

# Postoperative impact of regular tobacco use, smoking or snuffing, a prospective multi-center study

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**Background:** The aim was to study the effects of different tobacco administration routes on pain and post-operative nausea and vomiting (PONV), following three common day surgical procedures: cosmetic breast augmentation (CBA), inguinal hernia repair (IHR) and arthroscopic procedures (AS). We have prospectively investigated the effects of regular tobacco use in ambulatory surgery.

**Methods:** The 355 allocated patients were followed during recovery and the first day at home.

**Results:** Thirty-two percent of the patients used tobacco regularly, 33% of CBA, 27% of IHR and 34% of AS. Pain was well controlled in the post-anesthesia care unit at rest; during ambulation, 37% of all patients reported VAS > 3. Tobacco use had no impact on early post-operative pain. Post-operative nausea was experienced by 30% of patients during recovery while in hospital. On day 1, 14% experienced nausea. We found a significant reduction of PONV

among tobacco users (smoking and/or snuffing). Smoking or snuffing reduced the risk of PONV by nearly 50% in both genders on the day of surgery and at the first day at home. The reduction of PONV was equal, regardless of tobacco administration routes.

**Conclusion:** We found that regular use of tobacco, both by smoking and snuffing, had a significant effect on PONV during the early post-operative period. Non-tobacco users undergoing breast surgery were found to have the highest risk for PONV. We could not see any influence of nicotine use on post-operative pain. Thus, it seems of value to identify regular tobacco use, not only smoking, as a part of the pre-operative risk assessment.

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THE number of procedures in day surgery is increasing. Most day surgical procedures are not life saving or aimed at prolongation of life but rather performed to improve quality of life. Day case surgery has been shown to be reassuringly safe.<sup>1,2</sup> It is, however, of importance that procedures in conjunction with surgery and anesthesia are performed in accordance with evidence-based practice and with an acceptable standard of care, providing adequate patient satisfaction and safety. Evaluation of all aspects of quality, not only in-hospital but also after discharge, is of importance from the patients' perspective.<sup>3</sup> Pain and post-operative nausea and vomiting (PONV) are the most common symptoms causing patient discomfort during the early stage after ambulatory surgery.<sup>4</sup> Scores for prediction of the risk of PONV have become increasingly accepted and, as stated

by Apfel,<sup>5</sup> the use of risk score is mandatory in PONV research. These scores only include smoking habits, however, and do not address other forms of nicotine use besides smoking. It is still not known why smoking reduces PONV, whether it is an effect of nicotine per se or caused by other inhaled substances associated with smoking. As snuffing and other means of nicotine administration such as gums or nicotine patches are commonly used, the effects of such smoke-free nicotine administration is of interest to investigate the effects of smoke-free tobacco use on PONV.<sup>6</sup> There are also studies suggesting an interaction between nicotine use and post-operative pain.<sup>7</sup> Tobacco habits are, however, not at all included in the prediction score for post-operative pain suggested by Janssen et al.<sup>8</sup>

The aim of the present survey was to evaluate the impact of pre-operative tobacco habits, not just

smoking, but also snuffing, on the influence on PONV and post-operative pain during the early post-operative course. We evaluated three common elective day surgical procedures: cosmetic breast augmentation (CBA), inguinal hernia repair (IHR) and arthroscopic procedures (AS).

## Methods

This is a prospective multi-center repeated questionnaire follow-up study of patients scheduled for one of three different elective surgical procedures: CBA, IHR and AS, all performed as ambulatory surgery.

Consecutive patients over 18 years, understanding the Swedish language, were informed about the study and invited to participate. The data collection period was from autumn 2006 and until spring 2008. A dedicated nurse at each hospital informed the patients about the study, and signed informed consent was required before inclusion. The questionnaires used in this study had earlier been tested in a pilot study from which the final version was created (Appendix S1). The same nurse, who included the patients distributed the questionnaires. The questionnaire included questions about background demographic variables and pre-operative nicotine habits.

Trained nurses registered parameters such as pain, PONV and possible side effects in the recovery room and at the time of discharge. At discharge, the patients received a questionnaire to be answered on the first day after surgery. This questionnaire included questions regarding variables such as nausea, vomiting and pain and was to be returned in a prepaid envelope. The questionnaire had possibilities for comments and two reminders were sent to the patients if necessary.

The major anesthetic technique used was general inhalation anesthesia with a laryngeal mask. In the IHR patients 14 out of 107 received spinal analgesia and one patient received a wound local anesthetic infiltration. Eight of the AS patients received spinal or local anesthesia (Table 1).

Prophylactics for PONV were only given to patients with a history of nausea after previous surgery, following clinical routines. These patients were treated with oral or parenteral meklozin, metoklopramide or a 5HT<sub>3</sub>-blocker. Prophylactic corticosteroids were not used.

Preemptive pain treatment started pre-operatively with paracetamol (acetaminophen) and

NSAID (diclofenac) to all patients without contraindications for NSAIDs.

Post-operative pain management was based on a multi-modal analgesic approach. All patients received local anesthesia in conjunction to surgery; Local infiltration for CBA was performed with bupivacaine–adrenalin 5 mg/ml+5 µg/ml given bilaterally (10+10 ml) in the surgical field. For IHR, bupivacaine 2.5 mg/ml (20 ml) was injected into the incisional area and close to the ileoinguinal nerve at the end of surgery. For AS, Prilocaine was infiltrated around ports before start of surgery. At the end of surgery, ropivacaine 10 mg/ml (9 ml)+morphine 0.4 mg/ml (10 ml) was injected into the joint. After more extensive arthroscopic surgery, the patients also received ketorolac (30 mg) into the joint space and/or a pre-operative interscalene block. All patients had paracetamol, NSAID and weak opioid as base post-operative analgesics, while still in hospital, and small doses of intravenous opioid were provided if VAS>4.

This study was evaluated by the regional ethics committee (Dnr: 473-6) and was considered as being a non-interventional study. Thus, no evaluation was required. All procedures were conducted according to the declaration of Helsinki.

## Statistics

Standard descriptive statistics were used for demographic data. To test the impact of pre-operative nicotine use on post-operative outcome, Fisher's exact test was performed. Differences with a *P* value <0.05 were considered significant. Values are presented as means and standard deviation unless other stated. For all data analysis, the Statistical Package for the Social Sciences (SPSS) version 15.0 was used.

## Results

Demographics and surgical procedures are presented in Table 1. General anesthesia was used for 94%; local infiltration or spinal anesthesia was used in the remaining 6% of patients. A flow chart describing the patients included and questionnaire response rates at different time points is presented in Fig. 1. The response rate was 100% preoperatively, and at the post-anesthesia care unit (PACU) 97% and 83% day 1 after surgery. A failed response was most common among the AS patients; in all, 43 arthroscopy patients did not respond on day 1.

Table 1

Patient's demographics and characteristics for surgery and anaesthesia.

	CBA (n = 126)	IHR (n = 107)	AS (n = 122)
Age (year mean)	27	62.6	41.6
Gender (male/female, %)	0/100	82/18	52/48
Type of surgical procedure (n)			
CBA	126		
IHR		107	
Open		85	
Laparoscopic		21	
AS			122
Knee			93
Shoulder			28
Elbow			1
Anaesthetic technique			
GA, laryngeal mask	126	71	113
GA, intubation		16	1
Spinal analgesia		14	1
Wound infiltration		1	7
Duration of surgery, mean, min (range min)	53 (25–115)	76 (21–202)	50 (9–172)
ASA I, n	114	58	91
ASA II, n	4	42	21
ASA III, n		5	4
ASA IV, n			6
Missing, n	8	2	

GA, general anaesthesia; ASA, American Society for Anesthesiology; CBA, cosmetic breast augmentation; IHR, inguinal hernia repair; AS, arthroscopy procedures.

Thirty-two percent of the patients used tobacco regularly, 41 of 126 CBA (10 snuffers), 29 of 107 IHR, (17 snuffers) and 42 of 122 AS, (23 snuffers). Snuffing was more common among arthroscopy and hernia repair patients, due to the higher proportion of males undergoing these procedures. Females using tobacco were predominantly smokers (75%), while males using tobacco were predominantly snuffers (58% snuffers). In all, 45% of the tobacco users were mainly using snuff. Four patients responded as both snuffing and smoking (Tables 2a and b).

Post-operative nausea was experienced by 30% of patients during recovery while still in hospital. PONV was most frequently seen in patients undergoing breast surgery, where 59% complained about nausea and 29% vomited. Nausea was less frequent after IHR and AS (10% and 17%, respectively, complained about nausea). Day 1 after surgery, 40 out of the 293 responding patients complained about nausea, and 17%, 8% and 16% of breast augmentation, hernia repair and arthroscopy patients, respectively.

Tobacco use was found to significantly reduce the occurrence of PON during the stay in hospital

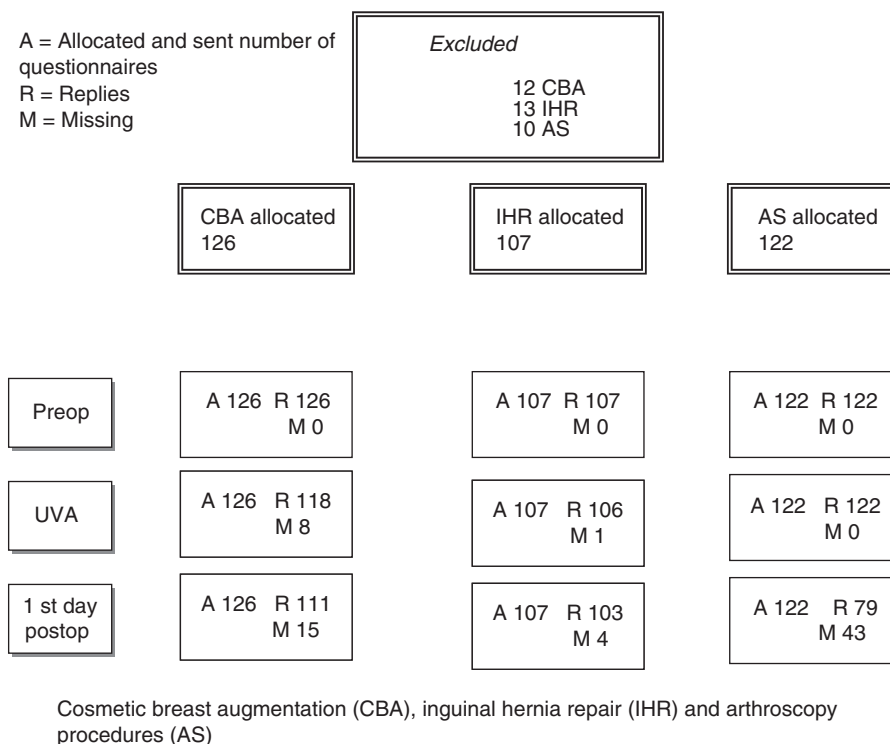


Fig. 1. Flow chart describing the patients included and reply rates at different times points. From start 138 CBA, 128 IHR and 132 AS were asked to participate. CBA, cosmetic breast augmentation; IHR, inguinal hernia repair and AS, arthroscopy procedures.

Table 2a

Pre-operative smoking habits for different surgery, numbers and %.

	CBA (n = 126)	IHR (n = 107)	AS (n = 122)	% of all
Smokers	32	16	22	20
Snuffers	10	17	23	14
Smokers or snuffers = Nicotine- use. (n = 112)	41	29	42	32
Non-nicotine users (n = 243)	85	78	80	68

CBA, cosmetic breast augmentation; IHR, inguinal hernia repair; AS, arthroscopy procedures.

Table 2b

Pre-operative smoking habits by gender, numbers and % of all patients studied.

	Smokers	Snuffers	Nicotine-use % of all
Females	45	15	17
Males	25	35	17

(21% vs. 34% for non-tobacco users;  $P < 0.05$ ), with approximately equal effects on PON of both snuffing (20% PONV) and smoking (21% PONV). However, in these rather small sub-groups of tobacco users, the reduction in vomiting did not reach statistical significance. In all patients, 11% of tobacco users and 16% of non-tobacco users vomited on one or more occasions. Regular tobacco use, age and sex correlated with nausea in the PACU ( $P < 0.01$ ,  $P < 0.05$  and  $P < 0.05$ , respectively) are represented in Table 3 and Fig. 2.

Pain was well controlled in the PACU at rest but 37% of the patients had a VAS score above 3 during ambulation, distributed as 65%, 37% and 10% for the CBA, IHR and AS groups, respectively. Pain at ambulation was most common among the breast augmentation patients (77 out of 118). Thirty-seven out of 99 IHR patients and 12 of the 122 patients who had undergone AS had a VAS > 3 during ambulation in the PACU. Day 1 after surgery, 67% of patients reported pain in the post-operative questionnaire, and 72%, 63% and 66% for the breast, hernia and arthroscopy patients, respectively. We found no significant impact of regular tobacco use on the incidence of post-operative pain (Table 4).

Table 3

Nausea in PACU and day 1 after different surgical procedures in nicotine and non-nicotine users.

	Nausea PACU		Day 1	
	Nicotine	No nicotine	Nicotine	No nicotine
CBA	17/41 (41%)	53/78 (68%)	3/41 (7%)	16/85 (19%)
IHR	2/29 (7%)	7/70 (10%)	1/29 (3%)	7/77 (9%)
AS	3/42 (7%)	18/80 (23%)	3/21 (14%)	10/59 (17%)
All	22/112 (20%)	78/228 (34%)	7/91 (8%)	33/221 (16%)

Numbers of patients and (%).

CBA, cosmetic breast augmentation; IHR, inguinal hernia repair; AS, arthroscopy procedures; PACU, post-anaesthetic care unit.

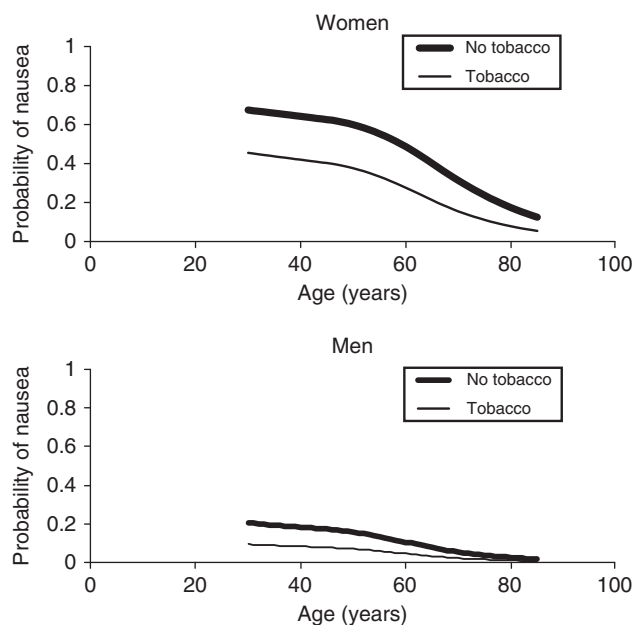


Fig. 2. Probability of nausea at recovery for men/women, age and tobacco use or not.

Table 4

Pain at PACU and day 1.

Pain PACU	Day 1	
	Nicotine	No nicotine
CBA	20/41 (49%)	57/85 (67%)
IHR	13/29 (45%)	24/77 (31%)
AS	5/42 (12%)	7/80 (9%)
All	38/112 (27%)	88/242 (44%)

VAS > 3 during ambulation in the PACU Numbers of patients and (%).

CBA, cosmetic breast augmentation; IHR, inguinal hernia repair; AS, arthroscopy procedures; PACU, post-anaesthetic care unit.

## Discussion

In this cohort of elective day case surgical patients, we found that every third (32%) patient was a

regular tobacco user, and that snuffing was almost as common as smoking. Regular tobacco usage from smoking or snuffing was found to have an impact, reducing post-operative nausea, but with no significant effect on post-operative pain.

Snuff (snus) is a powder tobacco product that is consumed by placing it under the lip. Snuff is not common in many European countries but is frequently used in Sweden and Norway. Its use may still become increasingly common due to the lower health risks associated with its use as compared with smoking.<sup>9</sup> We could only identify regular tobacco use; any exact amount of tobacco, number of daily cigarettes or number of snuffs was not included in the questionnaire. Smoking cessation recommendations have become increasingly popular before surgery; we, however, did not provide any explicit restrictions on smoking or snuffing.<sup>10</sup> Furthermore, we did not unfortunately include any question about tobacco used in close conjunction to surgery.

Snuffing is common among males in Sweden, and in 50- and 60-year-old males, snuffing has been shown to be as common as smoking,<sup>11,12</sup> which was also confirmed in the present study. Although snuffing is as common as smoking among men, snuffing is far less common among females, in whom, however, about 20% are regular smokers.

We studied three common but different day case procedures. In the present survey, two typical day surgical procedures paid by the social health care system and one entirely cosmetic and paid by the patients themselves were followed during the early post-operative phase. IHR is indicated for pain but also in order to avoid the low risk for incarceration and bowel obstruction. The typical patient is a male over 60 years shown in the present study to have a 27% probability of regular tobacco use, either by smoking or snuffing. The arthroscopy group was evenly distributed among the sexes and with a mean age of 42 years and snuffing or smoking was seen in every third patient. Breast augmentation is an entirely cosmetic procedure performed only in healthy young females, and in this study with a mean age of 27 years. Also in this group, one-third of the patients in our study were regular tobacco users, and thus higher than national average number of regular tobacco users among females.

Pain, PONV and fatigue are frequent complaints after discharge. Although much effort have been devoted to the management of perioperative PONV, it is, however, still common. Identifying pre-operative patient-related factors predicting the occurrence of pain and/or PONV is of importance in

order to better provide adequate care. We investigated a number of variables in order to evaluate their impact on post-operative pain and PONV. PONV was most frequent following breast surgery. Previous studies have shown that breast surgery is associated with a high risk for PONV.<sup>13</sup> The impact of smoking habits on the occurrence on PONV has been previously well recognized and smoking is included in the PONV scoring by both Apfel and Sinclair.<sup>14,15</sup> We found that the regular use of snuff seems to have the same 'prophylactic' effect in reducing early PONV. Our results show that the impact of tobacco diminishes with age, but this could perhaps be explained by an age-related decrease in PONV, making the effect of tobacco effects less important. Age is not a main factor in the Apfel PONV score. The impact of increasing age is, however, addressed among the Sinclair risk factors.<sup>14,15</sup> Both scores include an increased risk for PONV in females, also confirmed in the present study.

The mechanism behind the anti-emetic effect of smoking is not known. It is not well known whether it is the nicotine or some other substance in the smoke that induces the anti-emetic effects.<sup>16</sup> In an attempt to address the effect of the smoke-associated carbon monoxide component, the effect of inhalation of low concentrations of carbon monoxide (CO) on PONV was recently studied by Whalen et al.<sup>17</sup> These authors were not able to demonstrate any post-operative anti-emetic effect of CO, however. We were able to confirm the previously described decrease of the incidence of PONV in smokers, and we observed a similar effect from regular snuffing. This observation may indicate some substance in tobacco administrated also by the non-inhaled route as being responsible for the previously described decrease in PONV among smokers, reducing the likelihood of CO or other inhaled substances as being responsible for PONV reduction. This finding confirms studies supporting anti-emetic effects from nicotine patches in non-smokers.<sup>6</sup> The classical scores by Apfel and Sinclair include smoking as a PONV risk-reducing factor.<sup>14,15</sup> Our results support snuffing as having a similar effect on PONV risk reduction, leading to the conclusion that any means of chronic tobacco use should be included in these scores, not only smoking. The effect of tobacco was significant early after surgery but, although still numerically present, no longer significant day 1 after surgery, supporting studies by White et al.,<sup>18</sup> who suggest a lower impact of pre-operative risk factors on the occurrence of PONV after discharge.

Pain at rest was well managed during the early post-operative period while the patients were still in hospital. At ambulation, pain was, however, frequently reported during the stay in PACU and also during the first post-operative day at home. Nicotine has been suggested to have analgesic effects and previous studies have shown nicotine patches to reduce post-operative pain.<sup>7</sup> In the present study, we were not able to demonstrate any impact from smoking or snuffing on the incidence of post-operative pain. Thus, it seems unlikely that the effect seen from tobacco use in reducing the occurrence on emesis is related primarily to reduction in pain and the need for opioid analgesics.

There are of course several limitations in the present questionnaire-based survey. One must acknowledge that the present study is not a randomized intervention but an observational questionnaire study. All responses were only graded as yes or no; no amounts or VAS gradings were requested in the questionnaire. The number of patients included with regular tobacco use was not sufficient for further sub-group analysis and we cannot make any comments as to the potential effect of the amount of tobacco use or the duration of effect, time laps between the last tobacco dose and an anti-emetic effect. All therapy while in hospital was based on the routine of the department at the discretion of the attending anesthetists. Thus, we were not able to perform any analysis of the impact of the rather variable individual patient therapy. The observed reduction of PONV in snuffers needs to be addressed in further studies, analyzing the anti-emetic effects of non-inhaled tobacco use.

In conclusion, PONV varied sixfold between the procedures studied; it was common on both the day of surgery and on the first post-operative day following breast augmentation surgery under general anesthesia. Not only smoking but also snuffing seems to reduce the risk of post-operative PONV. Tobacco had no influence on pain after surgery. Our results suggest a change in the pre-operative PONV assessment, which should include other means of tobacco use in addition to smoking. Further studies are needed to confirm whether all regular uses of tobacco such as smoking, snuffing, intranasal nicotine use or patches have similar effects on PONV.

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## Supporting Information

Additional supporting information may be found in the online version of this article:

**Appendix S1.** Questions regarding your health to be answered before your operation.

**Appendix S2.** Please reply to these questions the first day at home after your surgery procedure.

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