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Clinical Science

Impact of smoking on perioperative outcomes after major surgery

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Abstract

BACKGROUND: To investigate the impact of smoking on perioperative outcomes in patients undergoing one of the 16 major cardiovascular, orthopedic, or oncologic surgical procedures.

METHODS: We relied on the American College of Surgeons National Surgical Quality Improvement Program database (2005 to 2011). Procedure-specific multivariable logistic regression models assessed the association between smoking status (non, former, or current smokers) and risk of 30-day morbidity and mortality.

RESULTS: Overall, 141,802 patients were identified. A total of 12.5%, 14.6%, and 14.9% of non, former, and current smokers, respectively, experienced at least one complication ($P < .001$). In multivariable models, current smokers had higher odds of overall, pulmonary, wound, and septic/shock complications following most cardiovascular and oncologic surgeries compared with nonsmokers. The odds of experiencing such adverse outcomes were significantly lower in former smokers compared with current smokers, but still higher compared with nonsmokers.

CONCLUSIONS: The effect of smoking on perioperative outcomes is procedure dependent. Current and, even though mitigated, former smoking negatively influence outcomes following cardiovascular or

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oncologic procedures. Patients undergoing major procedures should be encouraged to discontinue tobacco smoking to achieve optimal procedural outcomes.

In the 16th century, a French diplomat and scholar named Jean Nicot de Villemain introduced tobacco to the French Royal Court. The use of tobacco in its many forms quickly spread around the globe, yet it was not until about 1950 that Richard Doll first linked smoking to serious health problems, including the increased risk of cancer.[1] Currently, the World Health Organization identifies smoking as one of the biggest public health threats, directly responsible for 5 million deaths per year.[2] Despite antismoking campaigns and prohibitive increases in tobacco taxes, 19.3% of US adults were reported to be active cigarette smokers in 2010.[3]

The relationship between long-term smoking and the risk of cardiopulmonary morbidities is well established.[4] In consequence, smoking has been shown to be an independent risk factor of poor early perioperative outcomes following a variety of surgical procedures.[5–8] The impact of smoking on surgical outcomes is related to transient perturbations of the tissue microenvironment and the prolonged effect on inflammatory and reparative cell functions.[9] Specifically, higher rates of respiratory and cardiovascular events as well as surgical site infections have been reported among current smokers.[5–7]

On the basis of these previous investigations, we sought to determine the effect of current and prior smoking on the incidence of early perioperative (30-day period) adverse events within a comprehensive group of 16 major surgeries (cardiovascular, orthopedic, or oncologic surgical procedures). We used data from the American College of Surgeons National Surgical Quality Improvement Program (ACS-NSQIP), a multi-institutional prospective data collection initiative to facilitate the assessment of surgical outcomes and complications.[10] We hypothesize that smoking is an independent predictor of adverse perioperative outcomes in a subset of procedures where smoking-related comorbidities have a central role in the postoperative recovery mechanism.

Patients and Methods

Data source

This study relies on the ACS-NSQIP Participant User Files.[11] The ACS-NSQIP database contains risk-adjusted surgical patient data from member hospitals to facilitate the assessment of perioperative outcome measures following surgery. Trained Surgical Clinical Reviewers prospectively collect the ACS-NSQIP data.[12] Validated data from patients' medical charts allow quantification of 30-day risk-adjusted surgical outcomes, including postdischarge information. In 2011, the ACS-NSQIP included data from 315 participant institutions with more than 1.7 million cases having been contributed.

Study population

We focused on 16 major cancer and noncancer surgical procedures. Patients were identified in the ACS-NSQIP (2005 to 2011) using Current Procedural Terminology (CPT) codes for "cardiovascular surgery": carotid endarterectomy (CEA), coronary artery bypass grafting (CABG), lower extremity (LE) bypass surgery, abdominal aortic aneurysm (AAA) repair, cardiac valve repair/replacement; "orthopedic surgery": total hip or knee replacement; and "oncologic surgery": esophagectomy, gastrectomy, pancreatectomy, colectomy, radical prostatectomy, cystectomy, nephrectomy, hysterectomy, or pneumonectomy. For patients undergoing oncologic interventions, the extraction was limited to a concomitant cancer diagnosis code, and only patients with complete information for baseline parameters were included (CPT and International Classification of Diseases 9th edition codes are provided in the Appendix).

Patients were stratified according to their smoking status. According to previously described methodology,[5] each patient was classified into current, former, or never smoker. Briefly, a current smoker was defined as a patient who had smoked cigarettes within the last year and had answered "yes" to the current smoker variable. Former smoker was defined as a patient who had not smoked cigarettes during the 1-year period previous to undergoing surgery and had answered "no" to the current smoker variable but whose value for the pack-years variable was nonzero. Never smoker was defined as a patient who had answered "no" for the smoker variable and whose value for the pack-years variable was equal to 0. Patients with missing smoking status (n = 542) were excluded from the analysis. Overall, 141,802 patients were available for the analysis.

Covariates

For each patient, age at surgery, sex, race, body mass index (BMI), alcohol consumption, comorbidities, including history of hypertension, diabetes mellitus, cardiopulmonary disease, cerebrovascular disease, and others (liver disease, peripheral vascular disease, and chronic kidney disease), preoperative hematocrit (Hct), serum creatinine (SCr), American Society of Anesthesiologists (ASA) score, operative time, and anesthesia type were recorded. Furthermore, approach (open vs minimally invasive) was assessed wherever relevant.

Endpoints

Postoperative complications were grouped according to previously reported methodology[13]: cardiovascular