



Evaluation the Electrocardiography Changes in Patient with Perforated Peptic Ulcer (PPU) Underwent Surgery in Firouzabadi Hospital

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Abstract

Background & Aims: Although Peptic ulcer is a benign lesion of the gastrointestinal tract often caused by the secretion of gastric acid and/or the multiplication of *Helicobacter pylori*, but its rupture (perforated peptic ulcer (PPU)) is a surgical emergency and requires immediate action. PPU could cause ECG changes leading to masking the patient's main disease and wrong treatment. In this study we evaluated the prevalence of changes in the ECG of patients with perforated peptic ulcer in Firouzabadi Hospital.

Materials and Methods: In this cross-sectional study, demographic data of all patients with PPU in Firouzabadi Hospital were extracted from the archives and electrographs were earned by cardiologists and internal medicine specialists while visiting. Statistical analyses were fulfilled by SPSS V.22 software with significance level of 0.05.

Results: 119 patients (86 males and 33 females) with PPU with mean age of 48.99 ± 16.18 were included in this study. Among 66 patients (55.5%) with band changes, 41 patients had one, 16 had two, 4 had three, and 5 had four pathological changes in their ECG. The most common pathological finding was T wave inversion which was observed in 29 patients (24.5%). more in male patients. There was no significant relationship between ECG findings with factors likeage, smoking, alcohol consumption, and a history of diseases such as diabetes, hypertension, and ischemic heart disease ($P > 0.05$).

Conclusion: More than half of patients with PPU have at least one preoperative electrocardiographic change. Gender is an influential factor in PPU and electrocardiographic changes. Although the frequency of these changes was more common among populations with hypertension, diabetes, and ischemic vascular disease, but there was no statistically connections between them.

Keywords: Peptic ulcer perforation, Acute Abdomen Pain, Electrocardiography, Myocardial infarction

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Introduction

Peptic Ulcer Disease:

Peptic ulcers are lesions due to acidic injury to the gastrointestinal tract and result in benign mucosal and submucosal damages. However, in more severe conditions, hyperacidity can harm muscularis propria (1). The stomach and duodenum are significant sites of these lesions, but other tract parts like the esophagus and Meckel's diverticulum can be involved (1, 2). After *Helicobacter pylori* was titled as the most important cause of acid-induced ulcers, nations have remarkably controlled peptic ulcer incidence by treating *Helicobacter pylori* infections (2, 3). Although the prevalence of uncomplicated peptic ulcers is decreased, complications are still a concern for healthcare providers. These complications may refer to extensive use of Non-Steroidal Anti-Inflammatory Drugs (NSAIDs) like *aspirin* (4, 5). In more critical situations, bleeding and perforation are two major adverse issues of peptic ulcers that can occur due to chronic illnesses and stress (6). Patients with gastrointestinal bleeding due to peptic ulcers are candidates for less invasive interventions such as medications, radiological interventions, and endoscopic procedures. Whereas only less than two percent of bleeding cases need surgical therapy, gastrointestinal bleeding is considered as a medical emergency (7-9). Despite bleeding, perforation is less common but more serious. Based on recent studies, mortality of perforated peptic ulcer (PPU) can reach up to 25 percent, and half of the patients will undergo a burden of morbidity (10-12). In case of perforation, urgent surgical interventions are crucial to prevent peritonitis, sepsis, and death (13).

Myocardial Infarction:

Myocardial infarction is cardiac cell death due to prolonged ischemia. This is a consequence of an imbalance between oxygen demand and supply, which leads to cardiac tissue ischemia (14). The final etiology of cardiac ischemia is coronary arteries occlusion. Multiple factors play roles in developing atherosclerotic plaque, which is the primary mechanism of vascular occlusion (15, 16). Clinical presentations may vary from chest discomfort to sweating and fatigue (14). Cardiac

biomarkers such as cardiac troponin (cTn) and creatine kinase-MB (CK-MB) start to rise few hours after the injury, indicating any possible damage to cardiac tissue (17). In more extensive myocardial damages, electrocardiographic patterns change alongside cardiac enzymes. Various electrocardiogram abnormalities can occur during an ischemic event. T wave and ST-segment changes are usually the first evidence which represent infarction in the presence of clinical symptoms (14). However, these changes are not specific to infarction. Many conditions can cause ST-segment changes and T wave alterations such as Left Bundle Branche Block (LBBB), Left Ventricle Hypertrophy (LVH), acute pericarditis, and Brugada syndrome (18). Other electrocardiographic changes such as Right Bundle Branch Block (RBBB) and poor R progression may be seen in an ischemic heart attack (17).

ECG Changes in PUD and Necessity of Accurate Diagnosis:

In recent studies and during later clinical experiences achieved in the hospital, we found that some patients with the final diagnosis of perforated peptic ulcer had represented some abnormalities in their electrocardiogram patterns. Whereas these changes are assumed to be critical issues in clinical settings, most of the time main problems had been concealed behind the probable cardiac event. Since critical patients do need emergent interventions, these misinterpretations put patients' lives in danger. Therefore we conducted this study to examine the prevalence of electrocardiogram changes in perforated peptic ulcers so we could have more insight during clinical judgments.

Method & Materials

Study Population and Design:

Current survey is a cross-sectional study performed in Firouzabadi Hospital, Tehran, Iran from March 2019 to March 2020. We enrolled all patients with a history of perforated peptic ulcers who had been undergone laparotomy in Firouzabadi Hospital during the period mentioned above. A total of 119 cases were included in the study. All patients must have been confirmed as perforated peptic ulcers by a general surgeon or

diagnosed as a previous perforated peptic ulcer with a recent complication. People with prior history of Myocardial Infarction (MI) in the past six months have been excluded from the survey. The Ethics Committee has approved this study of Iran University of Medical Sciences under the code of IR.IUMS.FMD.REC.1399.654.

We designed a checklist consisting of different demographic and clinical features of the patients. The checklists were filled by hospital records, and information like age, gender, smoking history, history of consuming alcohol and illicit drugs, diabetes, hypertension, and previous history of ischemic heart disease were obtained in the day of filling checklists. For evaluating ECG changes, we referred to patients' data records and examined ECG just after the patient admitted (Table 1).

Statistics and Analysis:

After data were collected, they were analyzed by SPSS version 22. For continuous variables, "Mean±SD"

values were reported, and if data were not normally distributed, we used Median and Quartiles to describe them. Absolute values and percentages were used to describe categorical variables. T-test or ANOVA was performed to compare continuous variables, and Mann-Whitney U and Kruskal-Wallis tests were applied to assess values that were not normally distributed. To compare the variables between categories, we fulfilled Chi-squared and Fisher's exact tests.

Results

Overall, 119 patients met the inclusion criteria, which their demographic and characteristics are shown in table 2. The mean age of the participants was 48.99±16.18, and no significant differences were found between normal and abnormal ECG groups. Fifty-three cases did not show any changes in ECG patterns, and near one third of the patients had at least one ECG abnormality.

Table 2: Frequency of ECG changes among participants

Number of ECG changes	Frequency, n (%)
No changes	53 (44.5)
1 change	41 (34.5)
2 changes	16 (13.4)
3 changes	4 (3.4)
4 changes	5 (4.2)

There were 86 males and 33 females in the study. ECG changes were detected in half (43) of the men. Compared to men, 69.7% of women showed ECG abnormalities, and this difference was statistically

significant ($P = 0.05$). In contrast with gender, none of the clinical features showed a significant relationship between normal and abnormal ECG groups. Table 2 represents the relationship between ECG changes and medical factors studied in this survey.

Table 2: ECG changes and its relation with demographics and clinical characteristics

	Total	With ECG changes	Without ECG changes	P value
Age (years), mean ± SD	48.99 ± 16.18	49.47 ± 15.59	48.40 ± 17.02	0.72
Gender (male), n (%)	86 (72.3)			0.050**
Male, n (%)		43 (50)	43 (50)	
Female, n (%)		23 (69.7)	10 (30.3)	
Medical history				0.451

Smoking	17 (14.3)		
Smoker		8 (47.1)	9 (52.9)
Non-smoker		58 (56.8)	44 (43.2)
HTN*, n (%)	14 (11.8)		0.064
Hypertensive		11 (78.5)	3 (21.5)
Non-hypertensive		55 (52.3)	50 (47.7)
DM*, n (%)	12 (10.08)		0.220
Diabetic		9 (75)	3 (25)
Non-diabetic		57 (53.27)	50 (46.72)
IHD*, n (%)	5 (4.2)		-
Positive Hx		5 (100)	0 (0)
Negative Hx		61 (53.5)	53 (46.5)

DM: Diabetes mellitus, IHD: Ischemic Heart disease.

*: HTN: Hypertension, **: Pearson's chi squared test

T-wave inversion was the most frequent change among all ECG abnormalities, followed by sinus tachycardia and ST depression. Despite tachycardia,

there were rare cases of bradycardia and heart blocks (LBBB and RBBB). [Table 3](#) shows the frequency of each abnormality in detail.

Table 3: Frequency of each type of abnormalities among participants

ECG abnormality	percent
T-wave invasion	24.4%
sinus tachycardia	19.3%
ST-depression	8.4%
IAD	5.9%
LAHB	5%
Poor R progression	3.4%
P-pulmonary	3.4%
Atrial fibrillation	2.5%
ST-elevation	2.5%
Premature ventricular	2.5%
sinus Brady cardia	2.5%
RBBB	1.7%
T-flat	1.7%
QT-prolongation	1.7%
LBBB	0.8%
WPW	0.8%
PRP	0.8%
LBBB	0.8%

Discussion

We found in this survey that nearly half of the patients with such a critical problem as perforated peptic ulcer (PPU), which needs immediate intervention, show an abnormality in their entrance electrocardiography. This means one person with PPU out of two will be misled to a whole different approach which has nothing to do with their original problem. However, it is believed that even in this situation, surgeon should not hesitate to wait for cardiac screening since delay in operation may lead to both cardiac and severe septic damages (19). According to our findings, 53 cases (44.5%) were normal, and 41 patients appeared to have one ECG change. Sixteen cases have two abnormalities, and only four and five cases demonstrated three and four ECG pathologies, respectively (table 1). Many abnormalities have been found in this cross-sectional study. T-wave inversion and sinus tachycardia were the two most prevalent abnormalities among all PPU cases. Interestingly, the study detected various ECG pathologies such as heart blocks, poor R progression, QT prolongation, premature ventricular contraction, and Wolf Parkinson White (WPW). Table 3 represents these frequencies in detail. Based on what we found, females are more likely to represent ECG abnormality when other digestive tract events are underlying (69.7% for women vs. 50% for men; $P=0.05$). Although more males were included in the study, the prevalence of ECG changes was significantly more frequent in the female gender (table 2). Despite gender, age has no significant difference between normal and abnormal ECG groups (49.47 ± 15.59 vs. 48.40 ± 17.02 , respectively; $P=0.72$). Although strong correlations have been proved in developing coronary artery disease and some metabolic disorders like HTN and DM, neither hypertension nor diabetes were related to ECG changes in PPU cases (P values were 0.064 and 0.220, respectively). We assessed smoking status in our patients and found that there were 17 smokers among the population. In contrast with the previous belief, in non-smokers, ECG changes were more prevalent than normal ECGs (56.8 vs. 43.2%), and smoking was found to be statistically irrelevant to ECG abnormalities in PPU patients ($P=0.451$). Similarly,

smoking was found to have no relation to ECG changes. We also noticed that having a prior history of ischemic heart disease (IHD) does not play a role in mimicking cardiac pathologies in ECG. Although patients who had experience of MI in the past six months before the study were excluded from the survey, five patients remained in the study with a history of IHD and not a heart attack in the past six months. It was anticipated that IHD patients would demonstrate ECG abnormalities. We noted that all five patients had abnormal ECG. However, statistical analysis could not be performed due to the small sample size. Only one person used alcoholic drinks, and we could not examine the relationship between alcohol and ECG changes because of insufficient data. Electrocardiography changes have been detected in some other intra-abdominal disorders. Terradellas et. al. (20) in a series of seven case reports demonstrated that in some cases such as bacterial pneumonia and acute cholecystitis, ECG patterns might be altered in the absence of a prior history of cardiac and coronary disease. According to what Terradellas et. al. reported, these seven cases showed ST-segment elevation greater or equal to five mm, and all of them return to the normal isoelectric line within 24 hours. In another study, Fulton et. al. (21) Reported an acute necrotizing pancreatitis case which had represented electrocardiogram changes. In this case, one day after admission, ECG showed peaked tall T waves in V2 – V3, and T wave inversion in leads, 2, 3, aVF, V5, and V6, (21). These abnormalities are thought to happen due to a possible early infarction or pulmonary embolism followed by acute cor pulmonale or both of these mechanisms simultaneously. After all, no evidence of infarction was found in the autopsy (21). Another important idea about ECG and GI problems has been suggested by Gilbert et. al. (22, 23). They claimed that distention of abdominal viscera such as gall bladder and biliary tree may decrease coronary artery blood flow,. These ECG changes disappeared after cholecystectomy. To confirm this statement, Radvin et. al (24) tried to deliberately distend the common bile duct using a T-tube in two acute cholecystitis cases which used to have ECG abnormalities preoperatively.

Electrocardiographic alterations mimicked the previous pattern in both cases. Patients with perforated peptic ulcers have probably developed peptic ulcer bleeding. In such cases, patients are going to develop a pre-shock state due to hypovolemia, and this mechanism finally leads to decreased coronary artery perfusion. Master AM et. al. (25) reported after analyzing 103 cases that a severe hemorrhagic state like GI bleeding influences coronary artery supply.

Limitations and strength:

To admit our limitations and flaws, we mention that our population size was not large enough to determine the relationship of the less prevalent factors with our topic, in addition to that our time which we dedicated for the study was only one year which could be extended to a more extended period and ended up to more extensive data. Another issue worth mentioning is that we did not examine the prognostic value of the ECG patterns. We did not evaluate whether the ECG abnormalities play a predictive role in warning a probable future cardiac event or not. In the same manner, we missed the role of these ECG changes in post-operative complications and survival. So we propose a cohort study with a larger study sample and a long-term follow-up to determine the role of ECG abnormalities in gastrointestinal tract diseases more precisely. Missing data due to uncompleted hospital records were another issue that distorted our study. The first to emphasize as strength of our study is the study environment, which has taken place in a general hospital with a wide variety of cases. This can result in a sufficient study population, resuming that larger sample size always leads to better debatable results. Another point that validates our survey is the accurate interpretations of ECGs. Our focus on reading ECGs ended up diagnosing some rare cases like Wolf-Parkinson White (WPW) and gaining a more comprehensive overview of various changes in ECG patterns.

Conclusion

In general, it can be concluded that more than half of patients with perforated peptic ulcers have at least one

change in preoperative electrocardiography, and gender is an influential factor among the patients. Electrocardiographic changes and the frequency of these changes among populations with blood pressure, diabetes, and ischemic heart disease are more common, although no significant relationship has been found. Subsequent studies with larger for re-evaluation in these patients.

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Conflict of interest

The authors have no conflict of interest in this study.

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