Helicobacter pylori eradication failure in patients don't receive antibiotics with high resistance and have good compliance: a retrospective study

Canxia Xu (✉ xucanxia2000@163.com)

Third Xiangya Hospital

Ju Luo

Third Xiangya Hospital

Wenfang Zhao

Third Xiangya Hospital

Jingshu Chi

Third Xiangya Hospital

Peng Liu

Third Xiangya Hospital

Xiaoran Xie

Third Xiangya Hospital

Research Article

Keywords: Helicobacter pylori, Eradication, Bismuth-containing quadruple therapy, Retrospective study

Posted Date: February 1st, 2022

DOI: <https://doi.org/10.21203/rs.3.rs-1280572/v1>

License: © ⓘ This work is licensed under a Creative Commons Attribution 4.0 International License.

[Read Full License](#)

Abstract

Background: The eradication rate of the standard bismuth-containing quadruple therapy for *Helicobacter pylori* infection has gradually decreased in China, even patients don't receive antibiotics with high resistance and have good compliance.

Objective: To investigate why patients experienced standard bismuth-containing quadruple therapy (not include clarithromycin, metronidazole and [levofloxacin](#)) with good compliance still eradication failure, we performed a retrospective, single center study to identify causes of treatment failure.

Methods: Patients with *H.pylori* infection who were treated with standard bismuth-containing quadruple therapy (not include clarithromycin, metronidazole and levofloxacin) and received a test of cure at The third xiangya hospital between Oct. 2017 and May. 2021 were enrolled. Demographic and clinical data were recorded. Eradication rates were calculated and compared between regimens and subgroups. Logistic regression analysis was performed to identify risk factors of eradication failure.

Results: nine hundred and seventy five patients were included in the final analysis, 891 patients were successful eradicated, the total successful eradication rate was 91.4%. The quadruple therapy containing amoxicillin plus doxycycline achieved the highest eradication rate (93.0%), followed by therapy that consisted of amoxicillin plus furazolidone (92.1%) and doxycycline plus furazolidone (90.8%). There was no significant difference in the eradication rate between these groups. Logistic regression analysis found that male (OR 1.984 95%CI 1.176-3.345), 45-years old and above (OR 2.902 95%CI 1.628-5.171) were associated with an increased risk of eradication failure. In primary therapy, Male (OR 2.085 95%CI 1.188-3.658), 45-years old and above (OR 3.072 95%CI 1.659-5.688), the history of antibiotic abuse (OR 2.624 95%CI 1.267-5.436) and eating out (OR 1.923 95%CI 1.034-3.577) were associated with an increased risk of eradication failure.

Conclusions: Male, aged (≥ 45 years old) are factors affecting *H.pylori* eradication failure in patients don't receive antibiotics with high resistance and have good compliance. Male, aged (≥ 45 years old), the history of antibiotic abuse and eating out are factors affecting *H.pylori* primary eradication failure in patients don't receive antibiotics with high resistance and have good compliance.

Introduction

Helicobacter pylori (*H.pylori*) is a gram-negative flagellate and microaerophilic bacterium. Although a continuous decrease in *H.pylori* prevalence was reported from many regions, including Europe and Japan, the *H.pylori* infection is the most widespread prevalence disease in worldwide[1]. A systematic review assess the prevalence of *H.pylori* infection worldwide shows that more than half the world's population is infected[2]. In China, a developing country with a high prevalence of *H.pylori* infection and a high incidence of gastric cancer, the prevalence of *H.pylori* infection was from 43.8% to 52.3% in recent years[3,4].

H.pylori is associated with a substantial burden from both gastric and extra-gastric diseases. The bacterium is classed as a human carcinogen, being strongly linked with gastric cancer and is also associated with common conditions such as peptic ulcer and dyspepsia. Besides the already-known gastric disorders, many studies in the last year have confirmed that *H.pylori* is related to the diseases far from the primary site of infection such Alzheimer's disease[5,6], cardiovascular disease[7] and many other diseases[8]. Eradication of *H.pylori* can not only reduce the incidence of gastric cancer and peptic ulcer, as well as the prevalence and costs of managing dyspepsia, but also may have potential benefit to some related extra-gastric diseases.

In the early 2000, eradication rate of the triple therapy in Europe and the United States is nearly 85% and currently results as low as 50%[9]. Bacterial resistance and poor compliance are the main causes of eradication failure. Bacterial resistance to antibiotics is considered the most important determinant of treatment failure. Many studies have shown that metronidazole and clarithromycin were the least effective drugs, with a high resistance rates[10,11]. A prospective non-inferiority multi-center trial in Europe and a randomized controlled trial in China both show that improve the compliance could significantly increase the eradication rates in areas of high metronidazole, clarithromycin and levofloxacin resistance[12,13]. In our clinical practice, in order to improve the eradication rates, we usually avoid use antibiotics with high resistance, such as metronidazole, clarithromycin and levofloxacin. Nevertheless, we found that there are quite a few patients still eradication failure even with good compliance.

In this study, we reviewed the medical records of a large series of *H.pylori*-positive patients from the Third Xiangya Hospital, Central South University. To explore why the patients failure to eradication even they received a standard bismuth-containing quadruple therapy(not include clarithromycin, metronidazole and levofloxacin) and with good compliance.

Materials And Methods

Study design and research subjects:

This retrospective study was conducted in the Gastroenterology Department of the Third Xiangya Hospital of Central South University. The clinical data and questionnaire data of *H.pylori*-positive outpatients were collected from Oct. 2017 to May. 2021.

The inclusion criteria: *H.pylori* positive diagnosed by 14C/13C urea breath test (14C/13C-UBT); The baseline data was complete; Patients received 14-d bismuth-containing quadruple therapy (proton pump inhibitor (PPI), bismuth, and two antibiotics) for *H.pylori* eradication according to the standard antibiotic combinations and dosages specified in the "Fifth Chinese National Consensus Report on the management of *H.pylori* infection"; 14C-UBT or 13C-UBT was performed 4-8 weeks after drug withdrawal.

The exclusion criteria: Patients who took clarithromycin, metronidazole or levofloxacin; Patients with poor compliance(Poor compliance is defined as taking less than 80% of the total pills); Patients who did not review.

This research was conducted in accordance with the Declaration of Helsinki and national and institutional standards. The study protocol was approved by the clinical research ethics committee of the Third Xiangya Hospital of Central South University.

Statistical analysis

Statistical analyses were performed using SPSS version 22.0 (IBM SPSS Statistics, IBM Corporation, Armonk, NY, USA). Categorical variables were described by frequencies and proportions (%), and continuous variables were described by mean and standard deviation (SD), unless otherwise stated. Continuous variables were compared using Student's t-test or one-way analysis of variance, and categorical variables were compared using χ^2 test. Stepwise logistic regression analysis was used to test the relationship between *H.pylori* eradication failure and risk factors (probability of entry = 0.05 and probability of removal = 0.10). Two-tailed P value < 0.05 was considered statistically significant.

Results

Patient selection and clinical characteristics

A total of 1096 patients were enrolled. We excluded 46 patients who used clarithromycin, metronidazole or levofloxacin, 64 patients with poor compliance, and 11 patients who did not undergo review, for a total of 121. In the end, 975 patients were included in our study, 891 patients were successfully eradicated, and 84 patients failed (Figure 1).

Among the 975 patients, 73 (7.5%) had a prior history of *H.pylori* treatment, and 902(92.5%) did not. 526(53.9%) were male patients, 455(46.7%) were ≥ 45 years old, 129(13.3%) had a history of antibiotic abuse. One or more symptoms were observed in 715(73.4%) patients. A total of 630(64.6%) patients underwent gastroscopy, including chronic non-atrophic gastritis (37.2%), chronic atrophic gastritis 9.8%), peptic ulcers (17.0%) and early gastric cancer (0.6%). A total of 407 (41.8%) patients' family members underwent *H.pylori* examination, 172 were positive for *H.pylori*. The demographic and clinical characteristics of all the patients are shown in Table 1.

Helicobacter pylori eradication rates

Among the included 975 patients, a total of 891 were successfully eradicated, and the total eradication rate was 91.4%. The eradication rates for primary and rescue therapies were 92.0% and 83.5%, respectively. Figure 2 compared the *H.pylori* eradication rates between different antibiotic treatment regimens. The eradication rate was 93.0% in amoxicillin with doxycycline group, 92.1% in amoxicillin with furazolidone group and 90.8% in Doxycycline with furazolidone group. There was no significant difference in eradication rate between different antibiotic treatment regimens. The eradication rate was 91.7% in the ilaprazole group, 89.7% in the esomeprazole group, 91.5% in the lansoprazole group, 94.1%

in the rabeprazole group, 91.0% in the pantoprazole group, and 90.0% in the omeprazole group. There was no significant difference in eradication rate between different PPI treatment regimens.

Successful eradication group vs failure eradication group

According to eradication status, patients were divided into two groups, the successful eradication group (n=891) and the eradication failure group (n=84). The successful eradication group had a higher primary treatment population than the eradication failure group (93.1% vs 85.7%, $P=0.013$). The patients are younger (43.4 ± 12.6 yrs vs 50.2 ± 11.0 yrs, $P<0.001$) and less antibiotic abuse (12.0% vs 26.1%, $P<0.001$) in success group than failure group.

In the successful eradication group, 654 patients (73.4%) had symptoms; 68 patients (71.58%) in the eradication failure group had symptoms. 579 patients (64.8%) in the successful eradication group and 51 patients (60.6%) in the eradication failure group underwent gastroscopy. There were no significant difference between the two groups in symptoms, family member gastrosis and gastroscopic findings. There were no significant difference between the two groups in antibiotics and PPIs regimen. The demographic and clinical characteristics of the eradication success group and failure group are shown in Table 2.

Risk factors of eradication failure

Stepwise logistic regression was used to analyze the risk factors for eradication failure. We found that male (OR 1.984 95%CI 1.176-3.345), 45-years old and above (OR 2.902 95%CI 1.628-5.171) were associated with an increased risk of eradication failure, as shown in Table 3. In primary therapy, male (OR 2.085 95%CI 1.188-3.658), 45-years old and above (OR 3.072 95%CI 1.659-5.688), the history of antibiotic abuse (OR 2.624 95%CI 1.267-5.436) and eating out (OR 1.923 95%CI 1.034-3.577) were associated with an increased risk of eradication failure, as shown in Table 4.

Discussion

It has been suggested that the goal of *H.pylori* therapy should now be eradication in $\geq 90\%$ of treated patients[14]. There is a prospective clinical trials carried out in central-south of china found that the eradication rate of IDFB (ilaprazole, doxycycline, furazolidon and colloidal bismuth tartrate) was 91.8% in PP analysis[15]. Another prospective clinical trials carried out in central-south of china found that the eradication rate of RADB (rabeprazole, amoxicillin, doxycycline and colloidal bismuth tartrate) was 93.8% in PP analysis[16]. In this large-sized retrospective study, we focus on patients don't receive antibiotics with high resistance and have good compliance. We found that the overall eradication rates in this special population is 91.4%. The result is consistent with previously reported eradication rates in the same area.

Eradication success was significantly associated with younger age, the eradication rate showed a significant decreasing trend with increase in age[17,18]. Our study showed that age $\geq$ 45yrs was a significant risk factor for eradication failure. This finding is consistent with previous studies. Possible reasons for elderly groups have higher risk for eradication failure may include: 1.the aged population have more co-infection treatment maybe lead increased antibiotic resistance[18,19]; 2.Because of the hypertension, coronary artery disease and diabetes, the aged take more drugs, the possible drug interactions may lower the efficiency the quadruple therapy.

In this study, we also noticed that male is the risks for eradication failure. However, controversy exists over the role of gender as a risk factor. Our study and another prospective, nationwide, multi-center registry study in Korea both found out female sex was significantly associated with eradication success[18]. In contrast, some studies showed that female gender is the factor affecting *H.pylori* eradication failure[20,21]. However, those studies showed that the female gender is an unfavorable factor affecting eradication have something in common: the antibiotic regimens involve metronidazole, clarithromycin or levofloxacin. These antibiotics with high resistance were excluded in our study. This might be one of the reasons for different results. Therefore, the relationship between eradication failure and gender are needing further research.

Our study also analyzed the risk factors of the primary eradication population. Antibiotic abuse is a common phenomenon in china as medications are prescribed without supervision. Such an irrational use of antibiotics is responsible for the development of antibiotic resistance. Our study found that irrational use antibiotics without doctors` approve may cause *H.pylori* eradication failure. Government should strengthening antibiotics prescription supervision in order to improve eradication rates.

As we all know, *H.pylori* may be passed from person to person through direct contact with saliva. Always eating out may increase the risk of *H.pylori* infection of reinfection. However, to our best knowledge, this study maybe the first study found eating out is the risk factor associated with primary eradication failure. One reasonable guess is that people always eating out got more chance to exposure to the the resistant bacterial strains. Although, the relationship between eating out and eradication failure are needing further research.

We also found that in the absence of clarithromycin, metronidazole and levofloxacin, amoxicillin plus doxycycline, amoxicillin plus furazolidone and doxycycline plus furazolidone have almost the same efficiency in eradication *H.pylori*. Although numerous studies explored the eradication rates of various therapeutic regimens, most studies are involved clarithromycin or metronidazole, a few studies concerned only amoxicillin, furazolidone and doxycycline. A study showed that there was no significant difference between amoxicillin plus doxycycline and amoxicillin plus furazolidone in *H.pylori* eradication[22]. And another large-scale prospective, single-center clinical trial verified that the efficiency of amoxicillin plus furazolidone and doxycycline plus furazolidone are almost the same[23]. These findings were in consistent with our study. In addition to antibiotics, analyses were also performed according to different PPIs. However, we did not find various PPIs is associated with eradication failure.

The current study also presents some limitations: First, our study is a single center retrospective study, and the applicability of the results may be limited. Second, the antibiotics regimen and PPI regimen distribution in our study was uneven. The sample size of some antibiotics and PPIs are small, limit the reliability of the corresponding results. Finally, some important factors, such as [bacterial strains](#) and CYP2C19 genotype of patients were not included in our study. Future studies will be needed to include and analyses these factors.

Conclusions

In conclusion, our study revealed *H.pylori* eradication rate of an [group](#) population who don't receive antibiotics with high resistance and have good compliance. The eradication rate of this [particular](#) situation is 91.4% in Central-South of China. Male, aged (≥ 45 years old) are factors affecting *H.pylori* eradication failure. Male, aged (≥ 45 years old), the history of antibiotic abuse and eating out are factors affecting *H.pylori* primary eradication failure.

Abbreviations

H.pylori: Helicobacter pylori; 14C/13C-UBT: 14C/13C urea breath test; PPI: proton pump inhibitor.

Declarations

Availability of data and materials

Due to protect patient privacy, the original data used to support the findings of this study cannot be shared.

Ethics approval and consent to participate

This retrospective study conforms to the ethical guiding principle of the Declaration of Helsinki and was approved by the Ethics Committee of the Third Xiangya Hospital of Central South University (No.21157). According to the national legislation and institutional requirements, Informed consent was waived by the Ethics Committee of the Third Xiangya Hospital of Central South University because of the retrospective nature of this study.

Consent for publication

Not applicable.

Competing interests

The authors declare no competing interests.

Funding

This study is supported by the Scientific Research Project of Hunan Provincial Health Commission(NO.202103031034).

Author Contributions

Ju Luo and Wenfang Zhao wrote the main manuscript text. Ju Luo and Canxia Xu contributed to the conception of the study. Jingshu Chi performed the data analyses. Peng Liu and Xiaoran Xie helped perform the analysis with constructive discussions. All authors reviewed the manuscript.

Acknowledgement

Thanks to every patient who participated in our study, for patiently answering our questions and cooperating with the treatment.

References

1. Mezmale L, Coelho LG, Bordin D, Leja M. Review: Epidemiology of *Helicobacter pylori*.[J].*Helicobacter* 2020; 25 Suppl 1:e12734.
2. Hooi James K Y, Lai Wan Ying, Ng Wee Khoo et al. Global Prevalence of *Helicobacter pylori* Infection: Systematic Review and Meta-Analysis.[J].*Gastroenterology*, 2017, 153: 420–429.
3. Xu Chengfu, Yan Ming, Sun Yan et al. Prevalence of *Helicobacter pylori* infection and its relation with body mass index in a Chinese population.[J].*Helicobacter*, 2014, 19: 437–42.
4. Wang Wenhai, Jiang Wei, Zhu Shengtao et al. Assessment of prevalence and risk factors of *helicobacter pylori* infection in an oilfield Community in Hebei, China.[J].*BMC Gastroenterol*, 2019, 19: 186.
5. Fani Lana, Wolters Frank J, Ikram M Kamran et al. *Helicobacter pylori* and the risk of dementia: A population-based study.[J].*Alzheimers Dement*, 2018, 14: 1377–1382.
6. Roubaud-Baudron Claire, Mégraud Francis, Salles Nathalie et al. Detecting both current and prior *Helicobacter pylori* infection is important to assess its impact on dementia.[J].*Alzheimers Dement*, 2019, 15: 721-722.
7. Zhang Linfang, Chen Zhiheng, Xia Xiujuan et al. *Helicobacter pylori* infection selectively increases the risk for carotid atherosclerosis in young males.[J].*Atherosclerosis*, 2019, 291: 71–77.
8. Pellicano Rinaldo, Ianiro Gianluca, Fagoonee Sharmila et al. Review: Extragastric diseases and *Helicobacter pylori*. [J].*Helicobacter*, 2020, null: e12741.

9. Graham David Y, Dore Maria Pina. *Helicobacter pylori* therapy: a paradigm shift.[J].Expert Rev Anti Infect Ther, 2016, 14: 577–85.
10. Abdoh Qusay, Kharraz Lubna, Ayoub Khubaib et al. *Helicobacter pylori* resistance to antibiotics at the An-Najah National University Hospital: a cross-sectional study.[J].Lancet, 2018, null: S32.
11. Nyssen Olga P, Bordin Dmitry, Tepes Bojan et al. *Helicobacter pylori* European Registry on management (Hp-EuReg): patterns and trends in first-line empirical eradication prescription and outcomes of 5 years and 21 533 patients.[J].Gut, 2021, 70: 40–54.
12. Molina-Infante Javier, Romano Marco, Fernandez-Bermejo Miguel et al. Optimized nonbismuth quadruple therapies cure most patients with *Helicobacter pylori* infection in populations with high rates of antibiotic resistance.[J].Gastroenterology, 2013, 145: 121-128.e1.
13. Chen Yao, Yuan Hongxun, Ye Hui et al. Application of a semi-automatic, intensive follow-up for improving efficacy and adherence of *Helicobacter pylori* eradication therapy: A randomized controlled trial.[J].Microbiologyopen, 2021, 10: e1172.
14. Graham David Y, Fischbach Lori. *Helicobacter pylori* treatment in the era of increasing antibiotic resistance.[J].Gut, 2010, 59: 1143–53.
15. Li Huan, Xia Xiu-Juan, Zhang Lin-Fang et al. Comparative study of allicin-containing quadruple therapy vs. bismuth-containing quadruple therapy for the treatment of *Helicobacter pylori* infection: a prospective randomized study.[J].Eur J Gastroenterol Hepatol, 2021, 32: 194–200.
16. Gu Lei, Li Shenglan, He Ying et al. Bismuth, rabeprazole, amoxicillin, and doxycycline as first-line *Helicobacter pylori* therapy in clinical practice: A pilot study.[J].Helicobacter, 2019, 24: e12594.
17. Yan Tian-Lian, Gao Jian-Guo, Wang Jing-Hua et al. *Helicobacter pylori* Current status of eradication and risk factors for eradication failure.[J].World J Gastroenterol, 2020, 26: 4846–4856.
18. Kim Beom Jin, Yang Chang-Hun, Song Hyun Joo et al. Online registry for nationwide database of *Helicobacter pylori* eradication in Korea: Correlation of antibiotic use density with eradication success.[J].Helicobacter, 2019, 24: e12646.
19. Boyanova Lyudmila, Gergova Galina, Markovska Romyana et al. Primary *Helicobacter pylori* resistance in elderly patients over 20 years: A Bulgarian study.[J].Diagn Microbiol Infect Dis, 2017, 88: 264–267.
20. Chang Young Woon, Ko Weon Jin, Oh Chi Hyuk et al. Clarithromycin resistance and female gender affect *Helicobacter pylori* eradication failure in chronic gastritis.[J].Korean J Intern Med, 2019, 34: 1022–1029.
21. Cai Wenzhi, Zhou Liping, Ren Wei et al. Variables influencing outcome of *Helicobacter pylori* eradication therapy in South China.[J].Helicobacter, 2009, 14: 91–6.
22. Taghavi Seyed Alireza, Jafari Ali, Eshraghian Ahad, Efficacy of a new therapeutic regimen versus two routinely prescribed treatments for eradication of *Helicobacter pylori*: a randomized, double-blind study of doxycycline, co-amoxiclav, and omeprazole in Iranian patients.[J].Dig Dis Sci, 2009, 54: 599–603.

23. Zhou Jing-Jing, Shi Xiao, Zheng Shao-Peng et al. Efficacy of bismuth-based quadruple therapy for eradication of Helicobacter pylori infection based on previous antibiotic exposure: A large-scale prospective, single-center clinical trial in China.[J].Helicobacter, 2020, 25: e12755.

Tables

Table 1

The demographic and clinical characteristics of all the patients.

Variable	Case(<i>n</i>)	Percentage
Total	975	
Primary(rescue)	902(73)	92.5%(7.5%)
Female(male)	526(449)	53.9%(46.1%)
Age≥45yr	455	46.7%
Married	869	89.2%
College educated	482	49.5%
Family member gastropathy	273	27.9%
Chronic gastritis	175	17.9%
Ulcer	66	6.8%
Gastric cancer	32	3.2%
Family member <i>H.pylori</i> test	407	41.8%
Positive	172	17.6%
negative	235	24.2%
Smoking	170	17.5%
Alcohol	203	20.9%
Chewing areca-nut	50	5.1%
Bland diet	462	47.3%
Dining location☐home☐	683	70.0%
Serving chopsticks☐Yes☐	252	25.8%
Tableware Sterilizing☐Yes☐	452	46.4%
Antibiotics abuse	129	13.3%
Symptoms☐Yes☐	715	73.4%
Received gastroscopy☐Yes☐	630	64.6%
Chronic nonatrophic gastritis	362	37.2%
Chronic atrophic gastritis	96	9.8%
Peptic ulcer	166	17.0%
Early gastric cancer	6	0.6%
Antibiotic regimens		

Amoxicillin plus doxycycline	230	23.6%
Amoxicillin plus furazolidone	38	3.8%
Doxycycline plus furazolidone	707	72.6%
PPI regimens		
Ilaprazole	636	65.2%
Esomeprazole	68	7.0%
Lansoprazole	59	6.0%
Rabeprazole	105	10.8%
Pantoprazole	67	6.9%
Omeprazole	40	4.1%
Eradication rates(total)	891/975	91.4%
Primary	830/902	92.0%
Rescue	61/73	83.5%

Table 2

The demographic and clinical characteristics of eradication success group and failure group.

	Success group (n=891)	Failure group (n=84)	P value
Primary eradication	830[93.1%]	72[85.7%]	0.013*
male	403[45.2%]	46[54.7%]	0.094
age	43.4±12.6	50.2±11.0	0.001*
Age≥45yr	394[44.2%]	61[72.6%]	0.001*
Married	786[88.2%]	83[98.8%]	0.003*
College educated	449[50.3%]	33[39.2%]	0.052
Family member H.pylori infection	172[17.6%]	15[17.8%]	0.478
Antibiotics abuse	107[12.0%]	22[26.1%]	0.001*
Smoking	155[17.3%]	15[17.8%]	0.915
Alcohol	191[21.4%]	12[14.2%]	0.123
Chewing areca-nut	46[5.1%]	4[4.7%]	0.874
Bland diet	414[46.4%]	48[57.1%]	0.061
Dining location[home]	622[69.8%]	61[72.6%]	0.591
Serving chopsticks[Yes]	231[25.9%]	21[25.0%]	0.853
Tableware Sterilizing[Yes]	478[53.6%]	45[53.5%]	0.989
Symptoms[Yes]	654[73.4%]	61[72.6%]	0.877
Family member gastropathy[Yes]	254[28.3]	17[22.4%]	0.106
Chronic gastritis	163[18.2%]	12[14.2%]	0.360
Ulcer	61[6.8%]	5[5.9%]	0.755
Gastric cancer	30[3.3%]	2[2.3%]	0.628
Received gastroscopy[Yes]	579[64.8%]	51[60.6%]	0.434
Chronic nonatrophic gastritis	331[37.1%]	31[36.9%]	0.965
Chronic atrophic gastritis	92[10.3%]	4[4.7%]	0.102
Peptic ulcer	150[16.8%]	16[19.0%]	0.606
Early gastric cancer	6[0.6%]	0	
Antibiotic regimens			
Amoxicillin plus doxycycline	214[24.1%]	16[19.1%]	0.305
Amoxicillin plus furazolidone	35[3.8%]	3[3.5%]	0.872

Doxycycline plus furazolidone	642 72.1%	65 77.4%	0.296
PPI regimens			
Ilaprazole	583 65.5%	53 63.1%	0.667
Esomeprazole	61 6.8%	7 8.3%	0.609
Lansoprazole	54 6.1%	5 6.0%	0.968
Rabeprazole	96 10.8%	9 10.7%	0.239
Pantoprazole	61 6.8%	6 7.1%	0.918
Omeprazole	36 4.0%	4 4.8%	0.750

Table 3

Logistic regression analysis for Helicobacter pylori eradication failure

	Adjusted OR	95% CI	p value
male	1.984	1.176-3.345	0.010*
Age≥45yr	2.902	1.628-5.171	0.001*

Table 4

Logistic regression analysis for primary Helicobacter pylori eradication failure

	Adjusted OR	95% CI	p value
male	2.085	1.188-3.658	0.010*
Age≥45yr	3.072	1.659-5.688	0.001*
Antibiotics abuse	2.624	1.267-5.436	0.009*
Always eating out	1.923	1.034-3.577	0.039*

Figures

Figure 1

The flow chart of enrollment in this study.

Figure 2

The *H.pylori* eradication rates of different antibiotic treatment regimens.