Research Article

Utility of Rapid urease test in diagnosis of Helicobacter pylori infection

Shaan Khetrapal,[1] Samarth Shukla[2], Safia Rana[3], Zeeba S Jairajpuri[4], Sourya Acharya[5]

[1,3,4]Asst. Prof Department of Pathology. Hamdard Institute of Medical Sciences and Research, New Delhi

[2]Professor Department of Pathology DMIMS University Wardha Maharashtra

[5]Professor Department of Internal Medicine DMIMS University Wardha Maharashtra

Abstract:

Aim: To evaluate the role of rapid urease test in diagnosis of Helicobacter pylori infection in various gastro intestinal lesions vis a vis conventional and special staining methods.

Materials & Methods: This hospital based cross sectional study was conducted on 50 cases with gastro intestinal lesions. The obtained biopsies were then subjected to rapid urease test for detection of H. pylori by using the Pronto Dry Kit immediately. Further histopathology examination using conventional H & E (haematoxylin and eosin) stain and special Gimenez stain for H. pylori was done.

Results: In this study gender wise distribution of patients showed 58% males and 42% females. Chronic gastritis was found to be the most common diagnosis (28%), followed by squamous cell carcinoma (20%) chronic inflammation (16%), H. pylori gastritis and adenocarcinoma stomach (6%), adenocarcinoma esophagus, dysplasia, erosion, esophagitis and perforation in 4%. Least common diagnosis was atrophic gastritis and carcinoid in 2%. We found that 26 cases were positive for H. pylori with Rapid urease test and 24 with special stain (Gimenez).

Conclusion: This study amalgamates and incorporates the valuable clinical assessment along with the endoscopic findings, the surgical pathological (histopathology) evaluation of the biopsies along with the proto dry kit (rapid urease test), as a kind of "Gastric Triple Test" for declaring the patients as positive or negative for pathogenic infection with Helicobacter pylori.

Introduction:

It has been known for more than a century that bacteria are present in the human stomach. [1] About 20 years ago, Barry Marshall and Robin Warren described the successful isolation and culture of a spiral bacterial species, later known as Helicobacter pylori [2], from the human stomach which can colonize and induces inflammation of the gastric mucosa. It is a gram-negative bacterium, belongs to the family Helicobacteraceae. [3]

H. pylori colonize the stomach of more than half of the world's population, and the infection continues to play a key role in the pathogenesis of a number of gastro duodenal diseases. The prevalence of H. pylori infection varies widely by geographic area, age, race, and socioeconomic status (SES). The acquisition rate of H. pylori appears to be more rapid in developing than developed countries.[4, 5]

The primary disorder, which occurs after colonization with H. pylori, is chronic active gastritis. H. pylori-positive patients have a 10 to 20% lifetime risk of developing ulcer disease and a 1 to 2% risk of developing distal gastric cancer.[6,7]

The available tests to detect H. pylori infection are generally divided into invasive and non invasive tests. Invasive diagnostic methods such as histological stains, culture and urease test require an endoscopic biopsy of gastric mucosa. While serology, urea breath test, stools, urine, or saliva for detection of antibodies, bacterial antigens, or urease activity are currently available non invasive tests.

Various researches undertaken in present day point towards H. pylori as the prime culprit of the gastro intestinal lesions. There is however a paucity in the studies in central India regarding the same, this study of 50 patients was taken up at Acharya Vinobha Bhave Rural Hospital, Wardha. The crux of the study was to evaluate and establish the role H. pylori in Gastro intestinal lesions and to compare the utility of rapid urease test in detecting H. pylori infection with conventional and special staining methods.

Material & Methods:

Type of study: Cross sectional study

Duration: September 2016 to September 2018 (2 years)

Inclusion criteria:

1. Patients with symptoms of gastrointestinal disease.
2. Willing to go for endoscopic biopsies

Exclusion criteria:

1. Subjects with any major medical or surgical illnesses.
2. Patients already on drugs for gastro intestinal complaints.
3. Not willing to give informed consent.

Endoscopic biopsies were then taken from all patients. The

obtained biopsies were then subjected to rapid urease test (RUT) for detection of H. pylori by using the Pronto Dry Kit immediately. Further histopathology examination using conventional H & E stain and special Gimenez stain for H. pylori was done.

Pronto Dry Kit: This test is based on the principle that abundant urease enzyme produced by H. pylori hydrolyses urea to ammonia. The consequent rise in the pH of the medium is detected by phenol red indicator. $NH_2\text{-}CO\text{-}NH_2 + 2H_2O + H^+$ $2NH_4^+ + HCO3\text{-}$. [8]

Methods: The test is performed at the time of gastroscopy. A biopsy of mucosa is taken and placed onto it after removing the sticker.This medium contains urea and an indicator such as phenol red. Yellow –NEGATIVE, Red - POSITIVE.

Haematoxylin & Eosin Stain
Principle: Uses hematoxylin solutions for nuclear staining and eosin solutions for cytoplasmic staining.

Gimenez stain
Principle: The Gimenez technique may be valuable for detecting certain slow-growing or fastidious bacteria.[9]

Method:

This method uses a dilute buffered carbol fuchsin (Ziehl-Neelsen) for 1-2 minutes, followed by a water wash and stain with 1% malachite green for 45 seconds. Repeat the malachite green until section appears blue/green to the naked eye. Wash in water, blot and air dry.

Results:

Background - blue/green
Organisms - red/magenta
Mucin – pale blue

Data Management And Statistical Analysis:

Nominal data such as demographic data were presented as number and percentages. Cohen's kappa coefficient was also calculated, which is a statistical measure of inter-rater agreement or inter-annotator agreement[10] for qualitative (categorical) items, was carried out to measure the association between rapid urease test and special stain(Gimenez). A p value of <0.05 was considered as statistically significant. Chi square test was applied as appropriate for comparison of nominal data.

Results:

Table 1: Comparison test statistics for Rapid Urease Test and Special Stain

Special Stain (Gimenez)	Rapid Urease Test	
	Positive	Negative
Positive	24	1
Negative	2	23
Total	26	24
	Percentage(%)	95%CI(%)
Sensitivity	92.31	74.87 – 99.05
Specificity	95.83	78.88 – 99.89

PPV	96.00	79.65 – 99.90
NPV	92.00	73.97 – 99.02
Accuracy(%)	94%	
p-value	p<0.0001, Significant	

Kappa Statistics=0.812

Table 1: Rapid Urease Test (Pronto dry kit), was taken as a Gold standard test because microscopy may be false negative if number of organisms is quite low. In that case RUT yields positive result as H. pylori gets sufficient time to multiply in the urea.

Taking Rapid urease test as gold standard true positives, true negatives, false positives and false negatives were calculated.[8] Cohen's kappa coefficient was also calculated, which is a statistical measure of inter-rater agreement or inter-annotator agreement [10] for qualitative (categorical) items. This value of 0.812 in our study, signifies a very good correlation.

Table 2: Distribution of Endoscopic Biopsy site in RUT positive cases

Endoscopic Biopsy Sites	Total no. of cases	Positive cases	Percentage (%)
Antrum	24	23	95.83
Cardia	5	1	20.00
Duodenum	1	0	0.00
Fundus	2	1	50.00
Large Intestine	1	0	0.00
Lower Esophagus	13	0	0.00
Pylorus	4	1	25.00
Total	50	26	

Table-2 : shows the distribution of various endoscopic biopsy sites in rapid urease positive cases, taking the total no. of cases from that site as 100, percentage of each site is calculated.

Table 3: Distribution of Endoscopic Biopsy site in Special Stain positive cases

Table 3: shows the distribution of various endoscopic biopsy sites in special stain positive cases, taking the total no. of cases from that site as 100, percentage of each site is calculated.

Endoscopic Biopsy Sites	Total cases	Positive cases	Percentage(%)
Antrum	24	21	87.50
Cardia	5	2	40.00
Duodenum	1	0	0.00
Fundus	2	1	50.00
Large Intestine	1	0	0.00
Lower Esophagus	13	0	0.00
Pylorus	4	1	25.00
Total	50	25	

Table 4: Distribution of cases according to diagnosis

Diagnosis	No of cases	Percentage(%)
Adenocarcinoma Stomach	3	6
Adenocarcinoma Esophagus	2	4
Atrophic Gastritis	1	2
Carcinoid	1	2
Chronic Inflammation	8	16
Chronic Gastritis	14	28
Dysplasia	2	4
Erosion	2	4
Esophagitis	2	4
Perforation	2	4
H. Pylori Gastritis	3	6
Squamous cell carcinoma	10	20
Total	50	100

Table-4: shows the distribution of cases according to the diagnosis. In this study the most common diagnosis that we came across was that of Chronic Gastritis (28%), squamous cell carcinoma (20%), chronic inflammation (16%) and various other diagnosis forming the minority.

Table 5 : Cross tabulation of Special stain and RUT biopsy.

Biopsy Site	Rut	Special Stain
Antrum		
Positive	23	21
Negative	1	3
Total	24	24
Cardia		
Positive	1	2
Negative	4	3
Total	5	5
Duodenum		
Positive	1	1
Negative	1	1
Total	2	2
Fundus		
Positive	1	1
Negative	1	1
Total	2	2
Large Intestine		
Positive	1	1
Negative	1	1
Total	2	2
Lower Esophagus		
Positive		
Negative	13	13
Total	13	13
Pylorus		
Positive	1	1
Negative	3	3
Total	4	4

Table 5, shows the number of positive cases for H. pylori by rapid urease test and by special stain in various endoscopic biopsy sites.

Table 6: Cross tabulation of Special stain and RUT in H.Pylori diagnosis.

Histopathological Diagnosis	Rut	Special Stain
Adenocarcinoma Stomach		
Positive	2	1
Negative	1	2
Total	3	3
Adenocarcinoma Esophagus		
Positive		
Negative	2	2
Total	2	2
Atrophic Gastritis		
Positive	1	1
Negative		
Total	1	1
Carcinoid		
Positive		
Negative	1	1
Total	1	1
Chronic Inflammation		
Positive	3	3
Negative	5	5
Total	8	8
Chronic Gastritis		
Positive	11	11
Negative	3	3
Total	14	14
Dysplasia		
Positive	2	2
Negative		
Total	2	2
Erosion		
Positive	2	2
Negative		
Total	2	2
Esophagitis		
Positive		
Negative	2	2
Total	2	2
Perforation		
Positive	2	2
Negative		
Total	2	2
H. Pylori Gastritis		
Positive	3	3
Negative		
Total	3	3
Squamous Cell Carcinoma		
Positive		
Negative	10	10
Total	10	10

Table 6, shows the number of positive cases for H. pylori by rapid urease test and by special stain in various histopathological diagnosis.

Discussion:

Helicobacter pylori is the main pathogenic agent which is investigated and found to be responsible in the etiology of various gastro intestinal lesions. During the last 15 years, many studies have been undertaken concerning the role of H. pylori in the etiopathogenesis of chronic gastritis and peptic ulcer, as well as its role in the development of stomach malignancies. H. pylori causes chronic inflammation which also results in chronic atrophic gastritis and intestinal metaplasia. Hypoacidity results in excessive bacterial reproduction which also leads to the reduction of nitrates, in the diet, into nitrites and finally carcinogenic nitroxamines are released. In this way, a shift from metaplasia to dysplasia and intestinal type adenocarcinoma is possible.[11]

In 1994, based mostly upon epidemiologic evidence, the International Agency for Research on Cancer (IARC), a part of the World Health Organization (WHO), recognized infection by Helicobacter pylori (H. pylori) as a primary cause of gastric adenocarcinoma. [145] Left untreated, H. pylori infection leads to life-long chronic active gastritis, which is a risk factor for both intestinal and diffuse gastric adenocarcinomas. [13]

H. pylori is now accepted as having a critical role in duodenal ulcer also, where the prevalence of infection is 90 to 95%. There is also increasing evidence for the involvement of H. pylori in gastric ulcer, where infection is seen in between 60 and 80% and in complications of ulcer disease include bleeding, perforation, and stricture formation. In a very small proportion the lymphoid reaction to H. pylori infection appears to progress to become a mucosal associated lymphoid tissue (MALT) lymphoma.[7]

The tests available for detection of H pylori infection are numerous, including the invasive and non invasive ones.

Various authors evaluated the role of the H. Pylori in gastrointestinal lesion; nevertheless, there is a certain paucity of information and studies available in the rural population especially in the central part of India. Gender wise distribution of patients showed 58% male and 42% female patients. Chronic gastritis was found to be the most common diagnosis (28%), followed by squamous cell carcinoma (20%) chronic inflammation (16%), H. pylori gastritis and adenocarcinoma stomach (6%), adenocarcinoma esophagus, dysplasia, erosion, esophagitis and perforation in 4%. Least common diagnosis was atrophic gastritis and carcinoid in 2%. (Table 4) We found that 26 cases were positive for H. pylori with Rapid urease test and 24 with special stain (Gimenez). (Table 1)

Ola reported that the H. Pylori was better detected in the mucosa of the antrum (72%) than that of the duodenum (28%), p < 0.05. Author concluded that there was no benefit in taking additional biopsy from incisura angularis to that from the antrum.[14] In a study by **Woo**, the gastric angle site was positive in 100%. The prepyloric site was positive in 87%, and the corpus site was positive in 84.4% (p < .052 for angle or prepyloric antrum versus corpus). The maximum probability for detecting H. pylori infection using a RUT is to obtain a biopsy from the gastric angle. [15] **Yousfi** found that both antral and corpus culture specimens were positive (90%). [16]

In our study, it was also seen that the antrum was the most common endoscopic biopsy site which came positive for H. pylori. 95.83 % cases of the total antrum biopsies were positive by RUT (Table 2) and 87.50% by special stain. (Table 3) Antrum was further followed by other sites like cardia, fundus of stomach and pylorus. These findings are in concordance with the findings of **Ola, Woo** and **Yousfi** as stated above.

In a study by **Kassa** in 200 patients with dyspepsia, the sensitivity, specificity, positive and negative predictive values of Gimenez stain as compared to culture were 100%/87%/95%/100%. Whereas sensitivity, specificity, positive and negative predictive values of gram stain was 60%/98%/99%/51% and that of Giemsa stain were 100%/97%/99%/100%.

Fujiyoshi detected H. pylori infection using Gimenez stain and immunohistochemistry. [17] **Baird** examined 500 gastric biopsies showing some degree of inflammation using Gimenez stain. Author found that greater than 60% were positive for H. pylori organisms. Prominent inflammatory changes including both acute gastritis and diffuse chronic gastritis, resulting in over 87% of the biopsies being positive for H. pylori.

Gimenez stain claimed to meet the above standards in comparison with other techniques. This method is simple to perform and inexpensive. It takes about 10 minutes of technical time and gives a very good contrast when performed well, making identification of the organism easy. The Gimenez staining technique uses biological stains to detect and identify bacterial infections in tissue samples.

The Gimenez technique may be valuable for detecting certain slow-growing or fastidious bacteria. This is a really nice stain because the mucin stains a pale blue and the organisms really stand out. Advantages of the Gimenez technique are 1. It is a fast stain, 2. Stock carbol fuchsin is stable for months, 3. The test is quite inexpensive.

Though, the modified Giemsa stain is very straightforward, inexpensive, and takes about five minutes to perform, major disadvantage is that there is little contrast between organisms and tissue. In silver stain, microorganisms are black against a pale background. However, it is costly technique and has disadvantage in terms of disposing silver nitrate and/or uranyl nitrate. In some cases, silver precipitation may occur, mimicking and/or obscuring organisms.

Considering the advantages of Gimenez stain, it was used in our study. 25 cases out of a total of 50 cases were found to be positive for H. pylori by using this satin. (Table 3) The findings were found to be in concordance with other studies as stated above.

Rapid urease tests are easy to employ in the endoscopy room and provide a rapid result allowing deployment of H. pylori eradicating treatment immediately after gastroscopy. Pronto Dry®, for the diagnosis of H. pylori infection: This test has three potential advantages: rapid results, storage at room

temperature for two years, and simple use at room temperature.

In a study by **Morio,** sensitivity and specificity of Pronto Dry were 62.5% and 98.4% at 5 minutes and 84.4% and 98.4% at 30 minutes respectively. 75% of rapid urease tests (75%) were already positive at 5 minutes. Author concluded that the performance of Pronto Dry is similar to that of other rapid urease tests.[18]

In one study, **Said** found that the results for both the Pronto Dry and the CLO tests were completely concordant with sensitivity, specificity, positive predictive value, negative predictive value and diagnostic accuracy of 98.1%, 100%, 100%, 98.1% and 99%, respectively. The Pronto Dry test showed a faster reaction time to positive compared with the CLO test, with 96.2% positive reaction by 30 min versus 70.8% and 100% positive reaction time by 55 min versus 83%. The colorimetric change was also more distinct with the Pronto Dry test compared with the CLO test.[19]

In a study by **Perna,** Pronto Dry showed higher sensitivity in pre and post treatment setting compared to liquid phase-rapid urease test within 3 hours of incubation time. Sensitivity at 5, 15, 30 minutes, and 3 and 24 hours were 45%, 71.2%, 81.1%, 90.1% and 91.9% respectively for the Pronto Dry vs 6.3%, 31.5%, 51.3%, 78.4% and 90.1% for liquid phase rapid urease test.[20]

However, **Yakoob** found that the sensitivity, specificity, NPV and PPV of Pronto rapid urease test was reduced in patients who are on PPI. Pronto Dry was positive in 40% (44/109) and negative in 60% (65/109). Histopathology was positive for H. pylori in 57% (62/109) and negative in 43% (47/109). The sensitivity, specificity, PPV, NPV and like-hood ratio of a positive and negative Pronto Dry test with and without PPI were 43.3%, 86.4%, 81.3%, 3.18, 0.656 and 52.8% vs 71.9%, 80%, 82.1%, 69%, 3.59 and 0.35.[21]

In most circumstances, the biopsy urease test is the initial endoscopic test, and, if positive, no further evaluation is necessary. Because false-negative rapid urease tests occur with some regularity, **Cohen** recommended that additional biopsies be obtained routinely for histological staining in the event that the urease test is negative. Although histological assessment is not free of pitfalls, it is still one of the gold standards. The choice of stains should depend on the clinical situation, local expertise, and costs. Culture is not recommended for routine evaluation because of the many potential errors involved, leading to false-negative results.

By cohesion of RUT and Special stain (Gimenez) are results were formulated. (Tables 5 & 6) RUT was taken as a gold standard test because microscopy may be false negative if number of organisms is quite low. In that case RUT yields positive result as H. pylori gets sufficient time to multiply in the urea.[8]

In our study, the test statistics showed overall sensitivity of Gimenez stain as compared with RUT to be 92.31%, specificity was 95.83%, PPV was 96% and NPV was 92%. (Table 1) The accuracy of the test was found to be 94%. The p value of<0.0001 was found to be significant. The Kappa Statistics was also carried out, the value of it is 0.812, this

value is considered as very good. These findings are in concordance with the findings by **Kassa** showing the sensitivity, specificity, positive and negative predictive values of Gimenez stain to be 100%/87%/95%/100%. The findings in studies of **Fujiyoshi** and **Baird** using Gimenez stain are also comparable. The studies done using Pronto Dry by **Morio,** had sensitivity and specificity of 98.4%. **Said** also found the sensitivity, specificity, positive predictive value, negative predictive value and diagnostic accuracy results for the Pronto Dry to be of 98.1%, 100%, 100%, 98.1% and 99%, respectively. The study done by **Perna,** using Pronto Dry also showed sensitivity of 90.9%. **Yakoob** and **Cohen** also had comparable findings. Thus making our findings to be in line with the published literature.

Conclusion:

Today centre for disease and control CDC, declares that the helicobacter pylori infects more than 2/3rd of the world population, colonizing the vast domains of stomach and upper gastrointestinal ecology. The fact that these patients are more or less asymptomatic is another significant finding to take note of.

The study has recorded significant data on the pattern and nature of pathologic lesions caused by Helicobacter pylori. The observations made show and reaffirm that H. pylori is a major infective etiological factor in causation directly as well as a major risk factor in causing lesions like chronic gastritis which are know predecessors for development of cancers. This study amalgamates and incorporates the valuable clinical assessment along with the endoscopic findings, the surgical pathological (histopathology) evaluation of the biopsies along with the proto dry kit (rapid urease test), as a kind of "Gastric Triple Test" for declaring the patients as positive or negative for pathogenic infection with Helicobacter pylori.

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