Helicobacter pylori Infection in Pet Animals in Suez Canal Area and their Public Health significance

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ABSTRACT

A total number of 50 stool, 50 saliva and 50 serum samples were collected from 50 cats, 50 dogs and 50 owners from hospital of pet animals in port-Said governorate. As well as 23 stomach samples were collected from domestic cats recently euthanized in port-Said governorate. In addition 20 samples from human subjects suffering from dyspepsia, nausea, vomiting, and abdominal pain were collected. Specimens were subjected to bacterial isolation by culture and biotyping, ELISA and PCR to detect *UreC* subunit of urease gene. Endoscopic examination of 20 human subjects including normal and with gastritis, gastric ulcer and duodenal ulcer represented of 10%, 30%, 50% and 10%, respectively. Among them, 75% were *H. pylori* +ve by rapid urease test (RUT), 60% were *H. pylori* +ve by culture and 80%were +ve by ELISA. Stool and saliva from pet animals owners showed 10% and 18% *H. pylori* isolates meanwhile 48% of samples were +ve by ELISA. Among 50 studied dogs cases, no *H. pylori* isolates from stool and saliva while, 62% were *H. pylori* +ve by ELISA. Within 23 studied cats stomach, *H. pylori* isolates were found to be 8.7% using culture. 47.8% and 52.2% were +ve using RUT and ELISA respectively. Among 50 studied cats cases, *H. pylori* isolates from stool and saliva were found to be 2% and 4% respectively and 50% were +ve by ELISA. 84.6 of human isolates were positive by PCR meanwhile isolates from cats were negative.

INTRODUCTION

Helicobacter pylori (*H. pylori*) infection is considered a serious problem impairing the public health in both developed and developing countries and responsible for most duodenal and peptic ulcer and also plays an important role in gastric adenocarcinoma *(1).* The prevalence rates of canine and feline *Helicobacters* ranged from 86 to 100% in healthy dogs, 61 to 82% in dogs with upper gastrointestinal signs, 41 to 100% in healthy cats, and 56 to 76% in affected cats *(2)*. The spiral organisms associated with the gastric mucosa of animals was increased dramatically following the discovery of *H. pylori* in human disease, mainly due to lack of animal models for *H. pylori* and the possible zoonotic threat of gastric *Helicobacters (3)*. Several invasive and non-invasive diagnostic tests are available for ascertaining the presence of *H. pylori* infections. The invasive tests require endoscopy and include the biopsy, urease test, culture and Polymerase Chain Reaction (PCR). Different primer sets targeting different segments of *H. pylori* genome have been used including a portion of the *16SrRNA* gene, *ureA* gene, and *glmM* (*ureC*) gene *(4,5).* On the other hand, the non-invasive tests do not require endoscopy and include the Enzyme-Linked ImmunoSorbent Assay (ELISA). Although the past 28 years of the *H. pylori* era have dramatically changed our understanding and treatment of several gastric diseases, still many questions remain open and need to be answered. In attempt to answer some of these questions. The aim of present study was to isolate *H. pylori* from dogs, cats and their owners found in Suez Canal area. Identification the isolated strain was done by studying their culture characters, biotyping, ELISA and detection of a subunit of the *H. pylori* urease gene by using (PCR). The results were comparing to those noted in human infected with *H. pylori.*

MATERIAL AND METHODS

A total number of 150 samples of stool, saliva and serum (50 sample each) were collected randomly from 50 diseased dogs and 50 diseased cats of different breeds hosted in pet animals hospital in port-Said governorate. As well as, 23 stomach samples were collected from domestic cats recently euthanized in port-Said governorate. A total number of 50 stool samples (31 healthy and 19 induced diarrhea), 50 saliva and 50 serum samples were collected from 50 dogs and cats owners and their related persons. In addition, 20 samples were collected from 20 cases found in endoscopy unit, department of internal medicine, Suez Canal University hospital (13 male and 7 female). The main complains of the patients were dyspepsia, nausea, vomiting, and abdominal pain Patients taking antimicrobial drugs and/or bismuth salts two weeks before endoscopy were excluded. Two biopsy specimens were taken from antrum region of the stomach of each patient and from fundus of the stomach of cats. One mucosal sample was used for rapid urease test, and the second was used for isolation and identification. Stool and saliva samples were collected in sterile plastic bags. The stool was diluted to a 20% w/v solution in phosphate-buffered saline (PBS) and the suspension was sieved through a 250 µm strainer before plating onto selective media and saliva samples were collected by cotton swabs and treated with 1ml sterile physiological saline solution. All samples were plated on Brain heart infusion agar containing 5% horse serum and Dent supplement antibiotic and selective media Colombia agar with 7% sheep blood and Dent supplement antibiotic *(6)*. Blood was collected aseptically by vein puncture and the serum was separated and stored at - 20°C until further analysis by ELISA (Sigma Co and Biotech Co.).

Microscopical and biochemical identification: Film from the growing suspected colonies were stained by Gram stain and studying their culture characters and biochemical activity *(7)*, (oxidase test, urease test, catalase test and Nitrate reduction test) .

Storage of *H. pylori* isolates: Low temperature was the most practical method of long-term storage. Cells were suspended in 10% (v/v) glycerol in nutrient broth on glass beads at -70°C *(7)*.

DNA extraction and PCR: Boiling method was used for extraction and purification of DNA from *H. pylori* isolates. Twenty six human and 5 H.pylori isolates from cats were subjected to polymerase chain reaction to detect *UreC* subunit of urease gene. The oligonucleotide primers used for the amplification were, F: (5- GGA TAA GCT TTT AGG GGT GTT AGG GG-3) and R: (5- GCT TAC TTT CTA ACA CTA ACG CGC -3). This target DNA sequence was used in developing the PCR assay *(8)*. The reaction was performed using an automated thermal cycler, preheated to 85°C and then tubes were arranged in the block. It consisted of initial denaturation at 94 °C for 3 min. Followed by denaturation at 94 °C for 1 min., annealing at 45 °C for 1 min. and extension at 72 °C for 1 min. Repeation of denaturation, annealing and extension for another 39 cycles. Final extension at 72 °C for 5 min. PCR products were analyzed by 0.7% agarose gel electrophoresis. The position of Product length at 294 bp.

RESULTS AND DISCUSSION

Table 1. Incidence rate of *H. pylori* among examined dogs and cats using culture of stool and saliva as well as serum IgG detecting by ELISA.

Animal species	*H. pylori isolates from stool*		*H. pylori isolates from saliva*		*Serum IgG by ELISA*	
	No.	%	No.	%	No.	%
Dogs (n=50)	0	0	0	0	31	62
Cats (n=50)	1	2	2	4	25	50

Table 2. Incidence of *H. pylori* among 23 examined cats necropsies using RUT, culture and serum IgG detecting by ELISA.

Cats breed	*RUT*		*culture*		*Serum IgG by ELISA*	
	No.	%	No.	%	No.	%
Domestic cats(n=23)	11	47.8	2	8.7	12	52.2

RUT: rapid urease test

Table 3. Endoscopic findings and Frequency of *H. pylori* among 20 investigated cases using RUT, culture and ELISA.

Endoscopic findings cases	*NO*	*RUT*		*Culture*		*ELISA*	
		No.	%	No.	%	No.	%
Normal	2	1	50	0	0	1	50
Gastritis	6	4	66.7	3	50	4	66.7
Gastric ulcer	10	8	80	7	70	9	90
Duodenal ulcer	2	2	100	2	100	2	100
Total	**20**	**15**	**75**	**12**	**60**	**16**	**80**

RUT: rapid urease test

Table 4. Frequency of *H. pylori* among studied human subjects using culture (stool and saliva) and serum IgG detected by ELISA (N=50)

Human subjects	Apparently *healthy*	*Induced diarrhea*	*Total*	*Results*		
				H. pylori isolates from stool	*H. pylori isolates from saliva*	serum IgG detected by *ELISA*
Men	10	7	17	1	3	9
Women	9	4	13	1	2	8
Children	12	8	20	3	4	7
Total	**31**	**19**	**50**	**5 (10%)**	**9 (18%)**	**24 (48 %)**

Table 5. Identification of *H. pylori* in 26 human isolates and 5 isolates of cat using PCR.

Source of isolates	*Number*	*PCR result*			
		Positive	%	Negative	%
Human biopsy	12	12	100	0	0
Human saliva	9	7	77.8	2	22.2
Human stool	5	3	60	2	40
Total	**26**	**22**	**84.6**	**4**	**15.4**
Cat necropsy	2	0	0	2	100
Cat saliva	2	0	0	2	100
Cat stool	1	0	0	1	100
Total	**5**	**0**	**0**	**5**	**100**

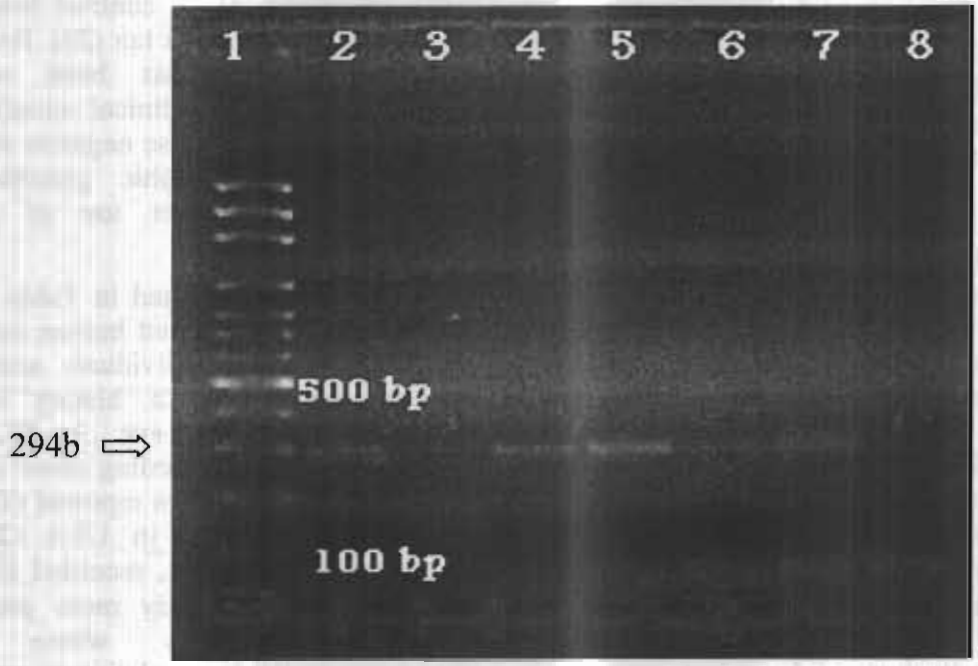

Photo 1. Ethidium bromide stained agarose gel of representative PCR amplicon. Lane1: Molecular weight marker, lane 2: positive control, lane:3 negative control, lane 4, 5, 7: positive human samples and lane 6, 8: negative cat samples.

The isolation of *H. pylori* and its incrimination as a cause of gastric ulcers in human, led to an increased attention to similar organisms in animals as *Helicobacter* organisms were observed in biopsies from the stomachs of dogs, cats, pigs and other carnivores *(9)*. Still culturing of *H. pylori* is difficult, time consuming, expensive and it is seldom required for the routine clinical practice, although helpful in determining the antimicrobial susceptibility of *H. pylori* for the planned treatment. The sensitivity of this method is low (15.4% and 51.0%) dependent on bacterial density, transport conditions, culture medium, incubation conditions, and the skill of laboratory *(10)*.

Regarding the results presented in Tables 1 & 2 *H. pylori* isolates were not detected in stool and saliva samples of examined dogs, while 2 (4%) of saliva samples and one (2%) of stool samples of examined cats had isolates of *H. pylori* on the other hand 2 out of 23

(8.7%) of cats necropsies had *H. pylori* isolates. Serum IgG of *H. pylori* detected by ELISA showed that, 31(62%) of dogs and 25 (50%) of cats were positive. Moreover 11 out of 23 (47.8%) and 12 out of 23 (52.2%) were +ve using RUT and ELISA respectively. The failure in isolation of *H. pylori* from dogs was confirmed by ***Takemura et al., (11)***. This can be explained by the fact that dogs are not naturally colonized with human *H. pylori* ***(12,13)***. Culture has been reported only in few cases, due to the complexity of the oral microflora and the fastidious growth of *H. pylori* on synthetic media. In addition, *H. pylori* could be present in this site as viable, but non-culturable coccoid organisms ***(14)***. In other studies higher prevalence of *Helicobacter* spp. infection of cats was determined by urease test ***(15,16)***. The false results for ELISA can be explained by the presence of cross-reacting antigens, specially flagellar proteins, between *H. pylori* and *campylobacters* ***(17)*** and by the fact that very slow decrease in antibodies after eradication (25% in titer within 6 months or more) ***(18)***. The use of serology for the detection of anti-gastric *Helicobacter* spp. antibodies in dogs and cats are complicated by the presence of five different gastric *Helicobacter* spp. and the possibility of coinfection with more than one species, The major protein bands of crude antigens of *H. felis* and *H. bizzozeronii* were very similar to those of *H. pylori*, high cross-reactivity between the immune responses to antigens obtained from *H. pylori* and *H. bilis* and antigenic homology between different *Helicobacter* spp. lead to suggestion that infection with the *Helicobacter* spp. cannot be distinguished serologically in most subjects given the high prevalence of studied *H. pylori* ***(19,20)***.

Results recorded in Table 3 revealed that among 20 patients (with Gastrointestinal symptoms) from endoscopic unit in Suez Canal University hospital, *H. pylori* was diagnosed in 12(60%), and 15(75%), by culture and RUT respectively. The results of culture and RUT come in accordance with other studies ***(21,22)***. Nearly similar results had been reported ***(23)***. The results of present study disagree with that stated by **Brooks *et al., (24)***. This might have been due to low viable bacterial cell count, sampling error, inadequate size of biopsy specimen and/or the use of proton-pump-inhibitors (PPIs) before endoscopy is known to reduce the sensitivity of the urease test to detect *H. pylori* ***(23)***.

On the other aspect 16 out of 20 studied human cases (80%) were found to be positive for *H. pylori* infection by ELISA Table 3. These finding was in agreement with other studies ***(21,24)***, while higher figures in Egypt were obtained ***(25)***, in contrast lower figures were recorded in packis tan ***(26)***. Recently, the role of serology has been reappraised especially in certain clinical situations when other tests will give false negative results, e.g. bleeding ulcers, atrophic gastritis, MALT lymphoma, and recent use of PPIs and antimicrobials ***(18)***.

The result presented in Table 4 showed that, among 50 examined human subjects (31 apparently healthy individuals and 19 with induced diarrhea) with history of animal contact, *H. pylori* was +ve by ELISA in 24 out of 50 (48 %). Regarding result of ELISA, nearly similar result was reported ***(18)***. Lower results were reported in USA ***(27)*** While higher results in Assiut, recorded Egypt ***(24)***. Infection is significantly more prevalent in developing countries where reported prevalence in adult population is around 90% as compared to less than 50% in developed nations, these differences may be due to difference in socio-economic conditions, socio-cultural background and genetic predisposition ***(28)***. The heterogeneity of *H. pylori* strains and the geographic variations in the immune response to *H. pylori* antigens and variability in the domination of different *H. pylori* antigens in different populations leads to variability in the performance of the same diagnostic test ***(29)***.

Regarding isolation of *H. pylori* from human stool in present work, 5 out of 50 (10%) was isolated. Nearly similar result reported to be 8% using rectal swab ***(30,31)***. The concentrations of bile as *H. pylori* are found in the duodenum may be inhibitory and

it could be cultured from faeces in the setting of rapid gastrointestinal tract transit. *H. pylori* needs to be rapidly excreted from the proximal gastrointestinal tract to be found viable in stools.

Regarding isolation of *H. pylori* from saliva in present work, 9 out of 50 (18%) was isolated. higher results were reported *(32). H. pylori* has been detected in dental plaque and saliva by culture and PCR methods, with the results obtained ranging from 0 to 100% for culture and 0 to 90% for PCR. This difference in results may be due to varying methods of detection and sampling *(33,34).* The discrepancy between *H. pylori* isolation from stool and saliva and ELISA in present study may be explained by the fact that serological tests are unreliable for the diagnosis of *H. pylori* since they may return false negative results up to 60 days after infection and remain positive for a considerable time after eradication *(19).*

In the present study, the *ureC* gene was used as a PCR target. PCR was applied to amplify and detect *H. pylori* DNA from the *ureC* gene. A PCR product of size (294 bp) was obtained from 12 human isolates from gastric biopsies. A PCR product of size (294 bp) was obtained from saliva and stool samples with a rates of 7 out of 9 (77.8%) and 3 out of 5 (60%) from saliva and stool respectively Table 5. The *ureC* (*glmM)* gene is highly conserved in and very specific to *H. pylori* and a number of researchers have used it in the examination of gastric tissues and other types of samples *(35).* The sensitivity of PCR was linked to the size of the amplified region, with the smaller 294 bp *glmM* product providing a more accurate result and it a high degree of sensitivity and specificity *(36,37).* Lower percentages obtained who reported that *H. pylori* DNA was found in 22% of oral swabs collected from patients and 8% of fecal samples *(33).* Controversy, still exists regarding the role of the oral cavity as a possible reservoir for *H. pylori* infection in healthy individuals due to the varying results obtained by different research groups throughout the world. It has been suggested that possible reasons for the lack of uniform positive findings of *H. pylori* within the oral environment are the sample collection procedure, methodology, and type of population studied *(14).*

On the other hand, 5 *H. pylori* suspected isolates from cats were subjected to PCR and showed a negative results for *ureC* PCR Table 5. Lower rate of *H. pylori* isolation from stool and saliva of cats in present study (2% versus 4%) was also observed in other study *(38)* while no evidence of *H. pylori* infection in cats were recorded in other studies *(11,39).* Moreover, some human epidemiological studies showed that contact with cats faeces occur during routine cleaning of litter boxes and exposure to vomit is considered as risk factor in the acquisition of *H. pylori (7).*

Conclusion and Recommendation

Dogs are not found to be naturally colonized with human *H. pylori* which is probably uncommon in cats and this may indicate that dogs do not represent a source of *H. pylori* for the human population. *H. pylori* infection was prevalent among humans in the areas studied. Rapid urease test is quick, simple and reliable method for diagnosis of *H. pylori* infection but its only limitation is that its need for endoscopy. Culture is very successful method for detecting *H. pylori* in gastric samples than saliva and stool samples. ELISA could be used for serodiagnosis of *H. pylori* in humanbeing but may be unreliable as it may remain for considerable time after eradication. Presence of *ureC* gene give strong confirmation of *H. pylori* identification. Further studies will be needed to determine the role of dogs and cats as reservoirs for humans with larger samples.

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الملخص العربى

عدوى الهليكوباكتر بيلوري في الحيوانات المنزلية في منطقة قناة السويس وأهميتها على الصحة العامة

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تم جمع ٥٠ عينة من البراز و ٥٠ عينة من السيرم و ٥٠عينة من اللعاب من القطط والكلاب وأصحابها من مستشفى للحيوانات الاليفة في محافظة بورسعيد. كما تم جمع ٢٠ عينة من النسيج المعدى من ٢٠ مريض في وحدة المناظير ، قسم الباطنه ، مستشفى جامعة قناة السويس ١٣ من الذكور و ٧ من الإناث ، و الذين يشكون من عسر الهضم ، والغثيان ، والتقيؤ ، وآلام في البطن. كما تم جمع عينات من المعدة من ٢٣ القطط المنزلية بعد قتلها قتلا رحيما. تم عزل ميكروب الهليكوباكتر بيلوري من كل نوع من العينات باستخدام المزرعه و التفاعلات البيوكيميائية. تم أخذ ٢٦ معزول من معزولات الهليكوباكتر بيلوري من الانسان و ٥معزول من معزولات الهليكوباكتر بيلوري من القطط وعمل تحليل التفاعل التسلسلى المتبلمر للكشف عن جين اليورياز. تم فحص عينات السيرم عن طريق الاليزا. و لقد أظهرت نتائج الفحص بالمنظار للعشرين مريض أن ١٠ % طبيعيين و ٣٠% يعانون من التهاب الغشاء المعدى و ٥٠% يعانون من القرحة المعدية و ١٠% يعانون من قرحة الاثنى عشر. لقد أظهر اختبار اليوريز ٧٥% يحملون الهليكوباكتر بيلورى بينما أظهر كلا من الزرع على المستنبتات المناسبة وكذلك الاليزا نتائج ايجابية بنسبة ٦٠% و ٨٠% لكل منهما. تم عزل ميكروب الهليكوباكتر بيلوري فى عينات البراز و اللعاب ١٠ % و١٨% على التوالى بين الحالات التى لها علاقه مباشرة بالحيوانات و ٤٨%من عينات السيرم اظهرت نتائج ايجابية باستخدام اختبار الاليزا. لم يتم عزل الهليكوباكتر بيلورى من الكلاب بينما ٦٢%من عينات السيرم اظهرت نتائج ايجابية باستخدام اختبار الاليزا. تم عزل الهليكوباكتر بيلورى بنسبة٨,٧% باستخدام المستنبتات المناسبة من النسيج المعدى للقطط . تم عزل الهليكوباكتر بيلورى فى عينات البرازواللعاب بنسبة٢% و ٤% على التوالى من القطط وكذلك ٥٠%من عينات السيرم اظهرت نتائج ايجابية باستخدام اختبار الاليزا. قد تم تحديد شريط عند٢٩٤ قاعدة زوجية فى كل ١٢ هليكوباكتر بيلورى المعزولة من النسيج المعدى للمرضى و٧٧,٨% من الهليكوباكتر بيلورى المعزولة من العاب و ٦٠% من الهليكوباكتر بيلورى المعزولة من البراز كدليل على وجود الوحدة الفرعية للجين المسئول عن انزيم اليوريز(يورى سى) فى ميكروب الهليكوباكتر بيلورى بينما أظهر اختبارتفاعل البلمرة المتسلسل نتائج سلبية مع السلالات المعزولة من القطط.