

Reports of Original Investigations

Interventions in the preoperative clinic for long term smoking cessation: a quantitative systematic review

[Interventions en clinique préopératoire pour la cessation du tabagisme : un compte-rendu quantitatif systématique]

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Purpose: To assess the efficacy of interventions offered to patients in the preoperative clinic to promote long-term (\geq three months) smoking cessation following surgery.

Methods: We searched The Cochrane Library, MEDLINE, EMBASE and CINAHL for all randomized controlled trials (RCTs) on smoking-cessation interventions initiated in the preoperative clinic. Trial inclusion, quality assessment, and data extraction were performed independently by two authors. Standard meta-analytic techniques were applied.

Results: Four RCTs ($n = 610$ patients) were included in the review. Interventions included pharmacotherapy, counseling, educational literature and postoperative telephone follow-up. The follow-up period ranged between three to 12 months with only one RCT following up patients for $>$ one year. Two studies used biochemical methods to validate subjects' self-reporting of smoking cessation at the follow-up assessment. Overall, the interventions were associated with a significantly higher cessation rate vs control at the three to six month follow-up period (pooled odds ratio: 1.58, 95% confidence interval (CI) 1.02–2.45, P value = 0.01, $I^2 = 0\%$). The only trial with longer follow-up period (12 months), however, failed to show any significant difference between the intervention and control groups (odds ratio: 1.05, 95% CI 0.53–2.09, P value = 0.88).

Conclusion: This systematic review suggests that smoking-cessation interventions initiated at the preoperative clinic can increase the odds of abstinence by up to 60% within a three- to six-month follow-up period. To evaluate the possibility of longer abstinence, future trials with at least one-year follow-up are recommended.

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Objectif : Évaluer l'efficacité des interventions destinées à promouvoir la cessation du tabagisme à long terme (\geq trois mois) après une chirurgie mises à la disposition des patients en clinique préopératoire.

Méthode : Nous avons effectué des recherches dans la Bibliothèque Cochrane et les bases de données MEDLINE, EMBASE et CINAHL pour identifier toutes les études randomisées contrôlées (ERC) traitant des interventions de cessation du tabagisme mises en œuvre en clinique préopératoire. Les critères d'inclusion de l'étude, l'évaluation de la qualité et l'extraction des données ont été menés de façon indépendante par deux auteurs. Les techniques standard de méta-analyse ont été utilisées.

Résultats : Notre compte-rendu a inclus quatre ERC ($n = 610$ patients). La pharmacothérapie, la consultation, la littérature de formation et le suivi postopératoire par téléphone constituaient les interventions analysées. La période de suivi allait de trois à douze mois, une seule étude randomisée contrôlée effectuant un suivi de plus d'un an. Deux études ont eu recours à des méthodes biochimiques pour valider les déclarations volontaires des patients concernant la cessation du tabagisme lors de l'évaluation de suivi. D'une manière générale, les interventions ont été associées à un taux significativement plus élevé de cessation que le groupe témoin à trois et six mois de suivi (rapport de cotes pondéré : 1,58, intervalle de confiance à 95 % (IC) 1,02-2,45, valeur $P = 0,01$, $I^2 = 0\%$). Cependant, la seule étude comportant une période de suivi plus longue (12 mois), n'a pas montré de différence significative

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entre les groupes intervention et témoin (rapport de cotes : 1,05, 95 % IC 0,53–2,09, valeur $P = 0,88$).

Conclusion : Ce compte-rendu systématique suggère que les interventions pour la cessation du tabagisme mises en œuvre en clinique préopératoire peuvent augmenter de 60 % au maximum les chances d'abstinence dans une période de suivi de trois à six mois. Toutefois, nous recommandons des études supplémentaires avec un suivi d'au moins un an pour évaluer la possibilité d'une période d'abstinence plus longue.

SMOKING is a major health problem which is responsible for at least 20% of all deaths in developed countries. According to the recent Canadian Tobacco Use Monitoring Survey, over 4.5 million people, representing 18% of the population aged 15 yr and older, were current smokers.^A Smoking is the most preventable cause of disease and premature death in Canada. More than 45,000 people will die prematurely this year in Canada due to tobacco use.^B Currently, clinical practice guidelines are present for clinicians to provide smoking cessation interventions.^C These guidelines recommend that clinicians should screen all adults for tobacco use and provide tobacco cessation interventions for those who use tobacco products. Systematic reviews have shown that advice provided by health care professionals combined with interventions for smoking cessation were effective in increasing the rate of abstinence among smokers in different clinical settings, such as hospitalized patients and patients visiting primary-care centres.¹⁻³

For patients undergoing surgical treatment, smoking is associated with increased postoperative morbidity.^D There is some evidence that smoking cessation prior to surgery reduces the incidence of postoperative complications.⁴ This reflects the fact that chronic exposure to cigarette smoke produces significant changes in the physiology of many organs including those of the cardiovascular and pulmonary systems. These changes may alter responses to perioperative interventions leading to subsequent complications and compromised recovery.⁵ As all smokers undergoing surgery are in a process of forced abstinence, they are in various stages of recovery from the changes caused by smoking. Despite this knowledge, a significant number of adults continue to smoke after surgery. Thus, the perioperative period offers a unique opportunity for smokers to promote prolonged abstinence.⁴

As perioperative physicians, anesthesiologists, whose scope of practice includes preventive medicine and extensive perioperative evaluation and preparation, are faced with the opportunity to provide preoperative anti-smoking advice to surgical patients who are smokers.⁶ This may reduce perioperative complication rates⁷ and possibly lead to smoking cessation beyond the perioperative period, i.e., long-term abstinence. In this scenario, it is important to investigate the potential of “teachable moments” (TMs) to promote long-term smoking cessation in the preoperative setting. A TM describes naturally occurring health experiences that would motivate individuals to readily accept risk-reducing behaviours.⁷ Interaction with smokers in the preoperative clinic may be viewed as a TM as patients facing surgery are more likely to be receptive to advice offered by health care professionals regarding tobacco cessation.^{7,8} Therefore, the preoperative period represents a window of opportunity for tobacco cessation interventions.

In this regard, Møller conducted a systematic review of preoperative interventions and found them effective for changing smoking behaviour perioperatively (i.e., prior to and shortly after surgery). Their results suggest that such interventions could reduce the incidence of complications postoperatively.⁹ However, the long term success of such interventions after surgery remains unclear. This systematic review was therefore undertaken to evaluate the best available evidence regarding the efficacy of interventions offered to patients in the preoperative clinic to promote long-term smoking cessation following surgery. The primary question was to address whether or not interventions initiated in the preoperative clinic are effective in promoting long-term smoking cessation beyond the perioperative period.

A Canadian Tobacco Use Monitoring Survey. Available from URL; http://www.hc-sc.gc.ca/hl-vs/tobac-tabac/research-recherche/stat/ctums-esutc/2006/index_e.html. 2006 (accessed October, 2007).

B Health Canada. Available from URL; http://www.hc-sc.gc.ca/hl-vs/tobac-tabac/res/news-nouvelles/fs-if/risks-risques_e.html. 2007 (accessed October, 2007).

C Rockville.t U.S. Preventive Services Task Force (USPSTF). Counseling to Prevent Tobacco Use and Tobacco-Caused Disease: Recommendation Statement: Agency for Healthcare Research and Quality (AHRQ). Available from URL; <http://www.ahrq.gov/clinic/3rduspstf/tobaccoun/tobcounrs.htm>. 2003 (accessed October, 2007).

D U.S. Department of Health and Human Services. The Health Consequences of Smoking. A Report of the Surgeon General. Washington, DC, U.S. Government Printing Office. Available from URL; <http://www.surgeongeneral.gov/library/smoking-consequences>. 2004 (accessed October, 2007).

Methods

This systematic review was carried out using the methods established by the Cochrane Collaboration¹⁰ and also described by Tramer *et al.*¹¹ In order to ensure that our conclusions were based on both clinically relevant and methodologically valid data, we took two primary factors into consideration. First, in the context of postoperative smoking cessation, an increase in the quitting rate was of primary interest. Second, in the absence of a “gold standard” intervention for smoking cessation, a randomized comparison between any “intervention to promote smoking abstinence” and “usual care” was the most valid study design to establish the relative efficacy. As it has been recommended that all smokers receive advice for smoking cessation³ from their health care providers, it was deemed unethical to have a control group with “no intervention”.

Search strategy

The literature search was carried out using the methods established by the Cochrane Collaboration.¹⁰ We searched the specialized register of the Cochrane Tobacco Addiction Group, the Cochrane Central Register of Controlled Trials (CENTRAL), and the Database of Abstracts of Reviews of Effects (DARE) in The Cochrane Library (Issue 3, 2007); and we conducted electronic searches utilizing MEDLINE from January 1950 to September 2007, EMBASE from January 1974 to September 2007, and CINAHL from January 1982 to September 2007. Both text-word and index-word terms were used; the text-word terms included in our search strategies included: smoking, cessation, intervention\$, surger\$, surgical\$, operation\$, operativ\$, and an?esthesia. We also exploded the following index-word terms: 'tobacco use cessation', 'smoking cessation', 'smoking', 'health promotion', 'preventive medicine', 'health education', 'preoperative care', 'surgery', 'surgical procedures, and operative' (see the Appendix for the search strategies). We hand-searched reference lists from the retrieved articles to identify further trials. In addition, contact was made with the principal authors, as well as experts in the field, to identify additional published or unpublished data relevant to the review.

Study selection criteria

Three reviewers (A.Z., A.A. and J.W.) independently assessed titles and/or abstracts of the hits retrieved from the electronic database and hand searches for possible inclusion according to the pre-defined selection criteria. Discrepancies between the authors were resolved by the fourth author (F.C.). Studies were

eligible for inclusion if they: were randomized clinical trials (RCTs) with parallel-group design; evaluated any intervention initiated in the preoperative clinic to promote smoking cessation in smokers scheduled for elective surgery; and included in their study outcomes quitting rates at three, six and 12 months after surgery. The intervention could include advice or more intensive behavioural therapy, with or without the use of pharmacotherapy or post-discharge follow-up. The control intervention could be usual care or any less intensive program, such as brief advice only. We included studies that reported the use of nicotine replacement therapy (NRT) or other pharmacotherapy *vs* placebo. Observational studies (e.g., with historical group) and trials which only focused on preoperative smoking cessation or post-operative surgical outcomes (e.g., wound infection, cardiovascular complications, etc.) were not considered for review.

Data extraction

We extracted the following information about each study: method of randomization, number and characteristics of study participants, baseline smoking behaviour, description of intervention, timing and duration, definition of smoking abstinence at each follow-up point, the number of smokers who quit smoking at three, six and 12 months after surgery, the change in the average number of cigarettes smoked per day at three, six and 12 months after surgery, and the frequency of complications (if any). Data were extracted from each trial by two reviewers (A.Z. and A.A.), they were verified for consistency and accuracy, and then entered into a computer database for analysis. The authors of included trials were contacted for any missing data.

Assessment of study methodological quality

Methodological quality was defined as having confidence that the design, conduct, and report restrict bias in the intervention comparison.¹⁰ It was evaluated independently by the reviewers (A.Z., A.A. and J.W.). Disagreements were resolved by the fourth author (F.C.). For each study we assessed the method of randomization, and of concealment of study intervention allocation, the degree of blinding, and the completeness of follow-up. Randomization was considered “adequate” if it was generated by a table of random numbers, computer-generated, or a similar methodology. Quasi-randomized trials in which an inadequate method of randomization was applied, such as alternation in patient recruitment (pseudo-randomization), were not included and assessed. Allocation concealment was graded “adequate” if the

allocation of patients was carried out by an independent staff member who was not involved in the study, and who used methods such as serially numbered opaque-sealed envelopes, an on-site locked computer, etc. Blinding was recorded as “adequate” for studies on pharmacotherapy if the patient, care givers, and outcome assessors were blinded to the treatment. However, for behavioural interventions (e.g., counseling), only those who were involved in data collection and outcome assessment could be blinded to group assignment and/or study hypothesis. Follow-up was considered “adequate” if the numbers and reasons for dropouts and withdrawals in all intervention groups were described, or where it was specified that there were no dropouts or withdrawals. Further, we registered whether the trial had reported the use of intention-to-treat analysis.

Data analysis

Statistical methods of RevMan analyses (Review Manager, version 4.2, The Nordic Cochrane Centre, The Cochrane Collaboration, Copenhagen, Denmark) were used for data analysis. In this review, we pooled the results of studies with three to six-month follow-up periods. The results of the only study with one year follow-up were not pooled with the others due to variability in the follow-up period. Pooled treatment effects were estimated using both fixed- and random-effect methods. However, in the text we report only the fixed-effect model, as the two analyses came to a similar conclusion in the sensitivity analyses. For dichotomous variables, e.g., quitting rates at three, six and 12 months after surgery, we calculated the odds ratios (OR) with corresponding 95% confidence intervals (CIs). We calculated the quitting rates according to the principles of intention-to-treat analysis for available cases.¹⁰ This was interpreted as including the data of all patients who were randomized into the study groups, regardless of whether or not they completed or received the study interventions. However, in order to deal with missing data (patients whose data were not collected at follow-up), we conducted sensitivity analysis based on the following approaches: 1) we excluded trials with remarkably high dropout rates (> 20%). 2) We recalculated quitting rates according to the full intention-to-treat analysis¹⁰ which included all patients regardless of whether their outcomes were actually collected. In order to do this, we used the number of patients randomized into each group as the denominator, excluding any deaths; and we counted those who dropped out or were lost to follow-up as continuing smokers (worst-case scenario). The continuous data, i.e., changes in average number

of cigarettes smoked per day were not sufficient to do a meta-analysis. The I^2 statistic was used to measure inconsistency among the study results. $I^2 = [(Q - df)/Q] \times 100\%$, where Q is the Chi-squared statistic and df represents the corresponding degrees of freedom.^{3,10} This describes the percentage of the variability in effect estimates that is due to heterogeneity rather than to sampling error (chance). A value greater than 50% may be considered substantial heterogeneity.¹⁰ In order to identify the potential effect modifiers, we planned subgroup analyses, where possible, based on the factors such as the methodology (quality) of trials. In order to perform sensitivity analysis, we analyzed data with both fixed- and random-effect model analyses and the results of both were reported. We planned an assessment of publication bias using funnel plots.

Results

The search strategies in The Cochrane Library, MEDLINE, EMBASE, and CINAHL yielded, 129, 778, 1,583, and 224 citations, respectively. After reviewing title, abstract and/or the full-text of the articles, we identified seven possibly eligible studies. Of these, two trials were excluded from the review because they measured non-relevant endpoints,^{12,13} and another study was excluded because it was a prospective cohort with a historical group.¹⁴ We eventually analyzed data from four RCTs involving 610 patients.¹⁵⁻¹⁸ Average sample size was 152 patients (range: 47 to 237). The included trials originated from Canada and the United States and were published between the years 2004 and 2005. Further search in other databases, and through the reference lists, did not yield any additional trials on the topic.

Characteristics of included studies

Patients in all the trials were recruited during the preoperative period ranging from one to 14 weeks before surgery while awaiting elective surgical procedures. Mean patient ages were between 42.5 to 50 yr. Myles recruited 47 patients (mean age 42.5 yr) expected to undergo surgery within an eight- to 14-week timeframe. Ratner enrolled 237 patients (mean age 50 yr) one to three weeks before surgery. Warner enrolled 116 patients (mean age 47.1 yr) visiting a preoperative clinic for inpatient or outpatient surgeries. Wolfenden recruited 210 patients (mean age 43.18 yr) one to two weeks before surgery.

All trials evaluated the baseline smoking status of patients when seen in the preoperative clinic. In order to evaluate smoking behaviour, the following factors were recorded from the patients: current consumption (no. of cigarette per day), duration of smoking

TABLE I Characteristics of included studies

	# of patients	AGE mean (\pm SD)	Gender (% female) control vs intervention	baseline smoking behaviour measured	Interventions	Outcome measured	Follow-up	Drop out rates	Quality of study
Myles 2004	47	42.5	37.5% vs 30.4%	Current consumption Level of nicotine dependence Previous quit attempts	Bupropion Counseling Self-help literature Telephone follow-up	Expired CO \dagger	3 w, 6 w, 6 m	42% (at 6 m)	Randomization, allocation concealment, blind assessment \ddagger = adequate Intention-to-treat analysis: Yes
Ratner 2004	237	50 (\pm 13.6)	51.3% vs 52.5%	Current consumption Level of nicotine dependence Stage of change	Counseling Self-help literature NRT \S Stress reduction aids Postop counseling Telephone follow-up	Expired CO \dagger Urinary cotinine	6 m, 12 m	15% (at 6 m) 29% (at 12 m)	Randomization, allocation concealment, blind assessment \ddagger = adequate Intention-to-treat analysis: Yes
Warner 2005	116	47.1 (\pm 13.4)	48% vs 50%	Current consumption Level of nicotine dependence Stage of change Previous quit attempts	Counseling NRT \S	Smoking behaviour Nicotine withdrawal score Perceived stress score	1 m, 6 m	14% (at 6 m)	Randomization, allocation concealment, blind assessment \ddagger = adequate Intention-to-treat analysis: Yes
Wolfenden 2005	210	43.1	65% vs 60%	Current consumption Heaviness of smoking Stage of change Previous quit attempts	Computer-assisted counseling NRT \S Telephone follow-up	Smoking behaviour	3 m	14% (at 3 m)	Randomization, allocation concealment, blind assessment \ddagger = adequate Intention-to-treat analysis: Yes

\dagger CO = carbon monoxide; \ddagger Assessor blinded post-allocation; NRT \S = nicotine replacement therapy; m = months; w = weeks; postop = postoperative.

(years), previous quitting attempts, level of nicotine dependence determined by the Fagerstrom Tolerance Questionnaire, and baseline “stage of change” determined by Prochaska and DiClemente’s stages of change model.¹⁹ Only Wolfenden measured Heaviness of Smoking Indices (a two-item scale assessing the time from waking until the first cigarette, and the usual number of cigarettes smoked per day) in their patients.

Patients in both intervention and control groups for all trials had similar baseline characteristics, including their smoking behaviour, and underwent similar types of surgical procedures (all $P = \text{NS}$). The percentage of patients with previous quitting attempts

varied among the studies, ranging from 25% to 87%. In addition, patients were in different stages of change at baseline assessment in different studies; e.g., the percentage of the patients in “the preparation stage” ranged between 10–50%. Therefore, smoking behaviour and history were different among the patients in the studies which were analyzed.

All trials offered pharmacotherapy in addition to behavioural interventions as part of their multi-component smoking-cessation programs in the preoperative clinic. Two double-blind, placebo-controlled trials^{15,17} studied the efficacy of counseling and pharmacotherapy (bupropion or NRT) *vs* usual care and placebo. However, two trials^{16,18} examined the effect

TABLE II Results of the outcome measured in the included studies

Study ID	Sample size	Follow-up time	Quit smoking		Cigarette consumption			Change in readiness to quit		
			OR (95% CI)	P-value	control	intervention	P-value	control	intervention	P-value
Myles 2004	47	3 weeks	6.3 (1.19-33.44)	0.03	No. of cigarettes smoked /day*			NA	NA	NA
6 weeks		1.82 (0.57-5.79)	0.25	11 (2-15)	0 (0-7)	0.01	NA	NA	NA	
6 months		3.14 (0.3-32.66)	0.61	12 (5-25)	1 (0-6)	0.06	NA	NA	NA	
Ratner 2004	237‡	6 months	1.41 (0.75-2.64)	0.10	NA	NA	NA	NA	NA	NA
12 months		0.95 (0.49-1.82)	1.00	NA	NA	NA	NA	NA	NA	NA
Warner 2005	116	30 days	1.38 (0.65-2.98)	0.29	Change in cigarettes/day from baseline †			NA	NA	NA
6 months		0.94 (0.37-2.43)	0.95	-11.4 ±10.9	-15.2 ±10.7	0.04	NA	NA	NA	
					-8.4 ±10.2	-8.8 ±10.5	0.62	NA	NA	NA
					Heaviness of smoking index†			No. of patients with improved stage of change		
Wolfenden 2005	210	3 months	1.7 (0.7-4.3)	0.18	2.1 ±1.8	1.9 ±1.9	0.65	19 (25%)	44 (42%)	0.02

OR = odds ratio; CI = confidence interval; *Values are medians (interquartile range); †Values are mean ± SD; ‡Nine patients were excluded from the analysis because they died during the follow-up period.

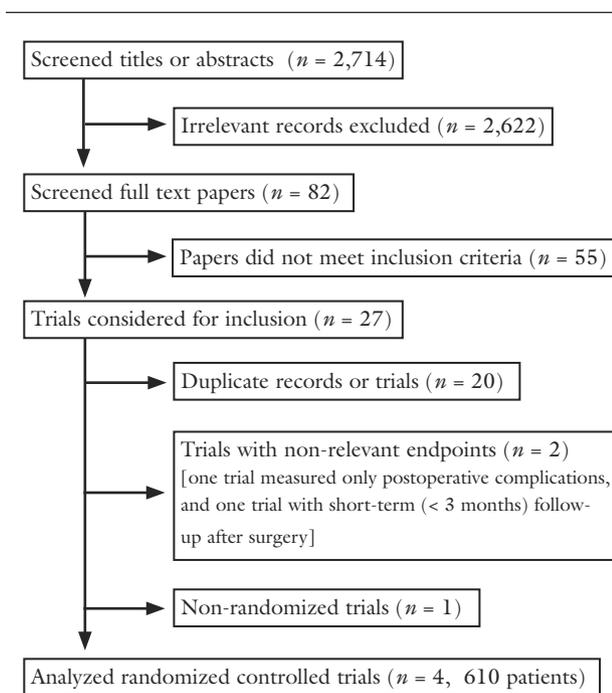


FIGURE 1 Flow chart of screened, excluded, and analyzed papers.

of more intensive behavioural interventions (e.g., a computer-assisted counseling program or counseling sessions followed by postoperative telephone follow-up) and NRT in promoting smoking cessation. Counseling interviews (five to 15 min duration) were

delivered by trained research assistants^{16,18} or registered nurses.¹⁶

For pharmacotherapy, bupropion was used in one study and NRT (patches or gums) was offered in the other four included papers. Myles offered bupropion (or placebo) as a single daily dose of 150 mg for the first three days, and then 150 mg twice daily for the remainder of the seven-week trial period. The dosing of the NRT patches was based on the average number of cigarettes/day at the baseline. Wolfenden considered patients smoking eleven or more cigarettes/day as nicotine dependent for receipt of nicotine replacement therapy during hospital stay. Overall, the duration of NRT varied among the studies ranging from one week to 30 days.

Myles and Ratner also offered postoperative follow-up telephone calls to monitor progress, to augment the initial counseling, or to provide information about preventing relapse. In all of the included trials, the intervention groups were compared with the “usual care” as control groups, which might include any routine smoking-cessation counseling (e.g., brief advice) offered as part of the standard usual clinical practice. Details are presented in Tables I and II.

Outcomes measured

The postoperative follow-up period ranged between three weeks to 12 months among the studies with only Ratner following up their patients for one year. Amongst the included trials, the following outcomes were measured at the time of follow-up: the prevalence of abstinence, the number of cigarettes smoked

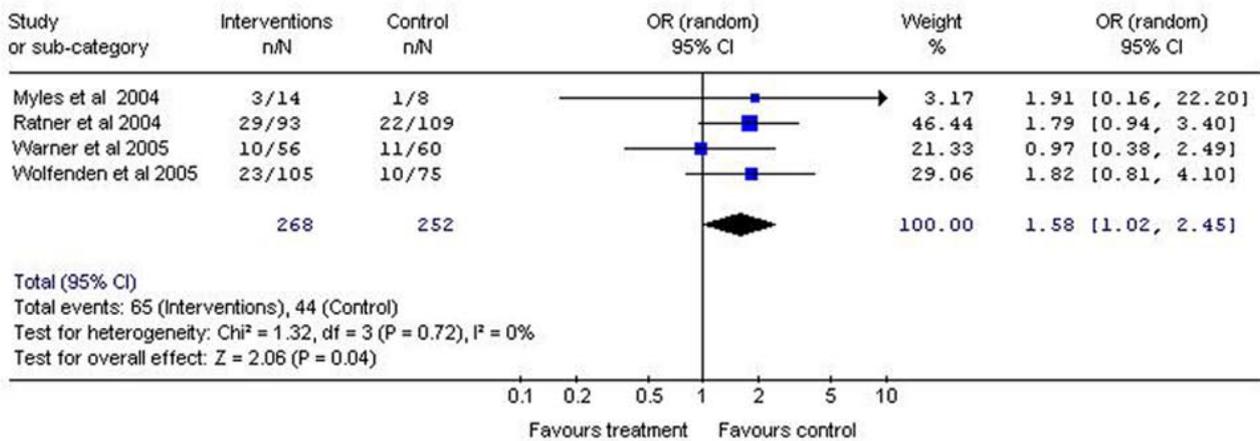


FIGURE 2 Meta-analysis of the results of included trials with three to six-month follow-up periods. The horizontal line with blue box shows the respective odds ratio (95% confidence interval) for individual studies and the dark diamonds represent the pooled odds ratio in each group of studies. The pooled odds ratio favours preoperative smoking-cessation interventions. The results are presented in the random-effects model. The sensitivity analysis using a fixed-effect model did not lead to significant change (odds ratio = 1.58, 95% confidence interval = 1.03–2.45).

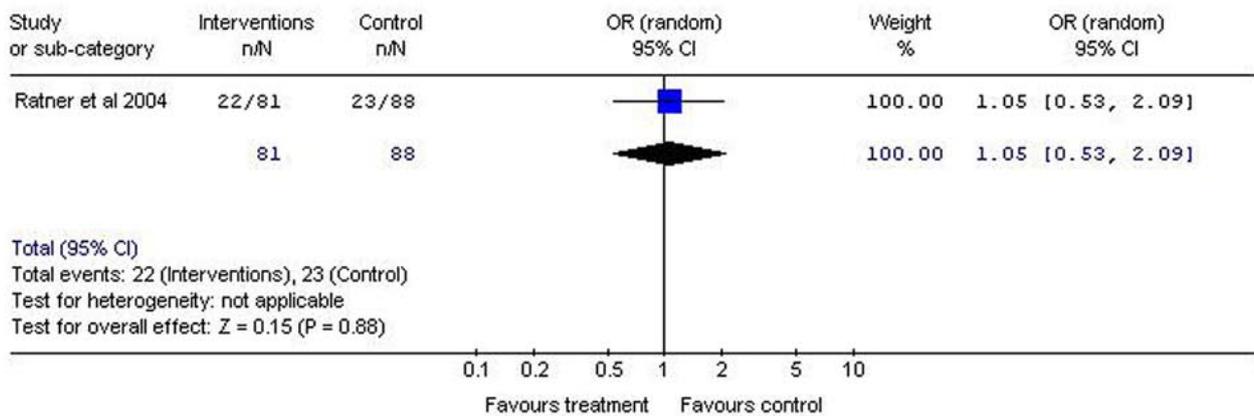


FIGURE 3 The results of the only trial with 12 month follow-up period. The horizontal line with blue box shows the respective odds ratio (95% confidence interval).

per day, the change in the smoker’s readiness for change, and the incidence of treatment-related complications (for pharmacotherapy interventions). In all trials, the self reports of smoking status were obtained from the patients through telephone calls at the time of follow-up.

Only Myles and Ratner used biochemical methods, i.e., measuring end-expiratory carbon monoxide (CO_E) or urinary nicotine metabolites, to verify

smoking status among the patients. Myles defined smoking cessation as no cigarette smoked for at least 28 days validated by CO_E ≤ 10 ppm using a Bedfont Micro Breathalyzer. Ratner, however, recorded the self reports after surgery, validated by the measurement of urinary cotinine (a metabolite of nicotine) with the Accutest NicoMeter cotinine test. All patients were mailed the NicoMeter test strips with instructions and asked to return them by mail to the research office.

Serum concentrations $> 100 \text{ mg}\cdot\text{mL}^{-1}$ were considered as evidence of recent smoking. The remaining three studies used patient self reports without verification to record smoking status.

In general, different outcome measures and various follow-up periods were used to evaluate the smoking behaviour in the included studies. In addition, in several trials the data for different follow-up periods were reported (e.g., three weeks, six weeks and six months). Besides the incidence of abstinence which was reported in all studies, the change in readiness to quit was evaluated in only one trial. The results of individual studies are presented in Table II.

Methodological quality of the studies

All RCTs described an adequate method of randomization (i.e., computer-generated or table of random numbers). Wolfenden randomly allocated patients into the treatment and control groups by using a 3:2 ratio, respectively. In other RCTs, allocation was equal between the two groups. Ratner, Warner and Wolfenden reported in their papers that treatment allocation was concealed. Myles did not provide this information in the paper. However, contacting the author revealed that an adequate method of allocation concealment was used. In all trials, collection and assessment of outcome data were done by research staff members who were blinded to the treatment allocation. Studies on pharmacotherapy interventions^{17,20} were reported as double-blind trials. The follow-up was not completed in any of the included studies; however, all trials reported the results based on intention-to-treat analysis considering patients lost during follow-up period as current smokers. The highest rate of dropout was reported by Myles as up to 42%; whereas the other three trials reported dropout rates between 14–15%. The reasons for dropouts were provided in details in all included studies.

Descriptive data and meta-analysis

The results of each trial including the rate of smoking cessation during the postoperative follow-up period (three weeks to 12 months) are presented in Table II. The quitting rates ranged between 18% to 31% in intervention groups and 12.5% to 20% in control groups. We pooled the results of the trials with similar long-term follow-up periods, i.e., three to six months (Figure 2). The results of the only study with longer follow-up (12 months) are presented separately (Figure 3). Overall, the interventions were associated with a higher cessation rate *vs* control in the follow-up period of three to six months (OR: 1.58, 95% CI: 1.02–2.45, P value = 0.04, $I^2 = 0\%$). Ratner showed that there was no signifi-

cant difference between the intervention (27.2%) and control groups (26.1%) in the percentage of participants who were abstinent at 12 months after surgery (OR: 1.05, 95% CI: 0.53–2.09, P value = 0.88).

Sensitivity analysis using a fixed-effects model did not change the pooled estimate of effects (OR: 1.58, 95% CI: 1.03–2.45, $P = 0.04$). In order to deal with missing data (patients whose data were not collected at follow-up), we excluded Myles' trials with a 40% dropout rate. The sensitivity analysis showed no significant change in the overall effect (OR: 1.57, 95% CI: 1.01–2.45, $P = 0.04$). Had we taken a more conservative approach and carried out a full intention-to-treat analysis where patients with missing data at follow-up were regarded as current smokers (worst-case scenario), the pooled estimate of the effects would have been in favour of interventions. However, it was not statistically significant (OR: 1.18, 95% CI: 0.76–1.83, $P = 0.45$).

The study's pre-specified factor for sub-group analysis was methodological quality. Since all included trials had the same quality (adequate randomization, concealment, blinding and follow-up), we were unable to proceed to subgroup analysis in the review. The funnel plot was not drawn due to the limited number of the trials (four RCTs); as both visual examination and statistical analysis of funnel plots have limited power to detect bias if the number of studies is small.¹²

Discussion

This systematic review examined the evidence including four RCTs ($n = 610$ patients) regarding the efficacy of interventions delivered in the preoperative clinic setting to promote long-term smoking cessation (i.e., at least three months) following surgery. The postoperative follow-up period ranged from three to 12 months amongst the included studies. The results of the meta-analysis suggest that preoperative smoking-cessation interventions can increase the chance (odds) of abstinence by almost 60% during three to six months after surgery. This equates to an absolute difference in the cessation rate of about 7%. The results of the meta-analysis were shown to be robust in different effect models (random *vs* fixed). No heterogeneity was found in any of the data analyses ($I^2 = 0\%$).

Out of the four trials included in this review, only Ratner *et al.*¹⁶ followed patients for up to one year, and that study failed to show the relative efficacy of the intervention in the study groups. They also provided the quitting rates at the six-month follow-up. The study included 237 patients, however; more than 30% of patients were lost to follow-up in each study group at the end of the observation period (12 months). In

addition, in this study the verification of self reports of abstinence could not be done in more than 50% of the patients who did not return the urine cotinine strips after one year. Due to these limitations, the study was unable to evaluate the efficacy of preoperative programs for smoking cessation at one year follow-up. Therefore, future trials of high methodological quality and low dropout rate that follow-up patients for at least 12 months after surgery are warranted.

In this quantitative systematic review, we chose to pool the data among the studies with similar follow-up periods (three to six months) for three reasons. Firstly, the primary objective of the study was to determine the efficacy of any type of smoking-cessation program that was initiated at the preoperative clinic to promote long-term abstinence. In other words, the primary focus of this study was the preoperative clinic (or period), itself, rather than types of provided interventions. Secondly, all the included trials used relatively similar interventions, i.e., behavioural approach plus pharmacotherapy. Thirdly, despite variability in the trials' interventions (brief *vs* more intensive counseling programs, or bupivacaine *vs* NRT) and follow-up periods (three *vs* six months), there was no between-study heterogeneity for the outcome of interest, i.e., long-term quitting rates in all the analyses ($I^2 = 0\%$).

The methodological quality of trials included in this review was judged as "fair", as all four reported adequate methods of randomization, treatment allocation, and outcome assessment. Although none of the RCTs could follow-up all the patients until the end of study, they all reported the number and reasons for dropouts and analyzed data using intention-to-treat analysis. However, the meta-analysis findings of this systematic review need to be interpreted carefully in light of the methodological limitations. Despite a comprehensive search for RCTs on preoperative smoking cessation programs with long-term follow-up (\geq three months), this review identified only four studies with average sample sizes of 150 patients. The results of each study showed that the absolute quitting rate was higher in the intervention group compared to controls, although in no trial was the difference statistically significant. This finding is inconsistent with the results of the meta-analysis showing that the pooled estimate of effect was in favour of the interventions ($P = 0.04$). This observation can pose the "small-study effect", i.e., the tendency for small trials to have inflated treatment effect estimates because of methodological differences (either design flaws or more rigorous implementation of treatment).²¹ None of the trials reported complete follow-up with the highest rate of dropout reported in Myles' study (42%).¹⁵ This

study showed that study compliance was higher in the active treatment group, indicating that dropout from the study generally followed an unsuccessful quitting attempt. However, this finding was not found in the other included trials where the drop-out rate ranged between 14–15%. In sensitivity analysis to investigate the effect of missing data, it was shown that deleting Myles' study did not change the overall effect; whereas, imputing missing values as continuing smokers (full intention-to-treat analysis) led to an insignificant pooled estimate of the effect. This finding can weaken the robustness of the results of our systematic review, as it can be changed based on our assumption regarding the patients with missing values. Finally, in this review, we were unable to assess publication bias, as both visual examination and statistical analysis of funnel plots have limited power to detect bias if the number of studies is small.¹⁰

When generalizing the findings of this study into clinical practice, several factors should be taken into consideration. Firstly, the control quitting rates in the included trials ranged from 12.5%–20% with a weighted average of 17.3%. This quitting rate among the control patients seen in the preoperative clinic appears to be higher than that observed in other systematic reviews. For example, Rigotti *et al.*,³ who reviewed interventions provided for hospitalized patients, reported a baseline quitting of about 10%. A similar rate was observed by Rice *et al.*² who evaluated nursing interventions for smoking cessation. The high quitting rates among the control groups in our review might reflect the fact that patients, scheduled for elective surgeries in preoperative clinics, are at a higher stage of readiness for smoking cessation (preparation or action stage).⁸ Secondly, the intervention in most trials included in this review was provided by research staff or trained nurses. The efficacy of such interventions in routine clinical practice, where they will be delivered by clinical staff, needs to be demonstrated. There is no current evidence supporting this point, suggesting that further studies are warranted to demonstrate the feasibility and efficacy of preoperative smoking-cessation interventions in routine practice.

Due to smoke-free policies in health care facilities, all smokers undergoing surgery are forced to be abstinent for at least some period of time. Smokers facing surgery are also more likely to be amenable to advice regarding smoking cessation.⁸ In recent years, there has been increased emphasis on the function of anesthesiologists as perioperative physicians.²² The scope of practice as perioperative physicians could include limited aspects of preventive medicine, in addition to extensive perioperative evaluation and preparation.

Rigotti *et al.* have shown that behavioural interventions that begin during a hospital stay, and include at least one month of supportive contact after discharge, can promote smoking cessation among hospitalized patients.³ On the other hand, Lancaster *et al.*¹ revealed that brief advice from physicians regarding smoking cessation can increase the odds of quitting. These findings, along with the results of our study, indicate a role for anesthesiologists to provide anti-smoking interventions to their patients. The short-term benefits of such programs could include lower rates of postoperative complications, and, in the long term, increased likelihood of permanent smoking cessation. These interventions might be more productive if the preoperative clinic were used as a teachable moment,⁷ and offered as part of an organized, multifaceted program, rather than as random advice offered at the discretion of the anesthesiologist.

In conclusion, the results of this study suggest that preoperative smoking interventions, including counseling and pharmacotherapy, can increase the chance of abstinence within three to six months following surgery. In light of these promising results, the efficacy of such interventions needs to be established by high quality RCTs with larger durations of follow-up, i.e., at least 12 months. If these results are to translate into public health benefits, the feasibility of a multifaceted program where anesthesiologists can play an important role to provide interventions in the preoperative phase needs to be studied.

References

- 1 Lancaster T, Stead L. Physician advice for smoking cessation. *Cochrane Database Syst Rev* 2004; CD000165.
- 2 Rice VH, Stead LF. Nursing interventions for smoking cessation. *Cochrane Database Syst Rev* 2001; CD001188.
- 3 Rigotti NA, Munafo MR, Murphy MF, Stead LF. Interventions for smoking cessation in hospitalized patients. *Cochrane Database Syst Rev* 2001; CD001837.
- 4 Warner DO. Tobacco dependence in surgical patients. *Curr Opin Anaesthesiol* 2007; 20: 279–83.
- 5 Warner DO. Perioperative abstinence from cigarettes: physiologic and clinical consequences. *Anesthesiology* 2006; 104: 356–67.
- 6 Lee A, Fleisher L. Is there an optimal timing for smoking cessation. *In: Fleisher L, Dripps RD (Eds). Evidence-Based Practice of Anesthesiology.* Saunders; 2004: 57–61.
- 7 McBride CM, Ostroff JS. Teachable moments for promoting smoking cessation: the context of cancer care and survivorship. *Cancer Control* 2003; 10: 325–33.
- 8 Emmons KM, Goldstein MG. Smokers who are hospitalized: a window of opportunity for cessation interventions. *Prev Med* 1992; 21: 262–9.
- 9 Moller A, Villebro N. Interventions for preoperative smoking cessation. *Cochrane Database Syst Rev* 2005; CD002294.
- 10 Higgins JPT, Green S. *Cochrane Handbook for Systematic Reviews of Interventions* 4.2.5 (updated May 2005), *In: The Cochrane Library.* Chichester, UK: John Wiley & Sons, Ltd.; 2005.
- 11 Tramer MR. *Evidence Based Resource in Anaesthesia and Analgesia*, 2nd ed. London: BMJ Books; 2003.
- 12 Sorensen LT, Karlsmark T, Gottrup F. Abstinence from smoking reduces incisional wound infection: a randomized controlled trial. *Ann Surg* 2003; 238: 1–5.
- 13 Moller AM, Villebro N, Pedersen T, Tonnesen H. Effect of preoperative smoking intervention on postoperative complications: a randomised clinical trial. *Lancet* 2002; 359: 114–7.
- 14 Rissel C, Salmon A, Hughes AM. Evaluation of a (pilot) stage-tailored brief smoking cessation intervention among hospital patients presenting to a hospital pre-admission clinic. *Aust. Health Rev* 2000; 23: 83–93.
- 15 Myles PS, Leslie K, Angliss M, Mezzavia P, Lee L. Effectiveness of bupropion as an aid to stopping smoking before elective surgery: a randomised controlled trial. *Anaesthesia* 2004; 59: 1053–8.
- 16 Ratner PA, Johnson JL, Richardson CG, *et al.* Efficacy of a smoking-cessation intervention for elective-surgical patients. *Res Nurs. Health* 2004; 27: 148–61.
- 17 Warner DO, Patten CA, Ames SC, Offord KP, Schroeder DR. Effect of nicotine replacement therapy on stress and smoking behavior in surgical patients. *Anesthesiology* 2005; 102: 1138–46.
- 18 Wolfenden L, Wiggers J, Knight J, *et al.* A programme for reducing smoking in pre-operative surgical patients: randomised controlled trial. *Anaesthesia* 2005; 60: 172–9.
- 19 Prochaska JO, Norcross JC. Stages of change. *Psychotherapy* 2001; 38: 443–8.
- 20 Myles PS. Cessation of smoking following tape suggestion under anaesthesia. *Anaesth. Intensive Care* 1992; 20: 540–1.
- 21 Kjaergard LL, Villumsen J, Gluud C. Reported methodologic quality and discrepancies between large and small randomized trials in meta-analyses. *Ann Intern Med* 2001; 135: 982–9.
- 22 Adebola O, Adesanya GP. Hospitalists and anesthesiologists as perioperative physicians: Are their roles complementary? *Proc (Bayl Univ Med Cent)* 2007; 20: 140–2.

APPENDIX Search strategies

<i>DATABASE</i>	<i>SEARCH STRATEGY</i>	<i>HITS</i>
The Cochrane Database of Systematic Reviews, Database of Abstracts of Reviews of Effects (DARE), The Cochrane Central Register of Controlled Trials (<i>CENTRAL</i>)-The Cochrane Library (Issue 3, 2007)	1 smoking adj3cessation	129
	2 smoking adj3 intervention	
	3 exp "tobacco use cessation"	
	4 exp "smoking cessation"	
	5 1 OR 2 OR 3 OR 4	
	6 (surgery or surgeries or surgical or operation or operative or anesthesia)	
	7 exp "surgery"	
	8 exp "surgical procedures, operative"	
	9 6 OR 7 OR 8	
	10 5 AND 9	
Ovid MEDLINE (January 1950 to September Week 3 2007)	1 smoking adj3cessation	778
	2 smoking adj3 intervention	
	3 exp "tobacco use cessation"	
	4 exp "smoking cessation"	
	5 1 OR 2 OR 3 OR 4	
	6 (surgery or surgeries or surgical or operation or operative or anesthesia)	
	7 exp "surgery"	
	8 exp "surgical procedures, operative"	
	9 6 OR 7 OR 8	
	10 5 AND 9	
EMBASE (January 1974 to September Week 3 2007)	1 smoking adj3cessation	1583
	2 smoking adj3 intervention	
	3 exp "tobacco use cessation"	
	4 exp "smoking cessation"	
	5 1 OR 2 OR 3 OR 4	
	6 (surgery or surgeries or surgical or operation or operative or anesthesia)	
	7 exp "surgery"	
	8 exp "surgical procedures, operative"	
	9 6 OR 7 OR 8	
	10 5 AND 9	
Cumulative Index to Nursing & Allied Health Literature-CINAHL (January 1982 to September Week 3 2007)	1 smoking adj3cessation	224
	2 smoking adj3 intervention	
	3 exp "tobacco use cessation"	
	4 exp "smoking cessation"	
	5 1 OR 2 OR 3 OR 4	
	6 (surgery or surgeries or surgical or operation or operative or anesthesia)	
	7 exp "surgery"	
	8 exp "surgical procedures, operative"	
	9 6 OR 7 OR 8	
	10 5 AND 9	