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## Smoking and wound complications after coronary artery bypass grafting



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### ABSTRACT

**Background:** The harmful effects of smoking on the postsurgical wound healing disturbances have been widely investigated across various surgical procedures. These effects after coronary artery bypass graft (CABG) surgery have been less explored. We aimed to investigate the association of smoking and the wound healing problems in post-CABG patients.

**Materials and methods:** We compared the incidence of wound complications in 405 smokers and 405 nonsmokers who underwent an elective CABG surgery. The incidence of leg and sternal wound complications was evaluated during the first 7 d as well as at a 6-wk postoperative visit.

**Results:** One hundred fifty-six leg wound complications were noted in 132 patients (16.3%). The overall rate of leg wound healing disturbances was significantly higher in smokers than those in nonsmokers (odds ratio, 1.47; 95% confidence interval, 1.109–4.019;  $P = 0.010$ ). The incidence rates of leg wound edge necrosis and dehiscence were significantly higher in smokers compared with those in nonsmokers (3.7% versus 0.7%,  $P = 0.004$  and 6.6% versus 0.7%,  $P < 0.0001$ , respectively). We found no significant differences between the incidence of postoperative leg wound infection, hematoma, wound edema, and seroma in active smokers and those who never smoked. Thirty-seven postsurgical sternal wound complications (4.6%) were developed in 33 patients (4.1%). The overall rate of sternal wound healing disturbances was similar between smokers and nonsmokers. There was a trend

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between the sternal wound dehiscence and smoking ( $P = 0.03$ ); however, the other sternal wound complications were not associated with smoking.

**Conclusions:** Smoking may contribute to the disturbances of wound healing, especially wound dehiscence, in post-CABG patients.

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## 1. Introduction

Arterial conduits are widely preferred for coronary revascularization; however, great saphenous veins are still commonly used in most coronary artery bypass graft (CABG) surgeries [1]. Despite improvements in surgical techniques and perioperative care, leg and sternal wound healing disturbances remain significant causes of postoperative morbidity, impaired quality of life, and increased in-hospital stay among patients undergoing CABG. The rates of sternal and leg wound healing complications after CABG surgery range from 0.5%–10% and 1%–44%, respectively [2–8]. Female gender, diabetes mellitus, obesity, and peripheral vasculopathies have been identified as significant independent predictors of post-CABG wound complications [9–11]. Also, smoking has been shown to be associated with wound healing complications after several types of surgeries [12–23]; however, the potential role of smoking as an independent contributor to the post-CABG wound healing disturbances has been less explored.

In this study, we aimed to compare the incidence of leg and sternal wound complications in two groups of post-CABG smoker and nonsmoker patients.

## 2. Materials and methods

### 2.1. Study design and population

A total of 810 patients including 405 smokers and 405 nonsmokers who had undergone an elective CABG surgery were enrolled consecutively between June 2007 and August 2013. The patients were excluded if (1) they were found to be immunocompromised or on steroids within the 3 mo before surgery, (2) they were unable to complete follow-up, and (3) the procedure involved the use of only arteries as conduits for myocardial revascularization. The demographic characteristics of patients and data regarding the New York Heart Association (NYHA) class of heart function, cardiovascular risk factors including diabetes, hypertension, hypercholesterolemia, smoking, and concomitant comorbidities including peripheral vascular diseases, chronic obstructive pulmonary diseases (COPD), and congestive heart failure were documented before surgery. The study was approved by the local ethical committee, and all patients signed an informed consent.

### 2.2. Surgical techniques

All surgical procedures, including saphenous vein harvesting and wound closure, median sternotomy with cardiopulmonary bypass, and vein–coronary artery anastomosis, were carried out at the Day General Hospital (Tehran, Iran) by a dedicated team of experts, led by a cardiac surgeon (M.-H.M.).

Open surgical methods were used on all median sternotomies, with a standard wiring technique for sternal closure. The veins were harvested using the traditional open vein harvesting procedure as previously described [24]. Briefly, the vein was dissected using Metzenbaum scissors, and a longitudinal incision was made over the course of the saphenous vein, starting at the ankle joint and ending at the groin or under the knee depending on the length of the vein required for CABG. After reversal of anticoagulation by protamine and local hemostasis, the leg incision was closed. The area was subsequently dressed, and an elastic bandage wrapping was applied for 3 d.

### 2.3. Wound assessment and follow-up

The incidence of any seven types of wound healing complications including wound infection, hematoma, edema, skin necrosis, seroma and/or lymphocele, dehiscence, and wound nonpurulent drainage were evaluated separately in the leg and sternum of patients during the first 7 d after surgery as well as at a 6-wk postoperative follow-up visit, by two independent general surgeons. Both surgeons were blinded to the smoking status of the enrolled patients. Diagnosis of postoperative wound infection was based on the presence of purulent drainage and isolation of causative organism(s) by smear and/or culture. The other wound healing disturbances were also defined clinically as follows: hematoma: palpable or visible subcutaneous collection of blood; edema: generalized leg/peristernal swelling with neither drainage nor evidences of infection detected in the leg as increase in ankle circumference as compared with preoperation or with other side; skin necrosis: dark distinctive necrotic skin with need for bedside or surgical debridement; seroma and/or lymphocele: pocket of clear serous and/or lymphatic fluid at the wound edge; dehiscence: separation and breakdown along the surgical sutures; wound nonpurulent drainage: serous, sanguineous, or serosanguineous discharge [25].

### 2.4. Statistical analysis

The data analysis was performed using SPSS 20 software (SPSS Inc, Chicago, IL). Nominal and continuous data are presented as percentage and mean  $\pm$  standard deviation, respectively. Univariate and multivariate logistic regression analyses were used to test if smoking is associated with post-CABG wound complications and to identify other clinical factors that are linked to the disturbances. The following variables were systematically assessed by univariate logistic regression analysis: surgery-related variables, age, gender, smoking, body mass index, NYHA class, cardiovascular risk factors, and a history of concomitant morbidities. The relevant univariate factors ( $P < 0.05$ ) were included in the multivariate analysis. The differences between smokers and nonsmokers for continuous

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