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Original article

Helicobacter Pylori Culture and Anti-biogram: Low Yield and Beneficial Results

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Abstract

Background: *Helicobacter pylori* (*H. pylori*) inhabits the stomach of more than 50% of the world' population. Antibiotic susceptibility testing and susceptibility-based eradication therapy is recommended to improve eradication therapy and to decrease rates of antibiotic resistance. **This study aimed to** assess the clinical usefulness of *H. pylori* culture and antibiotic sensitivity (for antibiotics commonly used in the treatment of *H. pylori* bacterium). **Patients and Methods:** One hundred adult patients presented for upper gastrointestinal endoscopic examination with *H. pylori-related* dyspepsia were included. The clinical history, physical examination and laboratory data were recorded. Additionally, five gastric biopsies were obtained from the body and antrum. Diagnosis of *H. pylori* was made by positive rapid urease test for gastric biopsies. Culture for *H. pylori was* done under microaerophilic incubation and when growth was detected, susceptibility of *H. pylori* bacterium to clarithromycin, levofloxacin, amoxicillin, moxifloxacin, metronidazole, doxycycline, and rifampicin were examined through disc diffusion method. **Results:** only 11% of gastric biopsies gave positive culture growth. There was a universal resistance to amoxicillin (100%), metronidazole (100%) and rifampicin (100%); variable resistance to clarithromycin (54.5%) and doxycycline (9.1%); with no resistance to levofloxacin (0%) or moxifloxacin (0%). **Conclusion**: The yield of *H. pylori* culture is low (11% in our study), but it gives beneficial data about antibiotic resistance and provides a clue to improve *H. pylori* eradication success rate and decrease antibiotic resistance.

Keywords: *Helicobacter*; *Pylori*; Culture; Resistance.

Introduction:

Helicobacter pylori (*H. pylori*) is a spiral-shaped bacterium which infects the stomach of majority of the world population [1,2]**.** It may remain asymptomatic, but it is the commonest and leading cause of the upper gastrointestinal diseases, including inflammatory and malignant disorders [3]**.**

The efficiency of standard triple therapy (proton pump inhibitor, amoxicillin, and clarithromycin) for *H. pylori* eradication has markedly decreased in the last decades [4]. The failure of this regimen is mainly caused by antibiotic (clarithromycin) resistance [5,6]. There is an emerging issue regarding resistance to other antibiotics including metronidazole, tetracycline, rifampicin, and fluoroquinolones [7,8]. Recognizing which regimen of antibiotics is most probably to reach eradication success for each individual and reducing the hazards of overusing antibiotics has become progressively more difficult [9].

Accordingly, susceptibility testing and susceptibility-based eradication therapy is recommended to improve eradication therapy results and to decrease rates of antibiotic resistance [10].

Aim of work:

This study aimed to assess the prevalence of H. pylori culture yield and antibiotic sensitivity (for most used antibiotics in H. pylori eradication).

Patients and Methods:

This observational cross-sectional study was conducted on 100 adult patients who underwent upper gastrointestinal endoscopic examination at the endoscopy unit of Hepatology, Gastroenterology and Infectious Diseases department, Benha University Hospital from January 2021 to December 2021. Biopsies were taken from the stomach and proved to be infected by *H. pylori* using rapid urease test. The committee of ethics of scientific research of Benha Faculty of Medicine approved this study protocol (approval number: MD.4.11.2020) and written informed consent was signed by all individual participants enrolled in the study and the study respected the principles of the Declaration of Helsinki.

Inclusion Criteria:

- Adult patients who underwent upper gastrointestinal endoscopic examination and confirmed to have *H. pylori* infection by rapid urease test for the gastric biopsies.

Exclusion criteria:

- Age less than 18 years old.
- Previous *H. pylori* treatment.
- Use of antibiotics or bismuth salts during the four weeks before endoscopy.
- Use of antisecretory drugs or sucralfate during the two weeks before endoscopy.
- History of bleeding or a coagulation disorder that preclude biopsy sampling.

History was taken from all participants regarding personal history, present history, past history, drug history and family history. Clinical examination was done including general and abdominal examination. Laboratory investigations, including complete blood count, prothrombin time, were checked before upper gastrointestinal endoscopy.

Upper gastrointestinal endoscopy and gastric biopsies:

Endoscopy allowed for the visual assessment of gastric mucosa, enabling the identification of certain macroscopic abnormalities or suspected lesions, and it provided gastric biopsy samples. For proper assessment of *H. pylori*-positive gastritis, six biopsies should be taken from different areas of the gastric mucosa including the antrum and gastric corpus [(11)].

Upper gastrointestinal endoscopy was done with multiple biopsies were obtained from the gastric mucosa of the corpus and antrum, then rapid urease test (CLO) was done and patients who had positive test were included in the study.

Rapid urease test:

The Campylobacter like organism (CLO) screening test is formed of a well of gel (urease indicator) put in a plastic slide. The gel contains urea, phenol red, buffers and a bacteriostatic material to avoid the growth of other urease-producing organisms that may contaminate the specimen. If the gastric biopsy contains the urease from *H. pylori*, it converts the gel from yellow color to bright magenta color.

H. pylori culture and antibiotic sensitivity (for gastric biopsies):

The gastric biopsies were sent to the microbiology laboratory within a sterile box. Each biopsy was made uniform and placed on Columbia blood agar treated with 5% sheep blood (known as Oxoid Columbia agar base). Dishes were incubated at temperature 37 ^{o}C up to 10 days in microaerophilic conditions using gas packs maneuver (Campy Pak; Becton Dickinson). Recognition of *H. pylori* was diagnosed by doing Gram stain for the colonies, recognized as spiral shaped, gram-negative bacterium, absence of growth aerobically on blood agar dishes, and testing positive for urease, catalase, and oxidase enzymes [(12)].

The susceptibility of *H. pylori* bacteria to clarithromycin, levofloxacin, moxifloxacin, metronidazole, amoxicillin, doxycycline, and rifampicin were examined by disc diffusion. Disc diffusion was done on Columbia blood agar treated with 5% sheep blood. When the colonies were inoculated, density was calibrated to turbidity of 0.5 McFarland through placing of each disc over the prepared medium for 72 hours duration under microaerophilic atmosphere [(13)].

Statistical analysis:

Sample size was calculated suggested by results of the local studies which showed that *H. pylori* clarithromycin resistance prevalence is approximately 55.7% [(14).] We assumed a treatment success rate for clarithromycin based triple regimens to be around 50%. From earlier local studies, levofloxacin based triple regimens has a treatment success rate more than 80% [(15)]. To detect this difference with 80% power and 95% confidence, a minimum sample size of 86 patients is required. Chi square test was used for categorical variables and two tailed *t* test was used for continuous variables.

Coded data were prepared on computer database for data entry on Office Excel program on Microsoft windows, 2013. Then, the data were entered to the Statistical Package of Social Science, version 20 (IBM Corp., Armonk, NY, USA) to analyze the data.

Results:

Baseline characteristics:

We enrolled 100 consecutive patients in this observational study. Patients ages ranged from 19 to 70 years (36.6±11.6 years) and 22 (22%) of them were males. Table, 1 showed the baseline socio-demographic and clinical features of the studied participants.

The most common endoscopic finding in our patients was mucosal hyperemia in 100% followed by nodularity in 76% of them. Table, 2 showed endoscopic findings of the studied patients.

Culture yield and antibiotic sensitivity:

Of the included patients, 11% of gastric biopsies had positive *H. pylori* culture growth as shown in table, 3 and fig. 1. There was a universal resistance to amoxicillin (100%), metronidazole (100%) and rifampicin (100%); variable resistance to clarithromycin (54.5%) and doxycycline (9.1%); with no resistance to levofloxacin (0%) or moxifloxacin (0%) as shown in table, 4 and fig., 2.

Table 1: Socio-demographic and clinical features of the studied patients.

Characteristics	Studied patients N = 100 (%)
Age (mean±S.D in years)	36.6 (±11.6)
Males	22 (22%)
Married	78 (78%)
Residence (Urban)	51 (51%)
No work	55 (55%)
Smokers	7 (7%)
Clinical presentation	
Post-prandial pain	83 (83%)
Heartburn	58 (58%)
Nausea	56 (56%)
Bloating	43 (43%)
Vomiting	32 (32%)
Weight loss	16 (16%)
Dysphagia	2 (2%)
Past history	
Previous operations	57 (57%)
Liver disease	12 (12%)
Hypertension	11 (11%)
Diabetes Mellitus	9 (9%)
Heart disease	2 (2%)
Kidney disease	1 (1%)
Drug history	
Antibiotics	100 (100%)
Family history	
H. pylori	58 (58%)
Gastrointestinal malignancy	3 (3%)
Laboratory parameters (mean±S.D)	
Hemoglobin (g/dL)	11.81 (±1.42)
White blood cells ($\times 10^9$/L)	6.38 (±1.87)
Platelets ($\times 10^9$/L)	254.47 (±72.08)

Table 2: Endoscopic findings of the studied patients.

Findings	Studied patients N = 100(%)
Reflux oesophagitis	44 (44%)
Stomach	
Hyperemia	100 (100%)
Nodularity	76 (76%)
Erosions	42 (42%)
Ulcerations	12 (12%)
Granularity	3 (3%)
Duodenum	
Hyperemia	24 (24%)
Erosions	7 (7%)
Ulcerations	6 (6%)

Table 3: Culture yield for the studied gastric biopsies.

Culture yield	Studied biopsies N =100(%)
Growth	11 (11%)
No growth	89 (89%)

Table 4: Antibiotic resistance of culture positive gastric biopsies.

Antibiotic	Studied biopsies n =11(%)
Clarithromycin	6 (54.5%)
Levofloxacin	0
Moxifloxacin	0
Amoxicillin	11 (100%)
Metronidazole	11 (100%)
Doxicycline	1 (9.1%)
Rifampicin	11 (100%)

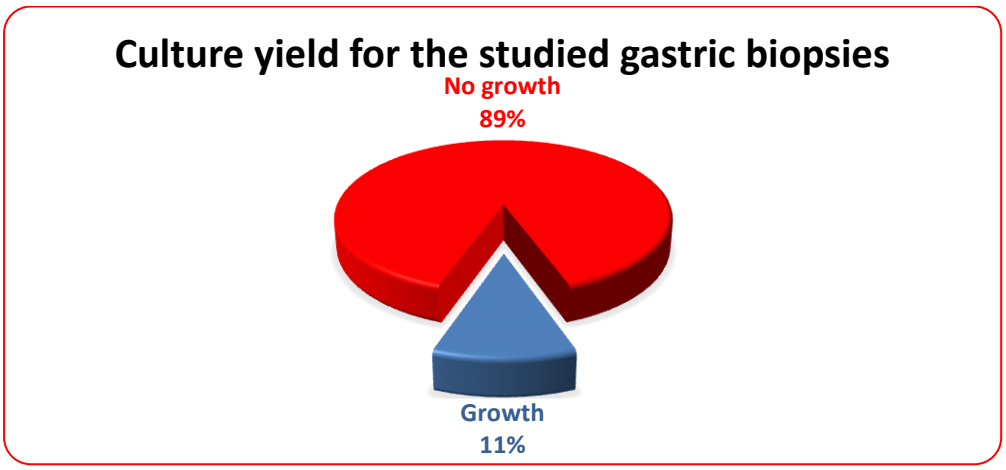

Figure 1: Culture yield for the studied gastric biopsies.

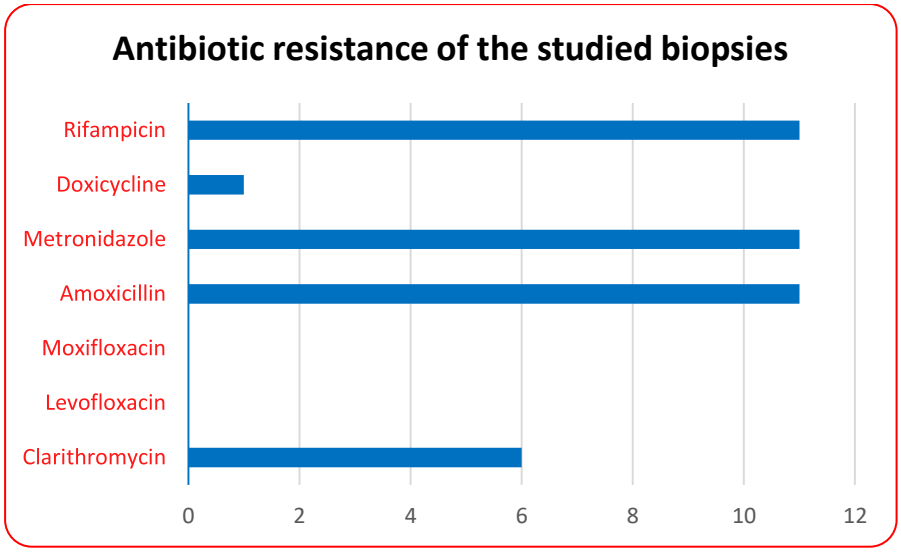

Figure 2: Antibiotic resistance of culture positive gastric biopsies.

Discussion:

This observational study was carried out on 100 consecutive patients who presented to the endoscopy unit for upper endoscopy. In the present study, 22 patients were males and 78 were females, this gender distribution was consistent with ***Azab et al.*** [16] and ***Peña-Galo et al.*** [17] where 60.7% and 55.2% consecutively of included patients were females what may indicate *H. pylori* predominant infection in females, but this dis-agrees with ***Khoder et al.*** [18] who reported male predominance (63%) in the included population in their screening study and with a world-wide systematic review done by ***Zamani et al.*** [19] that concluded that there were no difference in sex distribution between *H. pylori* infected populations.

The patients' age ranged between 19 and 70 years (mean±SD= 36.6±11.6). This indicates that most infected patients within our study were in the middle age group and this mean age distribution within middle-aged population was documented by ***Azab et al.*** [16] and ***Elantouny et al.*** [15]. But in another study like ***Khoder et al.*** [18] documented 25% infection between 2 and 5 years and 31% infection between 6 and 30 years. This difference could be explained by the different targeted populations, where in our study and the agreed studies the target populations were dyspeptic patients presented for upper endoscopy while the target population were all screened patients in ***Khoder et al.*** [18] study; this notifies us that despite the possibility of very early infection, the symptomatic presentation of the infection will mostly be in middle-aged population.

Most of our studied patients were married (78%), with nearly equal distribution between rural and urban geographic areas (49%, 51% consecutively), 55% had no work and only 7% were smokers.

All patients had epigastric pain and used antibiotics previously, 58% had family history of *H. pylori*, and 80% had epigastric tenderness.

Endoscopic gastric mucosal hyperemia was reported in all patients with gastric nodularity in 76% while 42% had gastric erosions, 12% had gastric ulcerations and

3% had gastric granularity. Reflux esophagitis was noted in 44% of patients. Duodenal examination showed that 24% of patients had duodenal hyperemia, 7% had duodenal erosions and 6% had duodenal ulcers. This indicates that the stomach was the most affected region endoscopically in *H. pylori* dyspeptic patients presented for upper gastrointestinal endoscopy examination. This agreed with ***Azab et. al.,*** [16] who reported that the commonest endoscopic abnormalities were detected in the gastric mucosa in the form of gastritis, nodular gastritis, erosions, or ulcerations.

In the current study 11% of patients' gastric biopsies showed positive culture growth for *H. pylori*. Other studies, found different rates of *H. pylori* culture growth, where 14.9%, 29.3% and 26.9% were detected in an Egyptian [20] ,Chinese [21] and Philippian studies. This discrepancy in results of culture growth may be referred to the number and site for biopsy taking, inadequate tissue sampling or different laboratory techniques (transport, processing, culture media and incubation).

In the current study, susceptibility testing showed that clarithromycin resistance was 54.5%, this agreed with ***Metwally et al.*** [20] who found clarithromycin resistance (40%), ***Tang et al.*** [21] who found clarithromycin resistance (44.4%) using disc diffusion method, ***Abdoh et al.*** [23] from Palestine (47%) and with ***Zaki et al.*** [24] from Egypt who documented that the cultured *H. pylori* had higher resistance (46.2%) for clarithromycin.

Clarithromycin resistance may be due to multiple point mutations in peptidyl transferase region within domain V of 23s rRNA especially with its overuse in respiratory tract infections [25].

Regarding levofloxacin resistance, it was zero percent in our study. Similar data was reported by ***Abdoh et al.*** [23] and ***Mabeku et al.*** [26]. However, in the study of ***Metwally et al.*** [20] it was 20%, while ***Tang et al.*** [21] reported 28.2% using disk diffusion method and in ***Hamidi et al.*** reported 28% [27].

Also, moxifloxacin (the other studied quinolone) in our study showed zero percent resistance. In the study of ***Metwally et al.*** [20] resistance to moxifloxacin was 10%, and in ***Abdoh et al.*** [23] it was 3%. This may suggest using moxifloxacin as one of the best antibiotics to treat *H. pylori*, but in other studies higher rates of resistance were reported, it was (42.9%) in ***Park et al.*** [28] and 38.5% in ***Shao et al.*** [29] study. This may suggest the need for further larger studies to detect the actual resistance of *H. pylori* to moxifloxacin.

Regarding amoxicillin resistance in our study, it was universal as all (100%) patients showed resistance. This was similar to ***Metwally et al.*** [20] and ***Mabeku et al.*** [26] studies as they reported very high resistance rate (97.1% and 97% respectively). On the opposite side, lower rates of resistance were detected in other studies by ***Shao et al.*** [29] and ***Tang et al.*** [21] who reported a rate of 1.6% and 7.7% respectively. While intermediate rates were documented by ***Abdoh et al.*** [23], ***Park et al.*** [28] and ***Hamidi et al.*** [27] (18%, 20% and 30% respectively). These wide differences between studies may be caused by different geographical locations and misuse of antibiotics in many countries which resulted in *H. pylori* resistance with different patterns.

Metronidazole showed 100% resistance in our study. Similar high resistance rates were documented by ***Metwally et al.*** [20] (100%), ***Abdoh et al.*** [23] (100%), ***Mabeku et al.*** [26] (97.9%), ***Tang et al.*** [21] (90.6%) and in ***Park et al.*** [28] it was (27%). This may be explained by its wide use in different

infectious diseases and over the counter use in different countries.

In the current study, doxycycline resistance was 9.1%. This may coincide with results reported by ***Metwally et al.*** [(20)], ***Hamidi et al.*** [(27)] and ***Park et al.*** [(28)] (10%, 16% and 18% respectively). Lower rates of resistance were reported by ***Mégraud et al.*** [(30)] (zero %), ***Tang et al.*** [(21)] (0.8%) and ***Hofreuter et al.*** [(31)] (2.2%).

Rifampicin resistance in our study was (100%) which may agree with ***Metwally et al.*** [(20)] who reported a rate of 90%, ***Tang et al.*** [(21)] and ***Hamidi et al.*** [(27)] where the resistance rate was 50% and 69.2% respectively. However, much lower rates of resistance were noted in ***Mabeku et al.*** [(26)], ***Mégraud et al.*** [(30)] and ***Shao et al.*** [(29)] who reported zero %, 1.2% and 2.8% respectively.

Camorlinga-Ponce et al. [(32)], using culture and antibiotic sensitivity testing, concluded an increased resistance to clarithromycin from 1997 to 2017 (1.85%–32.2%) and to levofloxacin (9%–58%), but metronidazole resistance decreased (73%–52%). While amoxicillin resistance was zero during 1997–2011, and reached 6.5% in 2017.

The relatively small sample size in our study with the lower rate of culture yield may represent one of the main limitations of our study. Another limitation was that we didn't investigate for the genetic resistance of antibiotics such as mutations at the V domain of 23S rRNA, encoding for peptidyl transferase, that may contribute to clarithromycin genetic resistance and its impact on treatment outcome. So, these points should be highlighted through further studies including larger sample size to ensure an adequate culture-positive patients taking into consideration the low yield of *H. pylori* culture.

Conclusion:

In spite of the low yield of *H. pylori* culture (11% in our study), it gives beneficial data about antibiotic resistance and provides very important clue to improve *H. pylori* eradication success rate and decrease antibiotic resistance by starting susceptibility-based treatment regimens.

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