Perioperative Smoking Risk

THE tobacco epidemic represents a significant preventable cause of death and is probably the greatest health disaster in human history, being associated with more than 5 million deaths annually.† Tobacco dependence is also, arguably, the most difficult dependency to break and often requires repeated interventions and attempts to quit.[1] A mounting body of evidence has led to the following two important conclusions. (1) Smoking harms nearly every organ of the body, causing many diseases and reducing smokers' health in general. (2) Quitting smoking has long-term benefits by reducing risks for diseases caused by smoking.[2]

In this edition of ANESTHESIOLOGY, Turan *et al.*,[3] from the Cleveland Clinic, Cleveland, Ohio, conducted an analysis of the American College of Surgeons National Surgical Quality Improvement Program Database of more than 600,000 patients. The results of this important work found that smokers had a higher mortality and increased rates of all cardiorespiratory and septic complications. The investigation details a propensity score–matched cohort comparison of *current smokers*, defined as "patients who reported smoking cigarettes in the year before admission for surgery," with a cohort of patients who reported a "zero lifetime pack-years." These definitions are important to recognize because the reported analysis excluded patients who had managed to break their tobacco dependency. Irrespectively, this study is an important addition to the literature because previous studies, linking smoking to poor outcomes, were limited by small sample sizes, single institutions, and limited follow-up.

In all observational research, it is important to recognize the potential limitations of the analysis. In the study by Turan *et al.*,[3] the authors did not adjust for the known, or suspected, comorbidities associated with long-term tobacco use, arguing that to adjust for these "confounders," such as chronic obstructive pulmonary disease and coronary disease, would "match away" the long-term effects of smoking. Although this method can be justified at some level, readers should understand that this is a form selection bias and that patients with coronary disease who never smoked would tend to be underrepresented in the analysis. This decision would tend to bias the end result and overestimate the risk of smoking. Furthermore, as the authors have noted, it is also likely the effects of smoking are overestimated because of the opposite of a healthy user effect. In this case, adjustment of the confounders cannot account for behaviors that are associated with smoking, such as increasing alcohol consumption, or minimal use of primary medical care.

However, this analysis has many strengths; most important, it is an analysis of a large population across many locations and is, thus, generalizable to most practices. Observational studies are seldom linked to causality, yet this analysis retains many elements of the Bradford Hill criteria for causality. These criteria for causation are a group of minimal conditions necessary to provide adequate evidence of a causal relationship between an incidence and a consequence. These criteria include the following: (1) strength of an association, (2) consistency, (3) specificity, (4) temporal relationship, (5) dose–response relationship, (6) biological plausibility, (7) coherence, (8) reversibility, and (9) consideration of alternate explanations. Even after accounting for the inherent bias, the article demonstrates a strong association between smoking history and adverse postoperative outcomes. The results are consistent with those of previous publications on cardiac,[4] vascular,[5] thoracic,[6] general,[7] urologic,[8] and plastic reconstructive surgical procedures.[9] There is a clear temporal relationship demonstrated. Furthermore, two figures (figures 3 and 4 in the article by Turan *et al.*[3]) demonstrate a clear and significant dose–response between amount smoked and adverse surgical outcomes.

The association between smoking and major adverse surgical events is biologically plausible. Nicotine induces hypertension and tachycardia through its effect on the sympathetic nervous system.[10,11] In addition, carbon monoxide (the concentration of which also bears a dose–response relationship with amount smoked) substitutes oxygen in the molecule of hemoglobin, shifts the oxygen–hemoglobin dissociation curve to the left, and decreases oxygen availability to the tissues.[12] The net effect of these interactions impairs oxygen delivery, leading to tissue ischemia. Tobacco use damages cilia, increases mucus production, impairs clearing of secretions, and renders the bronchial tree irritable,[13] leading to sputum retention,[14] pneumonia, and respiratory failure.[15] Cigarettes inhibit immune function, resulting in delayed wound healing and infection.[16,17] Smokers have abnormal bone metabolism and may experience delayed fracture healing.[18,19] Smoking has a direct effect on the central nervous system, affecting pain perception[20] and opiate requirements.[21]

Unfortunately, and as previously noted, the current study does not address smoking cessation (or reversibility) in either the long-term or the immediate preoperative period. The analysis was a restricted comparison between current smokers and patients who had a zero pack-year history; thus, all

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† WHO report on the global tobacco epidemic, 2008: the MPOWER package. Available at: http://www.who.int/tobacco/mpower/mpower_report_full_2008.pdf. Accessed December 21, 2010.

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patients who have managed to quit for longer than 1 yr were excluded. Because smoking has been identified as a significant independent risk factor for postoperative morbidity, we believe the most important issue is as follows: Does an intervention that decreases the number of patients who smoke (or the amount smoked) result in better postoperative outcomes? There is no debate that smoking cessation is beneficial, in the long-term, and that many of the detrimental physiologic effects of smoking are reversible after smoking cessation.[22,23] For the perioperative physician, the real issue is when the optimal timing of preoperative smoking cessation is unknown.

Prolonged abstinence from smoking significantly decreases the risk of postoperative respiratory complications.[13,24] Six months of abstinence restores antimicrobial and inflammatory alveolar macrophage function.[25] Smoking cessation for 6–8 weeks improves pulmonary function[26] and decreases wound-related and cardiovascular complications.[27] Three weeks of abstinence reduced the incidence of impaired wound healing.[28]

Every smoker undergoing surgery is in various states of recovery (withdrawal) from the effects of tobacco. However, the acute phases of this process are poorly understood. The available evidence on the effects of sudden withdrawal is contradictory and highlights the need for more high-quality investigation of the problem. Theoretically, at least, abstinence for 1 day could reduce nicotine (half-life, 1 h) and carboxyhemoglobin (half-life, 4 h) concentrations and, thus, may be long enough to decrease blood concentrations and improve tissue oxygen delivery.[13] Alternatively, observational data suggest that abstinence from cigarettes may exacerbate preoperative stress,[29] although many smokers do not experience nicotine withdrawal symptoms. Many investigators believe the postoperative period is an excellent opportunity to reinforce abstinence, especially in the hospital setting, where "no smoking" policies are almost universal. However, several other studies[30,31] have suggested that pulmonary complications may be exacerbated in patients suddenly withdrawing from tobacco. These trials have a small sample size and all manner of bias inherent to observational trials. We should not ignore the possibility that, in the short-term, smoking cessation may increase pulmonary complications; the inability to clear increased pulmonary secretions makes this finding biologically plausible. Again, it is evident that high-quality investigations, powered to show meaningful results and using the appropriate end points, must be conducted.

It seems that the need for surgery increases the likelihood of successful smoking cessation and confirms the concept that surgery and perioperative events create a "teachable moment" in a smoker's life.[32] The American Society of Anesthesiologists–sponsored Smoking Cessation Initiative Task Force has recommended that anesthesiologists use the Ask–Advise–Refer strategy that is designed to identify current smokers, advise them to quit, and refer them to the free national telephone quit line for further support.‡ Strategies such as this are potentially feasible and should be accepted as policy in every preoperative assessment clinic.[33] Interventions that begin 4–8 weeks before surgery include weekly follow-ups, and nicotine replacement therapy seems to be efficient in terms of both postoperative complications and long-term smoking cessation.[34] However, in many situations, a delay in surgery of up to 4 weeks, to facilitate these pathophysiologic improvements, is not feasible; surgical delays of this duration have been linked to increased morbidity.[35] There are simply not enough data to confirm that a brief intervention immediately before surgery results in a reduction in postoperative morbidity.[36]

Turan *et al.*[3] have increased our knowledge by showing that smoking increases perioperative morbidity, in a dose-related manner. Anesthesiologists are uniquely positioned at the crossroads of patient willingness to quit, institutional policy, and societal programs, whose primary intention is to stop smoking. As a profession, we should take a leadership role and influence this major public health epidemic. We should embrace the various smoking cessation initiatives, use this opportunity to comprehensively study the issues related to smoking cessation, and establish the optimal methods and timing for preoperative cessation and the effects these have on postoperative outcomes.

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‡ Similar initiatives are also underway in Canada. See Stop Smoking for Safer Surgery. Available at: http://www.ontarioanesthesiologists.ca/stopsmoking/. Accessed December 21, 2010.

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