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Original Article

Change in left ventricular systolic function in patients with ST elevation myocardial infarction: Evidence for smoker's paradox or pseudo-paradox?

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ABSTRACT

Background: The 'smoker's paradox' refers to the observation of favorable prognosis in current smokers following an acute ST elevation myocardial infarction (STEMI) in the era of fibrinolysis, however, several STEMI studies have demonstrated conflicting results in patients undergoing primary percutaneous coronary intervention (p-PCI).
Objective: Aim of the current study was to evaluate the impact of cigarette smoking on left ventricular function in STEMI patients undergoing p-PCI.
Methods: Our population is represented by 74 first-time anterior STEMI patients undergoing p-PCI, 37 of whom were smokers. We assessed left ventricular function by left ventricular ejection fraction (LVEF) on the second day after admission and at 3-month follow-up. Early predictors of adverse left ventricular remodelling after STEMI treated by p-PCI were examined.
Results: Basal demographics and comorbidities were similar between groups. Although the LVEF during the early phase was higher in smokers compared to non-smokers ($44.95 \pm 7.93\%$ vs. $40.32 \pm 7.28\%$; $p = 0.011$); it worsened in smokers at follow-up (mean decrease in LVEF: $-2.70 \pm 5.95\%$), whereas it improved in non-smokers (mean recovery of LVEF: $+2.97 \pm 8.45\%$). In univariate analysis, diabetes mellitus, peak troponin I, current smoking, and lower TIMI flow grade after p-PCI, pain-to-door time and door-to-balloon times were predictors of adverse left ventricular remodelling. After multivariate logistic regression analysis, smoking at admission, lower TIMI flow grade after p-PCI, the pain-to-door time and door-to-balloon times remained independent predictors of deterioration in LVEF.
Conclusion: True or persistent 'smoker's paradox' does not appear to be relevant among STEMI patients undergoing p-PCI. The 'smoker's paradox' is in fact a pseudo-paradox. Further studies with larger numbers may be warranted.

1. Introduction

Cigarette smoking (CS) remains the leading cause of preventable cardiovascular morbidity and mortality in the world.[1,2] It impacts all phases of atherosclerosis from endothelial dysfunction to acute thrombotic coronary syndromes.[3] Despite these well-known deleterious effect on cardiovascular health, some studies have suggested a "smoker's paradox" meaning neutral or better outcomes in current smokers following an acute ST elevation myocardial infarction (STEMI) in the era of fibrinolysis.[4–8] However, multiple studies in smokers have yielded conflicting results in STEMI patients undergoing primary percutaneous coronary intervention (p-PCI).[9–16] We aim to determine the presence of a 'smoker's paradox' in a cohort of first-time anterior STEMI patients undergoing p-PCI.

2. Method

We studied 74 consecutive Caucasian patients with first ever anterior STEMI, who underwent coronary angiography within 12 h

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Table 1
Basal demographic and clinical characteristics features in first anterior STEMI patients undergoing p-PCI.

Anterior STEMI patients undergoing p-PCI	Smokers (*n*: 37)	Non-smokers (*n*: 37)	*p* value
Age (year, mean ± SD)	54.68 ± 8.03	58.81 ± 11.05	0.070
Smoking pack-years	28.46 ± 8.19	–	NA
Gender (male, %)	78%	65%	0.197
Hypertension (%)	41%	46%	0.639
Diabetes mellitus (%)	27%	30%	0.797
Hyperlipidemia (%)	30%	35%	0.619
Premature family history for CAD (%)	22%	32%	0.295
Body mass index (mean ± SD)	26.68 ± 5.13	28.08 ± 4.09	0.199
Pain-to-door time (h, median, IQR)	5 (2)	6 (5)	0.402
Door-to-balloon time (min, median, IQR)	38 (15)	38 (10)	0.904
TIMI 0–1 flow grade before p-PCI (%)	100%	100%	NA
TIMI 3 flow grade after p-PCI (%)	88%	90%	0.862
Dual antiplatelet agents at 3 months post-discharge (%)	100%	100%	NA
Beta blocker at 3 months post-discharge (%)	92%	95%	0.643
ACE-I/ARB at 3 months post-discharge (%)	100%	100%	NA
Statin at 3 months post-discharge (%)	92%	97%	0.304
Furosemide at 3 months post-discharge (%)	22%	34%	0.295
Spirinolactone at 3 months post-discharge (%)	11%	19%	0.327
Peak troponin I (u'gr/L, median, IQR)	35 (14)	44 (20)	0.016
Killip class at admission (median, IQR)	1 (0)	1 (1)	0.141
Smoking quitting rate at 3 months post-discharge (%)	84%	–	NA

STEMI, ST elevation myocardial infarction; p-PCI, primary percutaneous coronary intervention; CAD, coronary artery disease; ACE-I/ARB, angiotensinogen converting enzyme inhibitors/angiotensinogen receptor blockers; SD, standard deviation; IQR, interquartile range; NA, not applicable.

after the onset of chest pain. All patients were treated by successful p-PCI for acute total occlusion of single vessel left anterior descending artery. Information about age, gender, body-mass index, family history of premature coronary artery disease (male first degree relatives <55 years old and female first degree relatives <65 years old), dyslipidemia (high LDL-cholestrol based on ATP III or HDL-cholestrol <40 mg/dL, or triglycerides >150 mg/dL), diabetes mellitus (fasting blood glucose ≥126 mg/dL, 2 h post-prandial glucose ≥200 mg/dL, or use of hypoglycemic agents or insulin), hypertension (positive past history of hypertension or use of antihypertensive drugs) and, CS consumption were collected.

The patients were categorized as active smokers or non-smokers at the time of hospital admission. The previous smokers, the previous history of STEMI and non-anterior STEMI patients were excluded from the study because of their possible confounding effect on results.

Univariate and multivariate analyses were performed to identify predictors for adverse left ventricular remodelling, defined as a decrease in left ventricular ejection fraction (LVEF) at 3-month follow-up compared with the baseline.

After primary PCI, the global LVEF was measured by an experienced physician unaware of patient identity using transthoracic echocardiography (System V GE Vingmed Ultrasound, Horton, Norway) at second hospitalization days and at 3 months post-discharge period. The LVEF was measured using the modified Simpson's rule.[17] All patients discharged with modern pharmacological treatment including beta-blockers, ACE-inhibitors or ARBs, dual antiplatelet and statins. Adherence to evidence-based medications was evaluated at post-discharge 3 months.

Written informed consent was obtained from all patients, and the study protocol was approved by the ethics committee of the hospital.

Statistical analyses were performed using Statistical Package for Social Sciences (SPSS) for Windows 20 (IBM SPSS Inc., Chicago, IL). We calculated that a sample size of 37 per group would be required to achieve a desired power of 0.80 with an alpha value of 0.05. Normal distributions of variables were evaluated with Kolmogorov–Smirnov test. Numerical variables with a normal distribution were presented as the mean ± standard deviation and numerical variables with a skewed distribution were presented as the median (interquartile range) and categorical variables were presented as percentages (%). Two group comparisons of normally distributed variables were tested by unpaired *t* test and paired *t* test. The nonparametric Mann–Whitney *U* test was used for comparisons of nonnormally distributed variables. Paired comparisons of nonnormally distributed variables were analyzed by the Wilcoxon signed-rank test. Chi square test and Fischer's exact 2 test were used for comparisons of categorical variables. Predictors of left ventricular remodelling were determined by logistic regression analysis. All items with significant results in univariate analysis were included in multivariate analysis, followed by a stepwise forward elimination. The strength of association between variables and the occurrence of adverse left ventricular remodelling were represented by odds ratios and their accompanying 95% confidence intervals. For all tests, a two tailed *p*-value less than 0.05 was defined statistically significant.

3. Results

Basal demographics and comorbidities were similar between groups (Table 1). Two patients in smokers group were excluded from study because of periprocedural cardiac death. No adverse cardiac adverse events including mortality or recurrence of angina at 3 months post-discharge follow-up were detected.

Although the LVEF during the early phase was higher in smokers compared to non-smokers (44.95 ± 7.93% vs. 40.32 ± 7.28%; $p = 0.011$), it worsened in smokers at follow-up (mean decrease in LVEF: −2.70 ± 5.95%), whereas it improved in non-smokers (mean recovery of LVEF: +2.97 ± 8.45%) (Fig. 1, Tables 2 and 3).

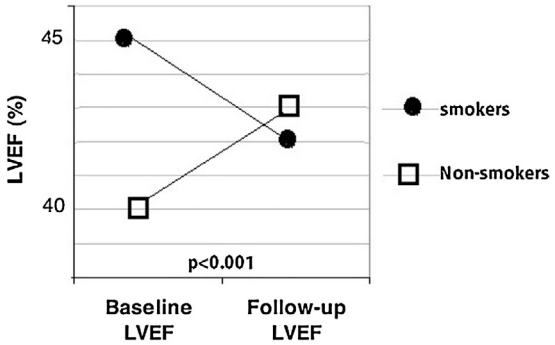

Fig. 1. Assessment of smoking status in STEMI patients predicts worsening of left ventricular systolic function.

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