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# Comparison of in-Hospital Outcome after Percutaneous Coronary Intervention between Patients with Anterior Myocardial Infarction and Those With or Without Ramus Intermedius

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**ABSTRACT**

**Introduction:** Primary percutaneous coronary intervention (PPCI) is used for the treatment of ST segment elevation myocardial infarction (STEMI). Anterior STEMI is associated with adverse outcomes, and it is possible that the presence of ramus intermedius (RI) would inversely affect the outcome. This research involved the evaluation of the influence of RI presence on clinical outcomes in patients with anterior STEMI and culprit lesion in the left anterior descending artery (LAD).

**Materials and Methods:** This study was conducted on 105 patients with acute anterior STEMI undergoing PPCI in Shahid Madani Hospital, Tabriz, Iran, from April 2016 to March 2018. The recorded data included the patients' demographic and baseline data, angiographic features, presence of RI, the occurrence of heart failure (HF), cardiogenic shock, and in-hospital and one-year mortality. All data were analyzed, using SPSS software (version 23; SPSS Inc., Chicago, IL). Chi-square test, Fischer's exact test, independent t-test, or Mann-Whitney U test were employed to compare data between the two groups. A *p*-value less than 0.05 were considered statistically significant.

**Results:** In this research, RI was present in 53 patients (50.5%). The RI presence was mostly detected in male patinas than in their female counterparts (88.7% vs. 69.2%; P=0.01). In addition, those with RI presence had a lower rate of single-vessel disease (60.4% vs. 80.8%; P=0.01) and higher proximal LAD involvement (71.7% vs. 32.7%; P<0.001). After the intervention, ST segment decreased more than 50% and was significantly higher in patients with RI, compared to those without it (52.8% vs. 25.5%; P=0.004). Furthermore, there were no significant differences between the groups regarding cardiac enzymes, ejection fraction, HF, cardiogenic shock, and in-hospital and one-year mortality rates.

**Conclusion:** The presence of RI was associated with more proximal LAD lesions and less frequent single-vessel disease. However, RI did not seem to influence in-hospital and one-year outcomes.

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## Introduction:

The ST segment elevation myocardial infarction (STEMI) is a major cause of in-hospital and long-term morbidity and mortality (1). Patients with anterior STEMI, compared to those with non-anterior STEMI, are at a higher risk of in-hospital and on-year major adverse cardiac events (2). The most effective method for the treatment of STEMI

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is primary percutaneous coronary intervention (PPCI) (3).

The PPCI is usually complicated by coronary anomalies and anatomic variations, especially if the culprit lesion resides within the anomalies (4). In this respect, one non-prevalent anomaly is ramus intermedius (RI). In this condition, the left main coronary bifurcates into the RI, in addition to the left ascending artery (LAD) and left circumflex (LCX) (5, 6). The RI is the most common anatomic variation in the left coronary system with an incidence range of 21.9-31.3%; however, a recent study reported an incidence of 68.8% (5, 7).

It is suggested that RI presence (either with or without culprit lesion) would adversely impact the outcome of patients with anterior STEMI (3). Studies in this regard are very limited; therefore, there is a need for better understanding of the role of RI presence in STEMI patients. For this purpose, the present study aimed to evaluate the role of RI in clinical outcomes among patients with anterior STEMI and culprit lesion in the LAD.

**Materials and Methods:**

This cohort study was conducted on 105 patients aged > 18 years with acute anterior myocardial infarction (MI) undergoing angioplasty in Shahid Madani Hospital, Tabriz, Iran, from April 2016 to March 2018. The exclusion criteria were non-anterior MI, mechanical complexes, stent thrombosis in the LAD, receipt of rescue PCI, candidacy for medical therapy or coronary artery bypass graft (CABG). The Ethics Committee of Tabriz University of Medical Sciences, Tabriz, Iran, approved the study protocol, and the patients filled out written informed consent forms.

The sample size was calculated 82 using G*Power 3.1.9.2 software and considering α error of 0.05, power of 0.8 and effect size of 0.3. However, the recorded cases during the verified two years meeting the inclusion criteria and not exclusion criteria were 105 and we included all for evaluations.

The acute myocardial infarction diagnosis was based on clinical ischemic symptoms, electrocardiographic (ECG) changes, and a typical rise in the biomarker levels of myocardial necrosis. The recorded data included patients' demographic and baseline data, including age, gender, coronary artery disease risk factors, comorbidities, previous MI, intervention, and angiographic characteristics (i.e., TIMI flow and number of vessels). The culprit lesion and RI artery were defined by two different physicians. They reviewed all angiograms, and the culprit lesion artery was identified. The definition of an infarct-related culprit lesion was pre-specified as the site of acute coronary occlusion. Furthermore, for non-occluded arteries, it was defined as the site of greatest narrowing within angiographically significant stenosis, corresponding to the electrocardiographic changes. In-hospital and one-year mortality, occurrence of heart failure (HF), cardiogenic shock, and new ECG abnormalities were recorded and compared between the patients with and without RI.

**Statistical analysis:**

All data were analyzed, using SPSS software (version 23; SPSS Inc., Chicago, IL). The results were expressed as mean±standard deviation or percentage. Kolmogorov-Smirnov test was used to assess the normality of distribution. In addition, Chi-square test, Fischer's exact test, independent t-test, or Mann-Whitney U test were employed to compare data between the two groups. A *p*-value less than 0.05 were considered statistically significant.

**Results:**

In this research, out of 105 patients with acute anterior MI, 53 (50.5%) cases had RI. Table 1 demonstrates the baseline and laboratory findings between the two groups. Both groups were comparable, except that RI had a significantly higher predilection in males. In addition, no patient had a history of previous MI or PCI. Based on the findings, the patients with RI had a significantly lower rate of single-vessel involvement (Table 2). In patients with RI, compared to those without this anomaly, there was also significantly more frequent proximal LAD involvement, consequently rendering a higher Gensini score. Although patients with RI had more frequent lesions in LCX, the difference was not significant. Furthermore, lesions were observed in 11 (20.8%) patients in this group, including 10 cases with proximal LAD involvement and 1 case with mid LAD involvement. Out of 11 patients, the stent was implanted in 2 cases

and the other 9 patients were followed up medically. Furthermore, 1 (1.9%) patient in the ramus group had no reflow after PCI. Following the intervention, the ST segment reduction of more than 50% was significantly higher in patients with RI, compared to that in the group without RI (28 [52.8%] vs. 13 [25.5%]; P=0.004). During a one-year follow-up, no significant difference was observed regarding HF, ECG abnormalities, and in-hospital and one-year mortality rates (Table 3).

Table 1: Baseline and laboratory findings between two groups

| | | Anterior MI with RI (n=53) | Anterior MI without RI (n=52) | P value |
|---|---|---|---|---|
| Gender | Male | 47 (88.7%) | 36 (69.2%) | 0.01ª,* |
| | Female | 6 (11.3%) | 16 (30.8%) | |
| Age (years) | | 57.56±10.57 | 59.69±10.24 | 0.29** |
| smoking | | 29 (54.7%) | 20 (38.5%) | 0.09* |
| Diabetes mellitus | | 10 (18.9%) | 14 (26.9%) | 0.32* |
| Hypertension | | 24 (45.3%) | 26 (50%) | 0.62* |
| Hyperlipidemia | | 4 (7.5%) | 1 (1.9%) | 0.36**** |
| Peak CTnI** | | 11.64±1.64 | 10.91±2.69 | 0.2*** |
| Peak CKMB** | | 98.30±14.96 | 96.42±19.68 | 0.36*** |

ª p-value is significant at 0.01. Statistical analysis methods were * Chi squre,** Student t-test and *** Mann-Whitney U test. **** Fisher's exact test. RI: Ramus intermedius; MI: Myocardial infarction;

Table 2. Angiographic findings between groups.

| | | Anterior MI with RI (n=53) | Anterior MI without RI (n=52) | P value |
|---|---|---|---|---|
| Vessels | Single | 32 (60.4%) | 42 (80.8%) | 0.01ª,* |
| | 2VD | 14 (26.4%) | 10 (19.2%) | |
| | 3VD | 7 (13.2%) | 0 | |
| TIMI score | 0 | 35 (66%) | 34 (65.4%) | 0.93* |
| | 1 | 11 (20.8%) | 12 (23.1%) | |
| | 2 | 7 (13.2%) | 6 (11.5%) | |
| LAD invovlement | Proximal | 38 (71.7%) | 17 (32.7%) | <0.001ª,* |
| | Mid | 15 (28.3%) | 35 (67.3%) | |
| Other lesions | Left main | 1 (1.9%) | 1 (1.9%) | ------ |
| | RCA | 7 (13.2%) | 9 (17.3%) | 0.55* |
| | LCX | 5 (9.4%) | 1 (1.9%) | 0.2** |
| | RI | 11 (20.8%) | ------- | ----- |
| Gensini score | | 63.20±22.55 | 47.40±19.90 | <0.001ª,*** |
| Stent diameter (mm) | | 3.24±0.34 | 3.27±0.36 | 0.68*** |
| Stent length (mm) | | 23.20±7.90 | 22.33±8.67 | 0.59** |

ª p-value is significant at 0.01. Statistical analysis methods were * Chi squre, ** Fisher's exact test and *** Student t-test. RI: Ramus intermedius; MI: Myocardial infarction; TIMI: 'Thrombolysis in Myocardial Infarction; LAD: Left anterior descending artery; LCX: Left circumflex artery; RCA: Right coronary artery;

| | Anterior MI with RI (n=53) | Anterior MI without RI (n=52) | P value |
|---|---|---|---|
| EF | 30.77±7.28 | 31.82±9.22 | 0.65*** |
| HF | 47 (88.7%) | 39 (75%) | 0.06* |
| Shock | 2 (3.8%) | 3 (5.8%) | 0.63** |
| Hospital mortality | 2 (3.8%) | 1 (1.9%) | 0.56** |
| One year mortality | 1 (1.9%) | 3 (5.8%) | 0.29** |
| AF | 1 (1.9%) | 1 (1.9%) | 0.98** |
| RBBB | 6 (11.3%) | 5 (9.6%) | 0.77* |
| LBBB | 0 | 1 (1.9%) | 0.31** |
| VT/VF | 1 (1.9%) | 3 (5.8%) | 0.29** |

Statistical analysis methods were * Chi squre, ** Fisher's exact test and *** Student t-test. EF: Ejection friction; HF: Heart failure; AF: Atrial fibrillation; RBBB: Right bundle branch block; LBBB: Left bundle branch block; VT: Ventricular tachycardia; VF: Ventricular fibrillation

**Discussion:**

The present study involved the evaluation of the frequency of RI in patients with anterior STEMI. The results revealed that 50.5% of our patients had RI variant. This condition was male-dominant; however, there was no difference between the groups in terms of age. In the previous studies, RI had an incidence rate of 21.9-68.8% (5, 7); in addition, this rate was reported as 29% among those with anterior MI (3). However, these studies have reported no age or gender differences. The higher incidence of RI in our study could be due to the small size of the study population.

Our results showed that the presence of RI is associated with higher multivessel disease, proximal LAD involvement, and Gensini score. In line with our findings, Galbraith et al. (3) reported more proximal LAD lesions in the presence of RI. Similar results have been also reported in the previous studies (8-10). The results of a couple of studies have recently revealed that culprit lesions in patients with STEMI are located immediately distal to bifurcations, or mostly in proximal LAD than in mid or distal sections (8, 9). Galbraith et al. (3) also showed that higher cardiac troponin-I and creatine kinase-MB levels are indicative of larger anterior infarctions in patients with RI presence, while there were no such differences in our study.

According to previous studies, anterior STEMI is associated with higher rates of mortality, stroke, re-infarction, and other adverse outcomes than non-anterior STEMI (3, 10, 11). It is presumed that with more proximal anterior lesions, larger territories of the myocardium are at the risk of infarctions and adverse outcomes; however, this hypothesis needs to be proven (3). However, no significant differences were observed in the left ventricular ejection fraction (LVEF) between the two groups, while there was a trend for higher HF in patients with RI presence. Moreover, the two groups showed no significant differences regarding cardiogenic shock, as well as in-hospital and one-year mortality rates. Galbraith et al. (3) indicated a trend toward lower LVEF in RI presence; however, they also found no differences in HF, cardiogenic shock, and mortality rates.

Proximal LAD was involved in most cases, and this was associated with higher ST elevation. Furthermore, those with RI has a higher reduction in ST after undergoing PPCI. Considering the small sample size in both studies and the lack of any other studies in this regard, any conclusions could not be made regarding the role of RI in the patient outcome. However, the possible role of this anomaly should be considered while evaluating anterior MI.

Among cases with RI variation, RI was accompanied by lesion in 11 (20.8%) patients. Out of 11 patients, the stent was implanted in 2 cases, and the other 9 cases were followed up medically. There is only one case report that indicated acute MI due to RI disease, which considered unsuitable for angiography and treated medically with no complications (12). The size of RI varies greatly from a very small vessel to a very large branching vessel (5). Therefore, the decision on the interventional or medical therapy can be variable from one individual

to another, depending on the anatomy and size of the RI.

As a rather novel study, there were some limitations to the present research. The evaluation of a small group of patient prevented us from generalizing the data to the whole population. As a retrospective study, some patients were excluded from the research, due to the lack of some main data, and also other variables could not be included for the analysis.

**Conclusion:**

In conclusion, the presence of RI was found to be associated with more proximal LAD lesions and less frequent single-vessel disease. The RI did not seem to influence the in-hospital and one-year outcomes.

**Conflicts of interest:** The authors declare that they have no competing interest.

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