

The Impact of Brushing Teeth on Carbon-14 Urea Breath Test Results

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Objective: The ^{14}C urea breath test noninvasively detects the presence of the urease-producing bacteria *Helicobacter pylori* in the stomach. Several sources of errors have been identified to cause false or indeterminate results on the test. The objective of this study was to identify whether brushing teeth affects the test results.

Methods: We performed the ^{14}C urea breath test on 168 patients, with breath samples counted at 10 and 20 min after oral administration of 2 μCi (74 kBq) ^{14}C urea. Ninety-four patients brushed their teeth before the test while 74 did not.

Results: Thirty-six of the 74 patients (49%) who did not brush their teeth had positive results at 10 min, which became negative at 20 min. None of the 94 patients who brushed their teeth before testing showed this pattern with agreement of results at 10 and 20 min.

Conclusion: We recommend brushing teeth before the ^{14}C urea breath test since it significantly decreased the ambiguous results of the test in our laboratory.

Key Words: carbon-14 urea breath test; *Helicobacter pylori*; teeth brushing

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Helicobacter pylori is an organism that lives in the stomach and duodenum of many individuals. It is a gram negative spiral rod, first described and noted over inflamed mucosa by John Warren in late 1970s. Marshal and Warren (1) were the first investigators to associate gastritis and peptic ulceration with a curved urease-producing organism cultured from gastritis patients, named *Campylobacter pyloridis* and *Campylobacter pylori* and later renamed *Helicobacter pylori*.

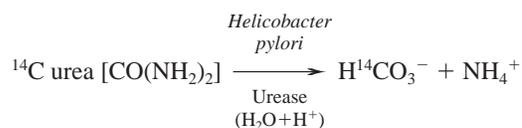
The prevalence of *Helicobacter pylori* infection is variable in different countries. Fallone (2) studied the determinants of ethnic or geographical differences of *Helicobacter pylori* prevalence and stated that the most important determinant is likely socioeconomic class, which influences living conditions and sanitation.

Helicobacter pylori infection is recognized now as the primary cause of several pathological disorders, such as gastric and duodenal ulcer (3,4), gastric cancer and lymphoma (5–7), chronic nonspecific gastritis (Type B gastritis), and nonulcerative dyspepsia (8). Eradication of *Helicobacter pylori* infection has been strongly linked to ulcer healing and prevention of ulcer recurrence (9). After eradication of the infection, the risk of recurrence of ulcer disease is reduced to less than 10% for gastric ulcer disease and to nearly 0% for duodenal ulcer disease (3).

Although *Helicobacter pylori* colonizes the gastric mucosa, it also can be found in the oral cavity. *Helicobacter pylori* has been isolated from saliva (10), cultured from dental plaque, and identified from dental plaque (denture) by polymerase chain reaction (11). No correlation has been found between the presence of bacteria in the oral cavity and gastric infection. However, oral presence reflects contaminants (11,12).

The methods of diagnosing *Helicobacter pylori* infection and of assessing posteradication treatment are numerous. There are 2 main methods: (a) invasive testing using either culture, histology, CLO (*Campylobacter*-like organism) test, or endoscopy coupled with biopsy; and (b) noninvasive testing using either antibody measurement or ^{13}C or ^{14}C urea breath tests. The ^{13}C urea breath test uses nonradioactive ^{13}C measured by mass spectrometry. However, the test is more expensive than ^{14}C , more time consuming, and requires a special calorie-rich meal intake to delay gastric emptying (13).

The ^{14}C urea breath test is based on a simple principle. *Helicobacter pylori* bacteria are able to neutralize the stomach acid with the enzyme urease. Urease converts urea, which is in the saliva and gastric juices, into bicarbonate and ammonia, which are strong bases. This creates a cloud of acid-neutralizing chemicals around the *Helicobacter pylori*, protecting them from the acid in the stomach. The action of urea hydrolysis is important because it is the basis of the ^{14}C urea breath test:



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The bicarbonate generated in the gastric mucosa enters the blood and is carried to the lungs, where it is exchanged rapidly from the lungs as a volatile carbon dioxide ($^{14}\text{CO}_2$). The $^{14}\text{CO}_2$ in the patient's exhaled breath is captured in a liquid vial, and can be detected by scintillation counting. The presence of a significant amount of $^{14}\text{CO}_2$ in the exhaled breath indicates an active *Helicobacter pylori* infection.

The ^{14}C urea breath test is a biologically plausible indirect measure of *Helicobacter pylori* presence (12). The ^{14}C urea breath test detects *Helicobacter pylori*, with a sensitivity of 90% and specificity rate of 95% (14). The ^{14}C urea breath test is less expensive than the ^{13}C urea breath test, and it is a simple test to detect the infection (13–15).

Although Logan (13) reported that the ^{14}C urea breath test provides a clinical gold standard against which the accuracy of other tests can be validated, errors may occur (7). False-negative or, more commonly, indeterminate results of the breath test may be reported if the test is performed on patients taking antibiotics, bismuth salts, proton-pump inhibitors, or sucralfate or if the patients have not fasted (7). False-positive results may be caused by urease-producing oropharyngeal bacteria if the test was performed 10 min after administration of ^{14}C urea (13).

There is a paucity of information about the effect of oral bacteria on the urea breath test results. The question we attempted to answer was whether brushing teeth affects ^{14}C urea breath test results.

MATERIALS AND METHODS

We performed the ^{14}C urea breath tests on 168 patients with breath samples counted at 10 and 20 min after oral administration of 2 μCi (74 kBq) ^{14}C urea. All patients were instructed to fast and stop smoking for 6 h before the test. Patients also were asked to stop taking the following medications: any gastrointestinal medications for 3 d; antibiotics or bismuth salts for at least 4 wk; Omeprazol and Sucralfate for 7 d; and H_2 receptor antagonists for 24 h. Patients were asked to brush their teeth before the test. On the day of the test, all patients were interviewed regarding the instructions including medications, endoscopy, clinical manifestations, fasting status, and whether they had brushed their teeth on the morning of the study.

The history of each patient was obtained. Each patient then was asked to drink 20 mL warm water containing 2–2.5 μCi ^{14}C urea. After 10 min and again at 20 min the patient exhaled through a straw connected to a tube, which terminated in a small bottle of collection liquid. The liquid contained 1 mL hyamine hydroxide (benzethonium hydroxide), 1 mL ethanoabsolute, and 1 drop of pH indicator. The breath sample was complete when a pH indicator (thymolphthalein) in the hyamine solution changed from blue (alkaline) to colorless (acid). Ten milliliters of scintillation fluid (micro-emulsified scintillation cocktail with water solution) were added to each sample. The sample and cocktail were adequately mixed and the β particles were absorbed in the sample phase. The samples were counted in the β scintillation counter for 1 minute and dpm were calculated.

In this study the reference values for the ^{14}C urea breath test

were:

- < 400 dpm at 10 min = negative for *Helicobacter pylori*
- 400–500 dpm at 10 min = nondiagnostic for *Helicobacter pylori*
- > 500 dpm at 10 min = positive for *Helicobacter pylori*.

In cases of nondiagnostic values, the patient was instructed to repeat the test.

RESULTS

Of 168 patients, 94 brushed their teeth before the test while 74 did not. Thirty-six of the 74 patients (49%) who did not brush their teeth had positive results at 10 min, which became negative at 20 min. None of the 94 patients who brushed their teeth before the test showed this pattern of results.

No discordant results were noted in the group who had brushed their teeth, with agreement of the 10- and 20-min results. This was not the case in the group of patients who did not brush their teeth.

DISCUSSION

The discovery of *Helicobacter pylori* has dramatically changed the understanding and the treatment of peptic ulcer diseases, antral gastritis, gastric ulceration, duodenal ulceration, and ulcer recurrence (16). Recent studies have emphasized the emerging role of the ^{14}C urea breath test as a safe, precise, cost-effective, and practical outpatient diagnostic test (9). Felz and Bruke (17) reported that the ^{14}C urea breath test is comparable to endoscopy and biopsy in diagnosing *Helicobacter pylori* and could become helpful in primary care settings for noninvasive evaluation of peptic ulcer disease.

Many studies have confirmed that the ^{14}C urea breath test is more convenient than endoscopy (13,17,18), and it can be used to detect the suppression of *Helicobacter pylori* infection and its rate of recurrence after different treatments (13).

The ^{14}C urea breath test detects much lower levels of *Helicobacter pylori* infection by assessing the whole gastric mucosa, avoiding the risks of sampling error. Balon et al. (7) reported that the contamination of oral flora with *Helicobacter pylori* may give false-positive results. Logan (13) reported that urease-producing oropharyngeal bacteria may occasionally introduce false-positive results if the test was done only 10 min after administration. This false-positive result should not persist in the 20-min breath sample (7). This implies that oral hygiene may affect the urea breath test and could be a source of false-positive results.

In our series of patients, we studied the impact of brushing teeth on the results of the ^{14}C urea breath test. Of the patients who did not brush their teeth before the test, 49% showed positive values at the 10-min breath sample, which became negative at the 20-min sample. All the patients who brushed their teeth before the test avoided this discordant pattern of results.

CONCLUSION

Patients who brushed their teeth before the ^{14}C urea breath test had significantly fewer ambiguous test results in our laboratory.

Our data emphasize the importance of brushing teeth before the procedure because it eliminated the source of error in the 10-min results.

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