

## PREVALENCE OF AND REASONS FOR PREOPERATIVE TOBACCO USE

*Smoking cigarettes has an impact on all aspects of the perioperative anesthetic. It is not known whether patients are typically educated regarding these effects.*

*Eighty-one patients completed a questionnaire concerning smoking behavior in the 24 hours before surgery. Variables measured were smoking history, tobacco addiction, and preoperative education. Chi-square analysis was used.*

*Of 81 participants, 66 (81%) smoked tobacco within 24 hours of surgery. Thirty-seven patients received no instructions to stop smoking, and only 2 patients abstained on their own. Of the 44 patients counseled not to smoke, 12 abstained from tobacco before operation. Thus, with counseling, the cessation rate was approximately 5 times greater ( $\chi^2 = 7.0$ ,  $P = .008$ ). A second correlation was seen when the patients were informed about tobacco's risks related to anesthesia. The smoking rate decreased from 15% to 4%, a 4-fold decrease ( $\chi^2 = 15.3$ ,  $P = .0001$ ).*

*The results indicate patients who smoke are not routinely informed of the risks of tobacco use or the benefits of abstinence before surgery. Counseling has a positive impact on the patient's smoking behavior in the 24 hours preceding surgery. Anesthesia providers and surgeons have a renewed obligation to instruct patients not to smoke before surgery.*

**Key words:** Addiction, anesthesia, carboxyhemoglobin, smoking, teaching.

Smoking cigarettes remains a major health problem. More than 70% of smokers visit a physician each year, 90% visit a physician at least once in 5 years, and one third of the patients who undergo surgery are smokers, presumably addicted to cigarettes.<sup>1-3</sup> Tobacco's effects on airway reactivity and mucociliary clearance and physiologic changes in the cardiovascular and immune system are well recognized; however, it is not known whether patients are typically educated about these adverse effects. This study's goal was to determine why patients who smoke regularly will not abstain from tobacco use before surgery. The study also was designed to determine the prevalence of tobacco use in surgical patients before surgery and to describe patients' perception of the reasons they did not abstain from tobacco use. Possible reasons for not abstaining included addiction, lack of preoperative education, or both.

Laryngospasm can be catastrophic during induction of anesthesia. Even while planning an emergence strategy, the presence of a reactive airway necessitates a decision by the anesthesia provider to extubate the patient under deep anesthesia, exposing the patient to further complications such as aspiration. Daley and colleagues<sup>4</sup> examined current practices regarding the performance of tracheal extubation of adult surgical patients while deeply anesthetized (deep extubation). They concluded from the 538 responses from anesthesiologists who frequently use this technique that one of the most frequent indications for deep extubation was for reactive airway diseases.<sup>4</sup>

Wigoda and colleagues<sup>5</sup> studied the vasoactive effects of smoking and found

that patients who smoke have increased numbers of complications such as poor wound healing; decreased blood flow to flaps, such as those used in mastectomies; and late problems with arterial revascularization compared with non-smokers following surgical procedures. They detected a significant reduction of blood flow and vasoactive properties caused by nicotinic effects on sympathetic fibers at the ganglionic levels in the hand and digits.<sup>5</sup>

Bluman and colleagues<sup>3</sup> examined the effects of preoperative smoking behavior on postoperative pulmonary complications through a prospective cohort study. They found smoking to be associated with a 6-fold increase in postoperative pulmonary complications, in part related to poor clearance and increased amounts of secretions by dysfunctional cilia and goblet cells, respectively. Unfortunately, they also found that a reduction in smoking within 1 month of surgery may not fully reverse the risk of postoperative pulmonary complications.<sup>3</sup>

The effects of exposure to passive smoking were related to an increased number of postoperative desaturation episodes after surgery following general anesthesia in children; the effects showed a relationship to the cumulative number of cigarettes smoked by individuals to whom the child was exposed.<sup>6</sup> A decreased ability to wean from the ventilator at 48 hours for smokers postoperatively also has been demonstrated.<sup>7</sup> Katz and associates<sup>8</sup> reported that patients who smoke have been noted to occasionally have violent coughing postoperatively that can have negative consequences on the operation performed, especially in eye surgery and hernia repair.

Woehick and colleagues<sup>9</sup> found that

smoking-related carbon monoxide exposure increased the incidence of ST segment depression in patients without evidence of ischemic heart disease. This suggests that patients at risk for myocardial ischemia should abstain from smoking for a sufficient time before surgery (6 to 24 hours) to reduce their carboxyhemoglobin concentrations and, therefore, reduce their risk of myocardial ischemia. The same group of researchers also found that patients younger than 65 years without symptoms of ischemic heart disease who smoked shortly before surgery had more episodes of rate pressure product–related ST segment depression than did nonsmokers, prior smokers, or chronic smokers who did not smoke before surgery. Women were at greater risk of ST depression than men.<sup>9,10</sup>

Smoking also has been noted as an independent risk factor regarding the length of time patients spend in the recovery room. Wound healing, although a late endpoint, has been reported to be decreased in smokers, presumably due to microvessel constriction and resultant tissue hypoxia.

The purpose of our study was to answer the question: do patients who have a history of smoking continue to smoke because of one or a combination of addictions, lack of preoperative education, or other factors? We also wanted to determine the prevalence of tobacco use in surgical patients before surgery and to describe patients' perception of the reasons they did not abstain from tobacco use. In addition, we wanted to describe factors or considerations that may have been responsible for the abstinence in patients who did not smoke before surgery.

## Materials and methods

This was a prospective, nonrandomized, noncontrolled descriptive study. Human subject approval was obtained from the Samuel Merritt College Institutional Review Board and the Institutional Review Board for the Protection of Human Subjects, Kaiser Foundation Research Institute.

- *Selection of patients.* The variables for this study of patients who had a history of smoking included the following: (1) smoking history for at least 24 hours before surgery, (2) type of preoperative teaching or instructions in reference to smoking cessation, (3) level of perceived tobacco addiction, and (4) other factor(s) the patient perceived as being the reason for smoking or abstaining from smoking just before surgery.

In a 6-month period, 81 participants were enrolled in the study. The participants were consecutive men and women older than 18 years, English speaking, ASA classification II or higher who smoked tobacco and were undergoing any elective outpatient surgical

procedure. Exclusion criteria consisted of patients with diminished autonomy and patients unable to give informed consent, patients younger than 18 years, nonsmokers, and patients who were admitted to the hospital due to inability to meet discharge criteria.

Study participants were kept anonymous, and no medical record numbers were recorded. The patient's identity was not discussed or obtained to protect the privacy of each patient. The only other information gathered during the study included the patient's age, sex, and type of surgery. All questionnaires were placed in a secured box with a lock located in the Phase II portion of the postanesthesia care unit (PACU).

- *Data collection.* The research was conducted in 2 major hospitals affiliated with a large western health maintenance organization group. These field settings were chosen because of the high volume of outpatient operations done each day. The questionnaire was written for the sixth-grade level, and patients who had any questions on how to answer the questionnaire were excluded from the study.

- *Field procedures.* To eliminate the potential problem of increasing patients' anxiety level by administering the study questionnaire preoperatively, the questionnaire was administered postoperatively in the recovery room (Phase II) before discharge. There was concern that if the study was administered 1 to 2 weeks after operation, the questionnaire's capture rate for participants would have been low due to patients losing interest. The potential confounder of patient confusion postoperatively was minimized by waiting until just before discharge.

Criteria for discharging patients from the PACU were established by the department of anesthesiology and the hospital's medical staff and were in concert with nationally accepted criteria for discharge. To guarantee discharge criteria had been met, the patients were evaluated and given a postanesthetic recovery score based on the Aldrete Scoring System. Ideally, the patient is discharged when the total score reaches 10. This scoring system includes orientation to person, place, and time; stable vital signs; ability to ambulate unassisted; ability to tolerate oral fluids; ability to void; and absence of significant pain and bleeding. At this time, sedation from the perioperative period is minimal, the patient is able to perform desired tasks of self-care and to understand and comprehend discharge instructions. The participant's information sheet and questionnaire were distributed during this time to ensure reliable and valid data.

The PACU nurses were given specific written and verbal instructions before the start of the study. The nurses were asked to administer the questionnaire to

all patients who had a history of smoking (noted in the history and physical or on the anesthetic record). They were asked not to comment or ask the patient any further questions in reference to the study. Nurses were instructed not to provide any assistance with completing the study items to reduce the possibility of the nurses biasing the patient's responses. Participants were asked by a PACU nurse to complete the questionnaire (Figure) after reading the "Information Sheet" regarding the study.

• *Statistical analysis.* Frequencies and percentages were calculated for the demographic items. All items on the questionnaire required a yes or no response. The sample size represents the number of patients who qualified for the study (those who answered "yes" to the question: "Do you smoke daily?"). Seven independent  $\chi^2$  tests were used to determine whether

there was a relationship between the participant's responses on the question regarding smoking behavior in the last 24 hours. We specifically looked at the patients' responses to and perceptions of the following items and their smoking behavior: (1) Did the patient believe it was important to stop? (2) Was the patient unable to abstain? (3) Was the patient informed about the risks of tobacco in relation to surgery and anesthesia? (4) Did patients perceive themselves as being addicted? (5) Did the patient have a history of smoking for more than 5 years? The question "Do you smoke daily?" was not used in the  $\chi^2$ . All  $\chi^2$  analyses were performed and reported to assess relationships between the questions in the survey and whether this made an impact on smoking 24 hours or less before surgery or the decision and/or ability to abstain. The level of significance was .05 for the  $\chi^2$  tests. The

**Figure. Data collection instrument**

**Prevalence of Preoperative Tobacco Use Survey**

The purpose of this study is to determine the prevalence of and reasons for tobacco use in surgical patients prior to surgery. Please take a few moments of your time to answer the following simple questions to help us provide you and future patients with better care.

You are free to refuse to participate in any part of the survey or refuse to answer any questions. Your decision whether or not to participate in the study will not affect your medical care. If you decide to participate, you are free to change your mind and discontinue participation at any time without any effect on your medical care or eligibility for future care or membership in Kaiser Foundation Health Plan (KFHP). All answers are kept confidential; no names will be used in the study.

	Yes	No
1. Do you smoke tobacco daily?	___	___
2. Did you use tobacco in the last 24 hours?	___	___
3. I <u>did not</u> think it was important to stop smoking prior to the surgery.	___	___
4. I was informed about the effects of smoking before surgery.	___	___
5. I was told that smoking might affect surgery outcome.	___	___
6. I feel that I may be addicted to tobacco.	___	___
7. I was unable to stop smoking prior to surgery.	___	___
8. I did think it was important to stop smoking prior to surgery.	___	___
9. I <u>was not</u> informed about the effects of smoking before surgery.	___	___
10. I was told that smoking might affect anesthesia.	___	___
11. I have been smoking tobacco for greater than 5 years.	___	___

Comments (fill in your answer)

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Thank you very much for your participation.

StatView 4.0 (Abacus Concepts, Berkeley, Calif) statistical package was used to analyze the data. Data collected in the “comments” section relative to reasons to abstain were reviewed for trends and quantified.

## Results

Eighty-one patients who regularly use tobacco completed the questionnaire. The results from the questionnaire are presented in Table 1. Of the 81 patients, 66 (81%) smoked tobacco 24 hours or less before surgery, 35 (44%) did not think it was important to abstain from tobacco use before surgery, and 70 (86%) perceived themselves as addicted to tobacco. This study determined that of the 37 (46%) who were not told to abstain from tobacco use before surgery, only 1 patient (3%) abstained. Of the remaining 44 (54%) who were informed about the risks of smoking related to surgery, 7 (16%) abstained from using tobacco before their operation. Thus, with counseling, the cessation rate was approximately 5 times greater ( $\chi^2 = 7.0$ ;  $P = .008$ ).

In preparation for surgery, only 46 of the study patients were informed about tobacco use and its effects specifically related to surgical outcome (see Table 1, question #9). Of those 46, only 5 patients abstained. Of the total population, 70 patients perceived themselves as being addicted to tobacco. Of these 70 patients, 50 said they were unable to stop smoking before their operation, so 71% of this “addicted” population smoked tobacco before their operation.

Fifty-three patients recognized the importance of stopping smoking, but this did not affect their smoking behavior in the preceding 24 hours ( $\chi^2 = 1.7$ ;  $P = .19$ ). Seventy-three patients (90% of the population) had a smoking history of greater than 5 years, which was not related to whether they smoked in the preceding 24 hours, that is, the inability to stop smoking is acquired in fewer than 5 years.

Fifty-one patients received no preoperative education regarding the effects of tobacco, particularly related to anesthesia and smoking within 24 hours before surgery. Of the 29 patients who were informed about the risks related to smoking and anesthesia, 15% abstained for at least 24 hours before surgery. Of the 51 patients who were not so informed, 4% abstained ( $\chi^2 = 15.3$ ;  $P = .0001$ ). In this study, we found that the surgical specialties were not equally diligent in educating patients on the effects of smoking before surgery: The head and neck service most frequently advised their patients on the effects of tobacco (72% were advised). The following are the numbers and percentages of patients counseled by the other specialties, those undergoing an ophthalmology procedure (29%), a general/vascular procedure (50%),

**Table 1. Frequencies and percentages of responses to questionnaire items**

Item	Yes No. (%)	No No. (%)
1. Do you smoke tobacco daily?	81(100)	—
2. Did you use tobacco in the last 24 hours?	66(81)	15(19)
3. I <u>did not</u> think it was important to stop smoking prior to the surgery.*	35(44)	45(56)
4. I was informed about the effects of smoking before surgery.	44(54)	37(46)
5. I was told that smoking might affect surgery outcome.*	33(41)	47(59)
6. I feel that I may be addicted to tobacco.	70(86)	11(14)
7. I was unable to stop smoking prior to surgery.*	49(62)	30(38)
8. I did think it was important to stop smoking prior to surgery.	53(65)	28(35)
9. I was <u>not</u> informed about the effects of smoking before surgery.*	33(42)	46(58)
10. I was told that smoking might affect anesthesia.*	29(36)	51(64)
11. I have been smoking tobacco for greater than 5 years.	73(90)	8(10)

\* Some questions were unanswered.

a gynecology procedure (56%), orthopedic/podiatry procedure (62%), and urology procedure (60%). Further research is needed to determine whether these results can be generalized to other institutions.

## Discussion

Preoperative teaching and education could, at least theoretically, decrease the incidence of tobacco use before planned operations. It seems that even a short smoke-free interval before surgery could restore immune function, ciliary function, and airway reactivity and eliminate carboxyhemoglobin.<sup>11,12</sup> Anderson and Belani<sup>12</sup> recommended 12 to 72 hours of smoking cessation to benefit from some of the potentially reversible physiologic changes caused by smoking. A physiologic justification for a brief preoperative smoke-free interval, which may decrease perioperative morbidity, is directly related to the potential reversible physiologic changes caused by smoking (Table 2).

The perioperative period may be a time of

increased motivation for patients to alter their smoking behaviors. Anesthesia providers and surgeons are in a unique position to provide smoking-cessation messages. Patients should be counseled by the surgeon perhaps 4 to 10 weeks before elective surgery and later by the anesthesia providers at the preoperative visit (Table 3). Although there is no consensus on the minimal or optimal duration of preoperative abstinence, it has been shown that perhaps the elevated incidence of postoperative pulmonary complications in current or previous smokers can be reduced significantly by persuading the patient to stop smoking before surgery.

It would seem intuitive that patients would not smoke before surgery, but this is clearly not the case, as the results support. Anesthesia providers should be concerned not only about the patient's nothing-by-mouth status and the medications the patient should take or avoid, but also about tobacco use. It cannot be assumed that patients will be responsible and abstain from smoking before surgery since results have shown that patients are not apprised of the risks involved with preoperative tobacco use. Anesthesia providers and surgeons have an obligation to instruct patients not to smoke before surgery.

Elective (nonemergency) operations are scheduled 1 to 6 months and sometimes up to 1 year in advance. During this time, anesthesia providers, surgeons, and other healthcare providers need to work closely together to promote or extend the smoke-free interval and reduce the disadvantageous acute effects of tobacco use before surgery. The healthcare team should be strict about the patient abstaining from tobacco and cancel operations if the patient smoked within 24 hours of surgery. Even a short cessation and respite period from tobacco use of 24 hours will decrease patients' carboxyhemoglobin exposure and, therefore, reduce their risk of desaturation and myocardial ischemia and potential anesthetic complications.<sup>10,12</sup> It has been noted that anesthesia providers are very good at compensating for problems encountered in patients who have reactive airways, but anesthesia providers should make it a priority to inform and advise patients on the effects of tobacco use related to anesthesia and surgery and encourage patients to make a conscious effort to abstain from tobacco use. See Tables 4 and 5 for preoperative interview strategies.

Lillington and Sachs<sup>13</sup> argued that "cold turkey" reduction in the number of cigarettes smoked could subject patients to the hazards of physiologic stress associated with nicotine withdrawal. The Department of Health and Human Services analyzed and reviewed

**Table 2. Potential reversible physiologic changes caused by smoking**

<p><b>Respiratory system</b></p> <ul style="list-style-type: none"><li>• Decreased mucociliary clearance</li><li>• Increased mucus secretion</li><li>• Small airway hyperactivity</li><li>• Altered surfactant activity</li></ul> <p><b>Cardiovascular system</b></p> <ul style="list-style-type: none"><li>• Decreased oxygen tissue delivery and utilization</li><li>• Increased heart rate</li><li>• Impaired myocardiocyte calcium regulation</li><li>• Increased systolic and diastolic arterial blood pressure</li><li>• Increased hematocrit</li></ul> <p><b>Immune system</b></p> <ul style="list-style-type: none"><li>• Increased IgE level</li><li>• Decreased neutrophil chemotaxis</li><li>• Increased white blood cell count</li><li>• Altered T-cell activity</li><li>• Decreased natural killer cell activity</li></ul>
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All these physiologic derangements can possibly be reversed by preoperative abstinence from smoking.<sup>12</sup>

smoking cessation practice guidelines. It has been shown that pharmacologic assistance in contrast to going cold turkey is the single most valuable tool for achieving smoking abstinence. They recommend nicotine replacement by other modes and the use of antidepressants, such as sustained-release bupropion (Zyban), which can safely achieve tobacco abstinence in as many as 40% to 50% of subjects during the period of medication administration.<sup>13</sup> Interestingly, the large majority of smokers try multiple times before they finally quit, but with persistence, half of all smokers quit, and if the smoker is able to remain abstinent for 3 months, relapse is unlikely.<sup>14</sup>

In the present study, there was a relationship between smoking abstinence and education. Those who were informed about the adverse affects of smoking were more likely not to smoke before surgery. It also has been shown that even brief clinician advice about smoking increases cessation rates.<sup>15</sup> This is in concert with the results of the present study that indicate that counseling related to the overall effects of smoking before surgery or specifically related to risks results in a 4- to 5-fold increase in smoking cessation. Therefore, information about tobacco use should be

**Table 3. Preoperative assessment\* and plan**

**Assessment**

1. How many pack years (number of packs smoked per day times number of years smoked)?
2. Auscultation of breath sounds: scattered rhonchi, wheezes
3. Hyperexpanded chest
4. Distant breath sounds
5. Productive cough
6. Characteristics of sputum (pulmonary infection?)
7. Poor exercise tolerance?
8. Chest radiograph shows hyperinflated lungs or consolidations
9. Pulmonary function studies: decreased forced expiratory volume in 1 second, increased closing volume
10. Medications: inhalers
11. Electrocardiogram
12. Arterial blood gases: low PaO<sub>2</sub> and oxygen saturation (%) and high CO<sub>2</sub> level
13. Airway examination: hyperreactive airway; oral, head, or neck masses; range of motion of neck

**Plan: Preoperative preparation**

1. Smoking cessation strategies (see Tables 5 and 6)
2. Goals: smoking cessation overnight to decrease carboxyhemoglobin and nicotine levels and 8 wk or more before surgery to decrease pulmonary complications
3. If patient is admitted preoperatively, aggressive pulmonary toilet, incentive spirometry, expectorants, bronchodilator therapy
4. Treat pulmonary infection with antibiotics
5. O<sub>2</sub> per nasal cannula as needed
6. Be prepared for the following: desaturation, propensity for bronchospasm, mucous plugging any time, and increased autonomic activity (increased heart rate and blood pressure secondary to nicotine in patients who have smoked just before administration of anesthesia)

**Intraoperative: Choose anesthetic technique**

1. Local infiltration with sedation
2. Regional
3. General

**Postoperative: Interventions**

1. Analgesia
2. Pulmonary toilet
3. Continue preoperative therapy
4. Early mobilization
5. Encourage permanent smoking cessation

\* Key factors that are well known to increase the incidence of postoperative respiratory complications

included in all preoperative counseling sessions. However, the healthcare team should recognize that possibly fewer than 20% of patients counseled will heed or consider the advice, perhaps indicating a need

for additional interventions.

While the results of the present study do not indicate which program of smoking cessation is most effective, a few of the current guidelines from the US

**Table 4. Anesthesia interview strategies for promoting smoking cessation**

1. Discuss the patient's present tobacco use status.
2. Determine the patient's willingness to quit or make an attempt to quit.
3. Discuss the pathophysiology of smoking related to surgery and anesthesia
4. Discuss the benefits of cessation short term (12-24 h) so carboxyhemoglobin levels will decrease to near normal (important in cardiorespiratory function),  $\geq 2$  mo is necessary to achieve a decrease in postoperative pulmonary morbidity and  $>5$  y to reduce cardiac morbidity related to smoking.
5. Collaborate with surgeons and internal medicine physicians in recommending and prescribing pharmacologic adjuncts, eg, nicotine gum or patch well before and again after the operative procedure.
6. Reinforce all recommendations with written material and phone numbers if patients should have any questions.
7. As part of postanesthesia care follow-up procedures, reinforce smoking cessation behaviors.
8. Promote change in hospital preoperative anesthesia forms to *include* instructions on smoking cessation before any surgical procedure and anesthesia care.
9. Be involved in making a video for perioperative expectations that includes instructions related to nothing by mouth before surgery, medications, and smoking cessation techniques; what to expect when going into the operating room; and the postoperative phase.

**Table 5. Key points for the anesthesia provider to share with patients**

**Good reasons for quitting smoking**

- You will live longer and live better.
- The people you live with, especially your children, will be healthier.
- Quitting will lower your chance of having a heart attack, stroke, or cancer.
- If you are pregnant, quitting smoking will improve your chances of having a healthy baby.
- You will have extra money to spend on things other than cigarettes.

**Five keys for quitting**

- Get ready.
- Get support.
- Learn new skills and behaviors.
- Get medication, and use it correctly.
- Be prepared for relapse or difficult situations.

**Special situations or conditions**

- Hospitalized patients: By quitting, you reduce health problems and help healing.
- Heart attack patients: By quitting, you reduce your risk of a second heart attack.
- Lung, head, and neck cancer patients: By quitting, you reduce your chance of a second cancer.
- Parents of children and adolescents: By quitting, you protect your children and adolescents from illnesses caused by second hand smoke.
- Pregnant women and new mothers: By quitting, you protect your baby's health and your own.

**Table 6. First-line therapeutic modalities identified as reliable for increasing long-term smoking abstinence rates**

1. Behavior therapies through one-on-one and group counseling
2. Nicotine gum—available over the counter
3. Nicotine patch—available over the counter and by prescription
4. Nicotine spray or inhaler—available by prescription
5. Anxiolytic such as valium—available by prescription
6. Buspirone (serotonergic agonist), which acts as an anxiolytic but produces minimal, if any, sedation, abuse potential, or physical dependence—available by prescription.<sup>14</sup> All are considered promising therapies for at least short-term cessation that may lead to successful lifelong abstinence.<sup>16</sup>

Public Health Service are given in Table 6. These therapeutic modalities also may be used to promote permanent smoking cessation. To help the patient abstain from smoking before surgery (which is of primary interest to anesthesia providers), nicotine gum and the patch are probably the most effective and simplest short-term strategies.

The next step in terms of continued research would be to study the incidence of smoking cessation before surgery using the algorithm of counseling plus a pharmacological aid (eg, nicotine patch, gum) to determine whether these measures are effective when promoted by anesthesia providers.

## REFERENCES

1. Lim JK. Tackling tobacco in the 21st century. *JAMA*. 2000;283: 2174.
2. Ferry L. Overcoming barriers to nicotine dependence treatment. *Prim Care*. 1999;26:707-746.
3. Bluman LG, Mosca L, Newman N, Simon DG. Preoperative smoking habits and postoperative pulmonary complications. *Chest*. 1998;113:883-889.
4. Daley M, Norman P, Coveler L. Tracheal extubation of adult surgical patients while deeply anesthetized: a survey of United States anesthesiologists. *J Clin Anesth*. 1999;11:445-452.
5. Wigoda P, Netscher DT, Thornby J, Yip B, Rappaport N. Vasoactive effects of smoking as mediated through nicotinic stimulation of sympathetic nerve fibers. *J Hand Surg [Am]*. 1995;20:718-724.
6. Lyons B, Frizelle H, Kirby F, Casey W. The effect of passive smoking on the incidence of airway complications in children undergoing general anesthesia. *Anaesthesia*. 1996;51:324-326.
7. Khuri S, Daley J, Henderson W, Barbour G, Lowry P. The national Veterans Administration surgical risk study: risk adjustment for the comparative assessment of the quality of surgical care. *J Am Coll Surg*. 1995;180:519-531.
8. Katz S, Lubow M, Jacoby J. Suck and spit, don't blow: orbital emphysema after decompression surgery. *Ophthalmology*. 1999; 106:1303-1305.
9. Woehick HJ, Connolly LA, Cinquegrani MP, Dunning MB. A1020 acute smoking increases myocardial ischemia during general anesthesia in humans [abstract]. *Anesthesiology*. 1997;87:1020A.
10. Woehick HJ, Connolly LA, Cinquegrani MP, Dunning MB, Hoffmann RG. Acute smoking increases ST depression in humans during general anesthesia. *Anesth Analg*. 1999;89:856-860.
11. McDonough P. Smoking-induced elevations in blood carboxyhaemoglobin levels: effect on maximal oxygen uptake. *Sports Med*. 1999;275:275-283.
12. Anderson ME, Belani KG. Short-term preoperative smoking abstinence. *Am Fam Physician*. 1990;41:1191-1194.
13. Lillington GA, Sachs DP. Preoperative smoking reduction: all or nothing at all? *Chest*. 1998;113:856-858.
14. American Psychiatric Association. Practice guideline for the treatment of patients with nicotine dependence. *Am J Psychiatry*. 1996;153:1-131.
15. Hughes JR. New treatments for smoking cessation. *CA Cancer J Clin*. 2000;50:143-151.
16. Jorenby DE, Leischow SJ, Nides MA, et al. A controlled trial of sustained-release bupropion, a nicotine patch, or both for smoking cessation. *N Engl J Med*. 1999;340:685-691.

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