# Assessing the Safety of Extended Fasting Following Percutaneous Coronary Intervention

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## ABSTRACT

**Background:** This study aimed to investigate the impact of prolonged fasting on symptoms and major adverse cardiac events (MACE) in patients who had undergone percutaneous coronary intervention (PCI)

**Methods:** Patients with a history of PCI exceeding one year were included in the study. Participants were educated on how to divide their medication intake across two meals. Patients were instructed to discontinue fasting and contact the clinic immediately if they experienced any cardiovascular symptoms such as shortness of breath, chest pain, or palpitations. After Ramadan, patients were interviewed via telephone to inquire about their symptoms and any occurrences of MACE.

**Results:** A total of 405 patients were enrolled, and there were no significant differences in baseline characteristics between the fasting and non-fasting groups. No MACE incidents were reported in either group. In the fasting group, 3.4% of patients (7 individuals) discontinued fasting during Ramadan due to dyspnea, chest pain, or a combination of both. Similarly, in the non-fasting group, 2.5% of patients (5 individuals) reported similar symptoms (p=0.581). Patients in the fasting group experienced more fluctuations in blood pressure (both increase and decrease) compared to the non-fasting group (p=0.04). However, these changes were not significant enough to prompt patients to seek medical assistance.

**Conclusion:** In patients with a history of PCI exceeding one year, fasting did not pose acute health risks. Proper patient education played a vital role in mitigating potential risks.

## ABBREVIATIONS

MACE: Major Adverse Cardiac Events; PCI: Percutaneous Coronary Intervention; CAD: Obstructive Coronary Artery Disease; BP: Blood Pressure

## INTRODUCTION

Various religions observe diverse fasting periods and practices. For instance, during Ramadan, Muslims abstain from food, drinks, and oral intake from dawn to sunset, adjusting their medication schedules accordingly. Islamic guidelines exempt ill individuals from fasting if it might worsen their health. In Judaism, fasting entails complete cessation of food and drink, lasting for 24 hours from sunset to the following sunset [1].

Prolonged fasting exhibits positive effects on mental and physical health. It can reduce anxiety and lead to beneficial changes such as increased high-density lipoproteins and decreased low-density lipoproteins, lowering the risk of cardiovascular diseases. Additionally, fasting aids in weight reduction, which further mitigates cardiovascular risks [2-5]. However, prolonged fasting can also bring adverse effects, including headaches, heartburn, constipation, dehydration, anemia, and decreased sleep quality.

While research has explored the impact of prolonged fasting on patients with Coronary Artery Disease (CAD), specifically those who underwent Percutaneous Coronary Intervention (PCI), there are limited studies on this topic. The PCI procedure, which has rapidly evolved since its introduction in 1977, is widely used due to its efficacy and cost-effectiveness.

Studies have indicated that Ramadan fasting does not affect stable CAD symptoms like chest pain or dyspnea. Patients with stable CAD can undergo prolonged fasting without experiencing Major Adverse Cardiac Events (MACE). However, individuals with unstable CAD or recent revascularization procedures should avoid extended fasting. Post-PCI patients who fasted immediately after the intervention did experience MACE, but the incidence decreased after 90 days. Concurrent conditions like chronic kidney disease and cardiovascular disease might lead to MACE during fasting.

Despite concerns, both Muslim and Jewish individuals with cardiovascular diseases often express a strong desire to fast. The safety of fasting for these individuals has been a topic of interest. A systematic review and meta-analysis suggested the overall safety of fasting for individuals with a history of coronary artery disease [6-8]. However, this study did not specifically include post-PCI patients. To address this gap, our study aims to investigate the impact of prolonged fasting on symptoms in patients who had undergone PCI more than a year ago. Additionally, we aim to determine the rate of MACE occurrences during prolonged fasting in this specific patient population.

## METHODOLOGY

This prospective cohort study was carried out between April 25 and May 24, 2020. Participants met the inclusion criteria if they had a history of Percutaneous Coronary Intervention (PCI) and had undergone angioplasty at least 1 year before enrollment. Exclusion criteria encompassed conditions such as heart failure (ejection fraction <50%), advanced kidney failure (glomerular filtration rate <60 mL/min), unsuccessful revascularization, coronary artery bypass graft, liver cirrhosis, and acute illnesses requiring repetitive treatment [9]. Additionally, patients whose PCI was performed less than 1 year prior to the study period and those with diabetes requiring insulin treatment were not included.

Between March 18, 2019, and April 18, 2020, individuals attending the Cardiovascular Clinic in Shiraz, Iran, for their annual check-ups were approached. The research project was explained to them, and volunteers were selected based on their preference for fasting or non-fasting. Detailed information about the research was provided, and written informed consent was obtained from all volunteers. Participants who chose not to participate were excluded [10-14].

Key risk factors such as hypertension, diabetes mellitus, dyslipidemia, and smoking were considered. Hypertension was defined in accordance with ACC/AHA 2020 guidelines, while diabetes mellitus was diagnosed based on the 2020 ADA guidelines. Dyslipidemia included conditions of elevated total cholesterol or low-density lipoprotein cholesterol, elevated triglycerides, or lowered high-density lipoprotein cholesterol. Blood pressure was measured at the clinic after 15 minutes of rest from both brachial arteries, three times at baseline, and the mean blood pressure was recorded. Similarly, at the end of the fasting period, blood pressure was measured three times in the morning, noon, and at 4 PM.

Participants were educated on dividing their medication across the two daily meals before dawn and after sunset during the month of Ramadan. They were informed to immediately cease fasting and consult the clinic if they experienced any signs of cardiovascular disease, such as shortness of breath, chest pain, palpitations, or uncontrolled blood pressure. After Ramadan, patients were contacted via telephone and questioned about their symptoms, including chest pain, dyspnea, uncontrolled hypertension, hospitalization, and Major Adverse Cardiac Events (MACE) [15,16]. MACE was defined as acute myocardial infarction, hospitalization due to congestive heart failure, new-onset atrial fibrillation, stroke, or cardiac arrest. Symptomatic patients were referred to the clinic for a cardiovascular examination.

To maintain blinding, the study was single-blinded. The clinic secretary ensured patients did not specify their fasting or non-fasting group when communicating with researchers. Researchers were blinded using alphabetical order within each group (X for fasting patients, Y for non-fasting patients). Statistical analyses were conducted using IBM SPSS software version 25. Categorical variables were compared using the chi-square test, while continuous variables were analyzed using Student's t-test. Nonparametric variables were assessed using the Mann-Whitney U test and Kruskal-Wallis test. Changes between the groups were compared using a two-way analysis of variance (ANOVA).

## RESULTS

During the study period, 488 eligible patients were referred to the cardiovascular clinic. After applying the exclusion criteria, 83 patients were excluded, leaving a total of 405 patients enrolled in the study. Among these participants, 125 were women (30.9%) and 280 were men (69.1%), with a mean age of 63.03 ± 9.44 years. Approximately half of the patients (205, 50.6%) chose to fast, while 200 patients (49.4%) opted not to fast. The prevalence of risk factors was notable, with 270 patients (66.7%) having hypertension, 92 (22.7%) diagnosed with diabetes mellitus, 65 (26%) experiencing dyslipidemia, and 111 (27.4%) being smokers. Mean Ejection Fraction (EF) was 54% (ranging from 50% to 65%) in the fasting group and 53.5% (ranging from 50% to 60%) in the non-fasting group. The mean Syntax score, a measure of disease complexity, was 14 (ranging from 10 to 27) in the fasting group and 15 (ranging from 9 to 26) in the non-fasting group (P=0.67), indicating comparable baseline characteristics between the two groups [14].

Participants in the fasting group observed an average fasting duration of 24.1±8 days. The majority of patients (393, 97%) in both groups adhered to their prescribed medication regimen. At the conclusion of Ramadan, no Major Adverse Cardiac Events (MACE) were reported in either group. In the fasting group, 7 patients (3.4%) discontinued fasting due to symptoms such as dyspnea, chest pain, or a combination of both. Similarly, in the non-fasting group, 5 patients (2.5%) reported similar symptoms (dyspnea, chest pain, or a combination), and the difference in symptom occurrence between the groups was not statistically significant (p=0.581).

| Parameters | Fasting group | Non-fasting group | p value |
|---|---|---|---|
| Mean age ± SD (years) | 64 ± 10 | 62 ± 9 | 0.081 |
| Male, n (%) | 134 (69.4%) | 146 (73.7%) | 0.096 |
| Hypertension, n (%) | 140 (68.3%) | 130 (65%) | 0.482 |
| Diabetes mellitus, n (%) | 51 (24.9%) | 41 (20.5%) | 0.293 |
| Dyslipidemia, n (%) | 34 (16.6%) | 31 (15.5%) | 0.766 |
| Smoking, n (%) | 52 (25.4%) | 59 (29.5%) | 0.351 |
| Mean Syntax score | 14 (10-27) | 15 (9-26) | 0.67 |

**Table 1:** Baseline characteristics in the fasting and non-fasting groups.

| Parameters | Fasting group (n) | Non-fasting group (n) |
|---|---|---|
| Major adverse cardiac events | 0 | 0 |
| Dyspnea | 1 | 2 |
| Chest pain | 3 | 2 |
| Combined chest pain and dyspnea | 3 | 1 |
| Palpitations | 0 | 0 |

**Table 2:** Frequency of symptoms in the fasting and non-fasting groups.

Regarding blood pressure changes, 194 patients (97%) in the non-fasting group experienced no significant alterations in blood pressure. In contrast, 178 patients (86.8%) in the fasting group maintained stable blood pressure, while 15 patients (7.3%) experienced a decrease in mean systolic blood pressure (with a mean decrease of 12 mmHg), and 12 patients (5.9%) had an increase in mean systolic blood pressure (with a mean increase of 15 mmHg). The comparison between the two groups showed a statistically significant difference (P=0.01) for decreased blood pressure and (P=0.04) for increased blood pressure. However, these changes were not severe enough to necessitate hospitalization or medical intervention.

## DISCUSSION

Fasting during the month of Ramadan, obligatory for Muslims except for those with medical conditions, raises significant concerns for individuals with cardiovascular diseases. Despite underlying health issues, many Muslims consult doctors annually about fasting. In 2015, approximately 420 million people globally had cardiovascular diseases, constituting a sizable population. One crucial concern is the risk fasting poses for these patients [16].

A study by Amin et al. revealed that patients fasting within the initial 3 months after angioplasty faced significantly higher Major Adverse Cardiac Events (MACE) rates. The incidence of MACE decreased

significantly 90 days post PCI, indicating that fasting within the first 3 months post PCI was unsafe. Our study focused on patients who had undergone PCI more than a year earlier and found no instances of MACE during Ramadan fasting. This suggests that patients can safely fast if more than a year has passed since their PCI. The endothelial repair process post PCI, spanning 5 to 12 months, might explain this safety after the 1-year mark. However, future studies should explore the incidence of MACE after 6 months post PCI.

Studies by Mousavi et al. and Al Suwaidi et al. indicated that patients with stable cardiac conditions, including prior PCI, could safely fast. Our study supported this, revealing that prolonged fasting had no significant impact on symptoms in patients more than 1 year post PCI.

For patients with diabetes, studies like the one by Benaji et al. have shown that fasting is acceptable if patients modify their diet and medication intake. Our study involved 92 patients with diabetes who were on oral medication. With proper medication management and patient education, fasting proved safe, with no reports of hypoglycemia symptoms during fasting.

Fasting not only leads to weight loss but also improves metabolic markers, such as fasting plasma glucose and blood pressure, preventing chronic health issues. It plays a role in reducing risk factors for cardiovascular diseases, decreasing plasma cholesterol, triglycerides, body mass index, and waist circumference, while increasing high-density lipoprotein cholesterol, a protective factor against cardiovascular diseases. Despite notable blood pressure changes in our study, they were manageable with medications, indicating that patients with hypertension and a history of PCI can tolerate fasting effectively.

## CONCLUSION

In our prospective cohort study, we determined that prolonged fasting was safe for patients who had undergone PCI more than 1 year earlier. Notably, there were no occurrences of Major Adverse Cardiac Events (MACE) during the fasting period. Additionally, there was no significant disparity in the occurrence of cardiovascular symptoms between the fasting and non-fasting groups. Patients with diabetes who were on oral medication were able to fast safely. This emphasizes the crucial role of patient education in mitigating potential risks associated with fasting in these populations.

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