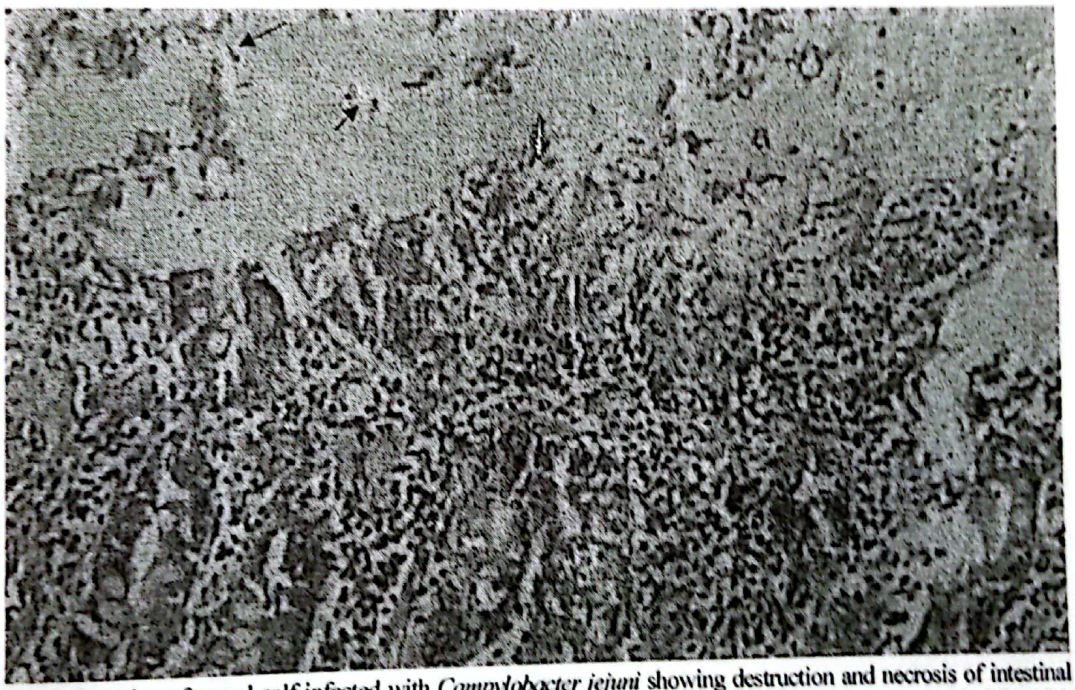

Fig. 2: Intestine of camel calf infected with *Campylobacter jejuni* showing destruction and necrosis of intestinal glands with inflammatory cells infiltration and wide dilatation of the lymphatics in most of villi which showed the microorganism in the destructed enterocyts.

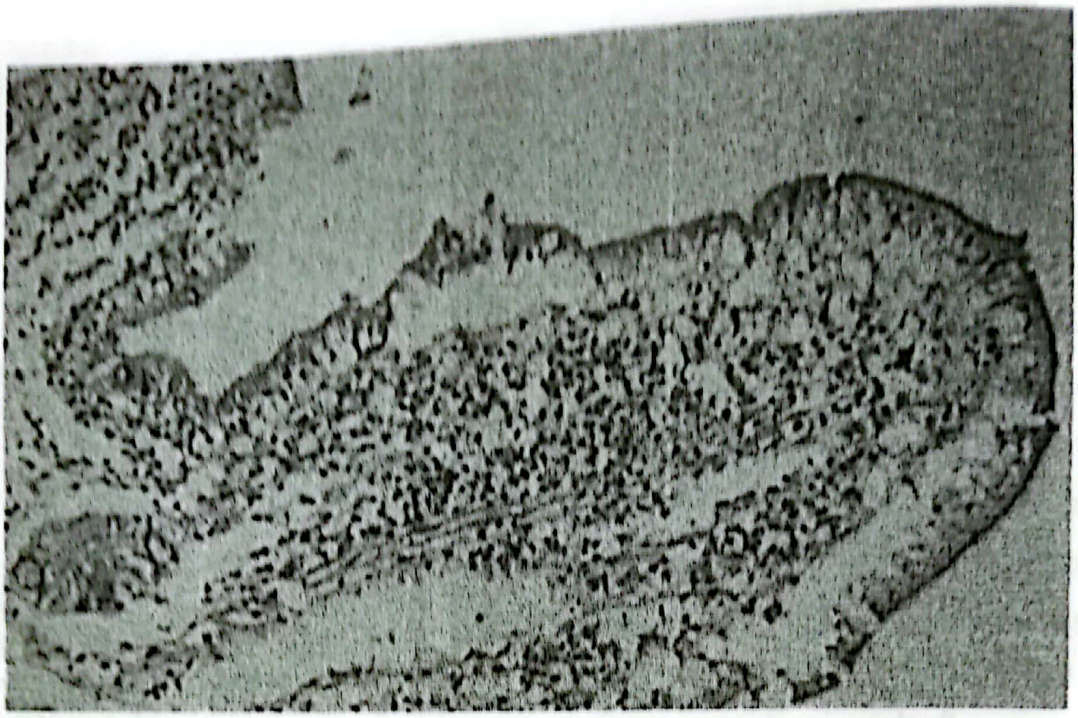

Fig. 3: Intestine of camel calf infected with *campylobacter coli* showing intense infiltration of mononuclear inflammatory cells with degenerated intestinal gland and destruction, desquamation of epithelial cells covering superficial surfaces of the villi H & E. X 100.

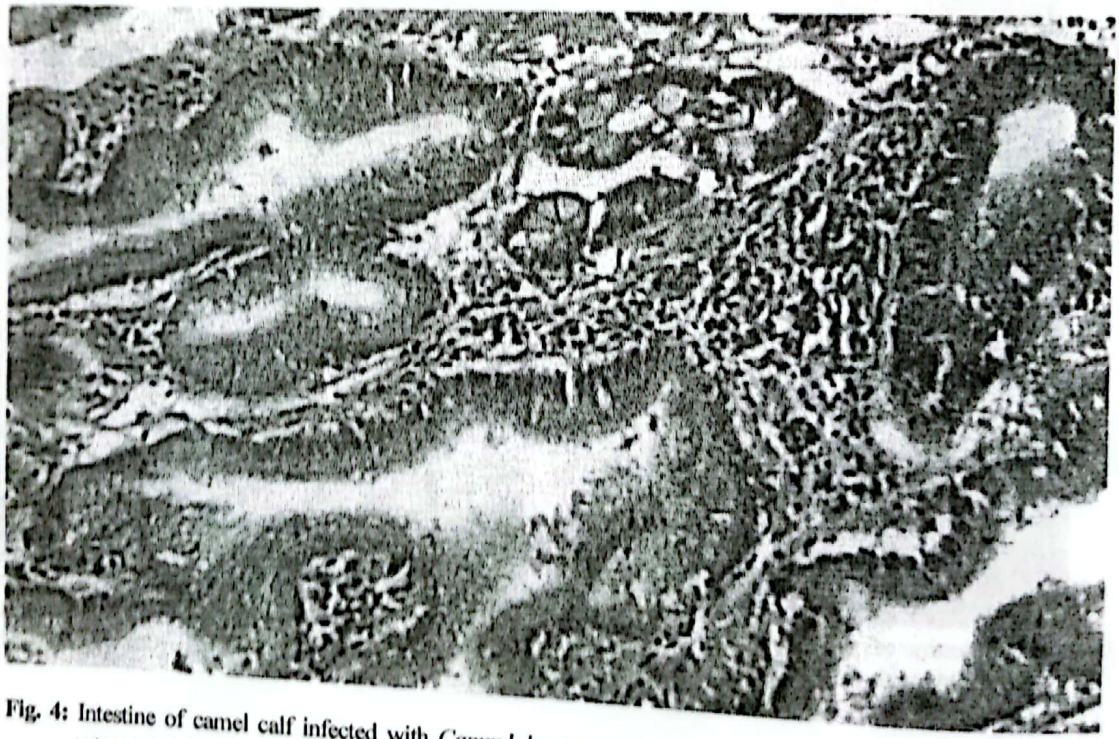

Fig. 4: Intestine of camel calf infected with *Campylobacter jejuni* and coli showing marked hyperplasia of enterocytes (collision necrosis of tightly packed proliferating enterocytes) with degenerated intestinal glands and focal aggregations of inflammatory cells H & E. X 100.

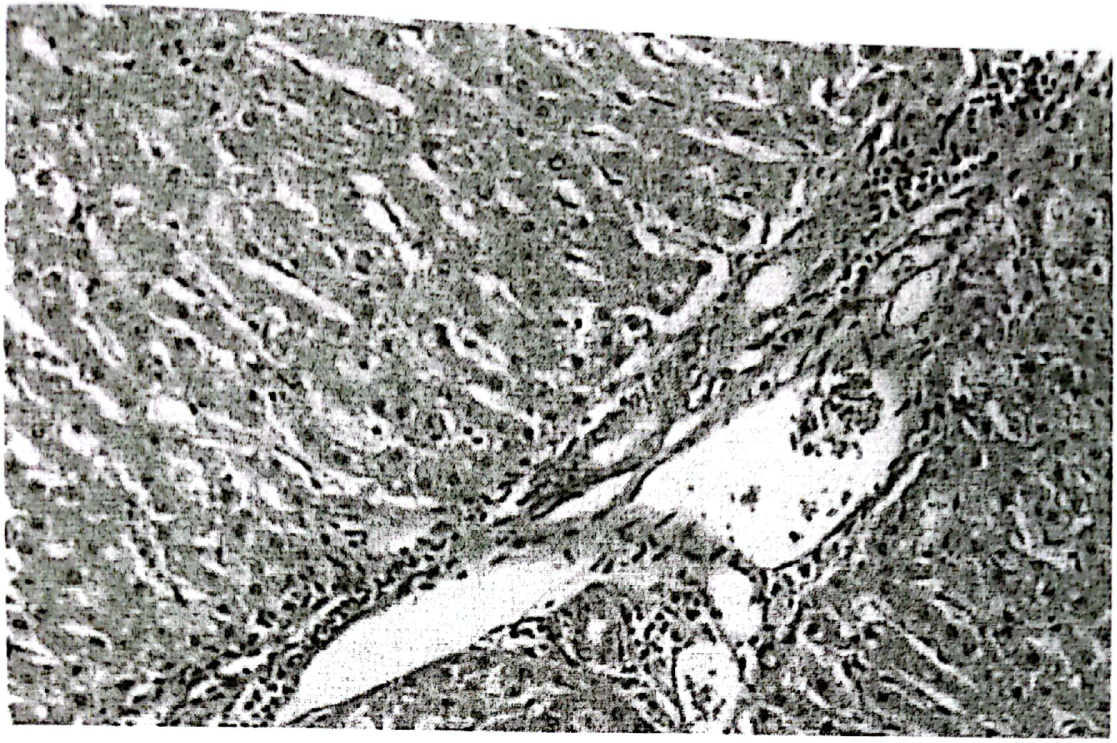

Fig. 5: Liver of camel calf infected with *Campylobacter jejuni* and *coli* showing focci of lymphocytic infiltrations and necrosis of hepatocytes with inflammatory cell aggregations at the portal area H & E. X 100.

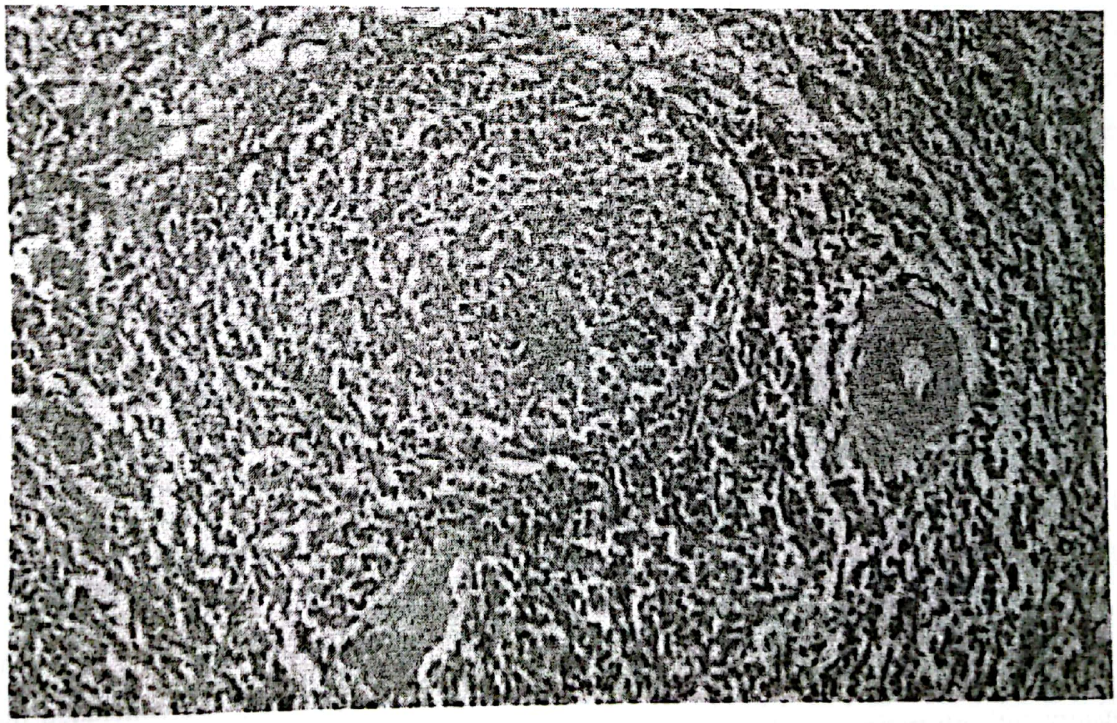

Fig. 6: Spleen of camel calf infected with *Campylobacter jejuni* showing pronounced depletion of the lymphocytes with degeneration and necrosis of the spleenic follicles H & E. X 100.

DISCUSSION

Camelus dromedaries (one humped camel) are economically important in Africa, particularly in Sudan and Somalia as well as in the Arabian states and in India. Many camels are exported to Egypt from Sudan and Somalia (Bayleyeg et al., 2004 and Badran et al., 2008).The thermophilic *C. jejuni* and *C. coli* have been recognized as a major cause of gastrointestinal human and animal infection in many countries through out the world (Ledergerber et al., 2003 and Ebrahim et al., 2010).

In the present study, the rate of isolation of *C. jejuni* in the diarrheic slaughtered camel-calves was 20% (Table, 2). This result was recorded by El-Shahawy et al., (2009) and Lutgen et al., (2009). But the presence of *C.jejuni* in the apparently healthy slaughtered camel-calves was 14 %(Table, 2) agreed with Heymann (2004). The prevalence of *C. coli* in this study was 4.7% in the diarrheic slaughtered camel-calves and 6% in the apparently healthy slaughtered ones (Table, 2). These results agreed with Moore et al. (2002).

The most predominant histopathological alteration noticed in this study were destruction and / or necrosis at tips of the villi and inflammatory cell infiltrations in the intestinal mucosa and / or submucosa, these findings come in agreement with the observations of Colgan et al., (1998). The obtained results revealed that the campylobacter toxins play an essential role in the infiltration of inflammatory cells in the small intestine and the absorbed toxins cause sub-epithelial edema where ischemia result in necrosis and or sloughing of the tips intestinal villi, such result coincided with that of Aiello and Mays (1998).Surface erosions and proliferation of cryptal enterocytes with the presence of comma –shaped and S-shaped bacteria in the apical cytoplasm of affected cells, also, the alteration of collision necrosis indicate the harmful effect of endotoxins of the bacteria on the cells which hence more proliferation and destruction but the proliferated cells try and run quickly by increasing the number and size to fight the microorganisms, this hypothesis was given by McGavin and Zachary (2004). Tissue alteration observed in the liver and spleen comes in agreement with Kumar et al., 1982; Skirrow 1994 and Surawicz et al., 1994). Moreover, Davis et al. (1998) recorded that; diarrhea was attributed to increased acetyl choline in inflamed intestine where the cholinergic enervation of the intestine can undergo rapid long-lasting alteration during inflammation. Finally, from this study we concluded that the tissue alteration due to the infection with *C. coli* in the intestine, liver and no detection for

bacteria in spleen, lymph node while the alteration which noticed in intestine, liver and spleen due to the infection with *C. jejuni* ensured that *C. jejuni* is the most powerful toxic bacteria for the tissues and its pathogenic effects become more intense when become in association with the other isolate such as *C. coli.*

We concluded that Egyptian camel is considered as a reservoir of human infection with *Campylobacter* species so further research required to determine and identified the other microorganisms which play a major cause of diarrhea and enterocolitis found in camels, Also, on attention should be paid for raising calf camel in farms and of even of small handlers under control measures of management, nutrition and medical care.

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دراسات باثولوجية على الكامبيلوباكتر جيجوناى وكولاى المسبب للاسهالات فى الجمال الصغيرة

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**قسم بحوث الامراض التناسلية – معهد بحوث التناسليات – مركز البحوث الزراعية – جيزة – ج. م. ع.

تم تجميع عدد ٢٠٠ عينة من الاحشاء الداخلية(أمعاء-كبد-طحال-غدة المساريقا) من الجمال الصغيرة عند عمر(١٤- ١٨شهر) المذبوحة فى السلخانات بالقاهرة والجيزة (١٥٠ عينة من جمال صغيرة تعانى من الاسهالات الواضحة ظاهريا وعدد ٥٠ عينة من الجمال الصغيرة السليمة ظاهريا) وقد فحصت جميع العينات بكتريولوجيا لتواجد ميكروبات الكامبيلوباكتر ثم أجريت الفحوصات التشريحية والميكروسكوبية للعينات الايجابية وقد أسفرت نتائج الدراسات البكتريولوجية كالاتى: تم عزل عدد ٣٧ عترة للكامبيلوباكتر جيجوناى بنسبة (١٨.٥%) من أجمالى عدد العينات وكذلك عدد ١٠ عينات أيجابية للكامبيلوباكتر كولاى بنسبة (٥%) من أجمالى عدد العينات وكانت نسبة عزل ميكروب الكامبيلوباكتر جيجوناى (١٥.٣٣%) من الجمال الصغيرة التى تعانى من الاسها ل ونسبته (١٤%) من الجمال الصغيرة السليمة ظاهريا . اما نسبة عزل ميكروب الكامبيلوباكتر كولاى فكانت (٤.٦٦%) من الجمال الصغيرة المصابة بالاسهال ونسبة تواجده فى الجمال الصغيرة السليمة ظاهريا هى (٦ %).

وكانت اعلى نسبة عزل لميكروبات الكامبيلوباكتر جيجوناى فى الامعاء ،تليها الكبد ثم الطحال بنسبة ٣٠% ، ٢٣.٣٣% ، ١٦.٦٦% من الجمال الصغيرة التى تعانى من الاسهال اما نسبة تواجده فى الجمال الصغيرة السليمة ظاهريا فكانت اعلى نسبة عزل فى الامعاء بنسبة ١٥% يليها الكبد والطحال بنسبة ٢٠%، اما بالنسبة لتواجد ميكروب الكامبيلوباكتر كولاى فكانت اعلى نسبة له فى العزل من الامعاء بنسبة ٨.٣٨% ثم الكبد بنسبة٦.٦٦ % أما نسبة تواجده فى الجمال الصغيرة السليمة ظاهريا فكانت بنسبة ١٠% فى كلا من الامعاء والكبد ولم يتم اى عزل للميكروب من الطحال فى جميع العينات كما أنه لم يتم اى عزل لكلا من الميكروبين قى الغدة الليمفاوية للمساريقا. وقد أسفرت النتائج الباثولوجية عن وجود تكسير وتساقط للاغشية المبطنة للامعاء فى الحالات المصابة بالكامبيلوباكتر كولاى، وتحلل للغدد المعوية مع تقرحات فى أعلى الغشاء المبطن للامعاء والذى يظهر منتشرا منه الشكل الواوى وشكل حرف S- للحالات المصابة بميكروب الكامبيلوباكتر حيجوناى ، أما فى الحالات المخالطة للعدوى بالميكروبين فتميزت بتطور واضح فى تكاثر الخلايا المبطنة والتفافها حول نفسها لتتفادى التحلل التجمعى نتيجة التأثير السمى لميكروب الكامبيلوباكتر جيجوناى وكولاى مع وجود تجمعات للخلايا الالتهابية و تخثر فى خلايا الكبد ، كذلك ظهور اضمحلال وتحلل لخلايا الطحال فى الحالات المصابة بمبكروب الكامبيلوباكتر جيجوناى

والتى لم تظهر فى الاصابة بحالات الكامبيلوباكتر كولاى ، كما انه لم يظهر أى عزل للميكروبين من الغدة الليمفاوية للمساريقا.

وأخيرا نستخلص من هذه الدراسة ان الجمال الصغيرة مصدر للعدوى بميكروبات الكامبيلوباكتر جيجوناى للانسان وان خطورته تزداد عندما تكون العدوى مصاحبه للكامبيلوباكتر كولاى لذلك يجب مراعاة النظافة العامة والقواعد الضرورية والفحص المستمر للاغذية المذبوحة بالسلخانات مع الاهتمام بمزارع تربية الجمال تحت رعاية صحية وغذائية عالية حتى نتفادى انتقا ل الامراض للانسان.