

A Prospective Study Of Perioperative Pulmonary Complications In Cigarette Smokers Undergoing Major Surgery Under General Anaesthesia.

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Abstract: Tobacco smoking has always been recognised as an important risk factor for perioperative complications. Despite large scale efforts to create awareness about the hazards of tobacco smoking, this habit has greatly increased in recent times. As an anaesthesiologist we encounter smokers frequently in our day to day practice. Many of them do report their smoking status themselves; while a large majority denies this habit and many a times an anaesthesia resident is taken by surprise when complications do arise during the procedure.

Perioperative complications in smokers have been described and studied by many people. It has been found that frequency and severity of different specific respiratory events are higher in smokers compared to non smokers. These specific respiratory events include laryngospasm, bronchospasm, aspiration, hypoventilation, hypoxemia, reintubation after planned extubation, and pulmonary edema. Risk of wound infections, marked hemodynamic changes following tracheal intubation also add to the perioperative morbidity of smokers.(1)

Keywords: laryngospasm, bronchospasm, aspiration, hypoventilation, hypoxemia, reintubation, pulmonary edema, smoking, anesthetic complications.

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I. Introduction:

The respiratory effects of smoking are diverse. An increase in postoperative respiratory morbidity (PORM) was demonstrated by Morton, in 1944.(9) who showed that patients who smoked more than 10 cigarettes/day had a six fold increase in postoperative chest complications. Other studies have confirmed these findings, although the magnitude of increased risk varies according to the definition of PORM.

Postoperative respiratory morbidity was subdivided into three categories on the criteria of 1) Altered sputum volume and purulence (bronchitis),

2) chest x-ray changes (collapse), or

3) both (pneumonia).

The type of PORM with the most marked difference between smokers and nonsmokers was "bronchitis" and the three patients who developed severe postoperative "bronchitis" after minor surgery were all heavy smokers (> 20 cigarettes per day). There was no difference in PORM rate overall between light (<20 cigarettes/day) and heavy smokers. Prospective studies with 111 patients classified as light (1-9), moderate (10-19), heavy (20-29), and very heavy (>30 cigarettes/day) smokers. PORM rates were 9%, 23%, 29%, and 43%, respectively, whereas the rate was 7.9% in nonsmokers. There are three major mechanisms by which smoking may increase PORM-mucus hypersecretion, impairment of tracheobronchial clearance, and small airway narrowing. (14)(15)(16)

II. Aims And Objective

To study the nature and incidence of perioperative pulmonary complications in cigarette smokers undergoing major surgery under general anaesthesia and compare it with that in non-smokers.

III. Material And Method

Ethical clearance was obtained from ethical committee and informed consent was obtained from each patient.

Study design

This was a prospective comparative study.

Subject and data collection

Fifty consecutive patients who satisfied the inclusion criteria were selected for smokers group of the study.

Inclusion criteria

1. Patients who gave assent to informed consent and were ready to be part of study willingly
2. ASA 1 & ASA II Grade patients.
3. Patients who were habitual smokers and are still smoking.

Exclusion criteria

1. Patients not giving consent.
2. ASA status 3 and above who were diseased.
3. Acute emergency surgeries when pre operative evaluation not possible
4. Patients less than 18 years and more than 60 yrs of age.
5. Patients with history of atopy and hypersensitivity.
6. Patients with history of adverse events during previous exposure to general anaesthesia.

Control group

Fifty non smokers aged above 18 years of ASA 1 and 2 physical status presenting for major elective surgery. Many similar studies included all current smokers in their study. Our reference study regarding the risk of pulmonary complications in smokers by Paul S. Myles et al (11) included patients smoking more than ten cigarettes per day for more than 10 years. So we also followed the same inclusion criteria.

Pre anaesthetic check up:

General examination and routine investigations were done.

Patients were not advised to stop smoking at any time prior to surgery.

The day before surgery all the patients were instructed to keep fasting for at least 6 hrs.

Premedication :

All the patients will be pre medicated with oral diazepam 0.1 mg/ kg body weight on the night before surgery and tab. rantidine 3 mg/ kg bw on the night before and on the morning of day of surgery.

Preparation :

In the operating room, patients were connected to monitors including, ECG with heart rate, non invasive blood pressure and pulse oximeter. Baseline values of heart rate, blood pressure and arterial oxygen saturation were recorded. Intravenous access was established.

Induction :

All the patients were pre oxygenated with 100% oxygen for 3 minutes with tidal volume breaths. Before induction everyone were given injection of glycopyrolate 0.004 mg / kg I.V. and Inj. Ondansetron 0.08 mg/kg bw I.V. followed by Inj. Fentanyl (2 µg/kg). General anaesthesia was induced with inj propofol 2 mg/ kg. Inj succinylcholine 1.5 mg / BW. was then given . Orotracheal intubation was done gently and IPPV was commenced.

Maintenance:

Both the groups were maintained on inhalational agents (O₂ 33% & N₂O 66 % with sevoflurane (0.2 – 1.8%) with non depolarizing muscle relaxant inj vecuronium bromide (loading 0.1 mg/kg and maintenance 0.02 mg/kg bw).

Fluid management:

All the patients were given intravenous fluid judiciously. Fluid of choice was ringer lactate or normal saline. Colloid and / or Whole blood was given as if required.

Reversal :

At the end of the surgical procedure, all the patients were reversed with 50 µg/kg Neostigmine and 10 µg/kg glycopyrolate I.V. Patients were extubated following standard protocols.

Monitoring :

Both the groups were monitored carefully. SpO₂, incidences of laryngospasm, bronchospasm, secretions, use of bronchodilator, coughing, pulmonary edema and reintubation if any were watched carefully till patient is recovered

Observation :

Data was collected every 5 minutes and analysed according to appendix I & II.

Statistical Methods:

Chi-square test was used to test the significance of events that occurred during the surgery. The resultant were considered significant if $p < 0.05$.

Assessments:

1) Arterial oxygen desaturation.

This condition was recorded if pulse oximeter showed SpO₂ value less than 92% for more than 1 minute, either during induction or maintenance or recovery from anaesthesia.

2) Laryngospasm

The incidence of audible stridor or airway obstruction, not relieved by airway manipulations by anesthesiologist.

3) Bronchospasm

Audible wheezing or unexplained increase in airway pressure.

4) Increased oral secretions: classified as

Grades: 1. Wet (dry by one suction)

2. Moderate (2-3 suction)

3. Copious (more than 3 times)

4. Thick (Thready secretions)

5) Severe coughing.

More than 2 paroxysms or coughing for more than 5 seconds.

6) Re intubation after planned extubation.

7) Requirement of opioid antagonists (Naloxone) in the post anaesthesia care unit.

8) Incidence of pulmonary oedema.

Statistical Methods:

Chi-square test was used to test the significance of symptoms, desaturation and Oral secretions between Smokers and nonsmokers.

Chi-Square Test

$$\chi^2 = \sum \frac{(O - E)^2}{E}$$

O = the frequencies observed

E = the frequencies expected

\sum = the 'sum of'

IV. Result:

Study design: A Comparative study consisting of 50 smokers and 50 non-smokers undertaken to compare the pulmonary complications in the peri operative period between the two groups.

Table 1: Age distribution

age in yrs	smokers		non smokers	
	No	percentage	No	percentage
≤20	4	8	2	4
21 -30	7	14	8	16
31 -40	13	26	9	18
41 -50	12	24	14	28
51 -60	14	28	17	34
total	50	100	50	100
mean ±SD	43.1 ±12.58		40.33 ±12.51	
p value is > 0.05, hence age is comparable.				

Table 2: Sex distribution

sex	non smokers n=50		smokers n=50	
	no	percentage	no	percentage
male	27	54	38	76
female	23	46	12	24
total	50	100	50	100

Table 3: ASA Grading

ASA Grade	non smokers n=50		smokers n=50	
	no	percentage	no	percentage
I	27	54	26	52
II	23	46	24	48
Total	50	100	50	100

Table 4: Comparison of procedures

Procedures	non smokers		smokers	
	no	percentage	no	percentage
Laposcopic cholecystectomy	28	56	26	52
Exploratory laprotomy	10	20	12	24
Total abdominal hystrectomy	8	16	7	14
Liver and biliary tract surgery	4	8	5	10
Total	50		50	

Table 5: No of cigarettes per day

no of cigarets per day	non smokers		smokers	
	no	percentage	no	percentage
nil	50	100	nil	
≤10	nil	-	21	42
11-20	nil	-	27	54
21-30	nil	-	2	4
≥31	nil	-	nil	-
total	50	100	50	100

Table 6: Peri operative complications

perioperative complications	non smokers		smokers		p value
	no	percentage	no	percentage	
oxygen desaturation	1	2	7	14	0.0271*
laryngospasm	0	0	0	0	–
bronchospasm	2	4	4	8	0.401
secretion	3	6	12	24	0.012*
coughing	2	4	5	10	0.238
pul edema	0	0	0	0	–
reintubation	0	0	0	0	–
use of opioid antagonist	0	0	0	0	–
total	8	16	28	56	<<0.05
inference	Peri-operative events are 6.781 times significantly more in Smokers groups when compared to nonsmokers with $X^2 = 17.361$, $P < 0.001$				

* Significant at 5% .

Table 7: No of smokers / non smokers who have peri operative pulmonary complications

non smoker		smokers	
no	percentage	no	percentage
8	16	28	56

Table 8: Oral secretions at recovery

oral secretions	non smokers		smokers		p value
	no	percentage	no	percentage	
grade I	26	52	15	30	0.025*
grade II	20	40	23	46	0.542
grade III	3	6	10	20	0.037*
grade IV	1	2	2	4	0.555
* Significant as $p < 0.05$					

We studied 50 smokers and 50 non-smokers who were eligible and willing to be included in our study. Samples were age matched with $p < 0.05$.

In smokers group, most of the patients belonged to 31-40 years of age. In non-smokers, majority of the patients were younger between 41 - 60 years of age. Mean value of age was 43.10 ± 12.58 in smokers and 40.33 ± 12.51 in non smokers which is statistically matching. Since smoking habit among females is still not very much common in our part of the country, most of the smokers were males (76 %). In non smokers 46% of the patients were females as compared to 24% among smokers.

ASA grade was statistically similar between smokers and no smokers with p value > 0.05 . But 46% of the smokers were ASA II patients when compared to 48% in non smokers. Chronic smoking with its associated complications would have increased the risk in these patients. Regarding type of procedures in each patient; surgeries on upper abdomen were very well matched in both the groups.

When individual peri-operative events were compared, oxygen desaturation was found be significantly high in the smoker group with p value 0.0271.

Incidence of laryngospasm and bronchospasm were also more in smokers group but the values were found statistically not insignificant. Bronchospasm occurred in 2 of non smokers. None of our patient in either of the groups had laryngospasm. Incidence of oral secretion during recovery were seperately analysed in 4 grades.

There was no incidence of the re-intubation after planned extubation or naloxone use in the recovery or pulmonary edema in both the groups.

When total adverse pulmonary events in the peri operative period were considered it was found that such events were 6.78 times more significant in smokers when compared to non smokers, with p value < 0.001 .

V. Discussion:

A study conducted by Tait AR et al in 1991 (4) found that severity post operative oxygen desaturation was significantly greater in smoking group. Overall incidence of hypoxemia was 68.4% in smokers and 58.3% in non smokers.

In our study we recorded 14% of incidence of desaturation in smokers when compared to 2% in non smokers. Incidence of desaturation was significantly less in both groups when compared to the study by Tait et al. But still smokers had higher incidence of desaturation.

In a study conducted by Dennis A et al 1994 (2) regarding effects of passive and active smoking on induction of anaesthesia they have considered the parameters like desaturation, coughing, breath holding and laryngospasm as adverse events during induction. There were 3 groups-active smokers ($n=57$), passive smokers ($n=21$), and true non smokers ($n=42$). Sample size was comparable with present study. They found that active smokers had 43.8% incidence of adverse effects when compared to 19.4% in non smokers. In the present study when we compared the incidence of 3 of the above 4 adverse events. We found that incidence was 56% in smokers when compared to 16% in non smoker.

In a large scale study conducted by Schwilk et al in 1997 (3) the incidence of specific peri operative respiratory events in smokers was 5.5% when compared to 3.1% in non smokers. The relative risk of specific respiratory events was 1.8 in all smokers and 6.3 in obese young smokers. The specific respiratory events included reintubation, laryngospasm, bronchospasm, aspiration, hypoxemia, hypo ventilation and pulmonary edema and others. Most frequent respiratory events in this study were bronchospasm, laryngospasm and coughing. The incidence of adverse events was 27.5% in non smokers when compared to 38.6 % in smokers, which is almost 1.4 times more than our reference study by Myels Paul et al 2002 (1) . In this study also smokers exhibited 3.2 times more incidences of bronchospasm, coughing and hypoxemia.

Wound infection was another parameter considered in that study which did not come into our consideration due to technical reasons. References of end points of all observation for our study were taken from that our reference study; like arterial oxygen desaturation, severe coughing, laryngospasm, bronchospasm etc. The table below is a comparison of events in that particular study with present study.

Table 9

peri operative complication	reference study			present study		
	non smokers	smokers	p value	non smokers	smokers	p value
arterial desturation	12.60%	9.40%	0.49	2%	14%	0.027
laryngospasm or bronchospasm	4%	9.40%	0.051	4%	8%	0.4
coughing	10.90%	19.80%	0.048	4%	10%	0.238
total	27.50%	38.60%		10%	32%	

The main difference in the results is that smokers did not show any increased incidence of arterial oxygen desaturation in the operating room or in the recovery room in the reference study. But most of the other similar studies recorded higher incidence of arterial oxygen desaturation in smokers. (1)(2)(3)

The explanation given by the author Paul S. Myles (4)(5) is that immediate expert attention by the anesthesiologist and PACU staff was available in those areas, who were able to avoid more serious morbidity.. Supplemental oxygen was administered immediately. In another study conducted considering the risk of desaturation during recovery in smokers from general anesthesia by Rao M et al. in 2002 (34), it was found that smokers have significantly greater desaturation ($p < 0.001$) during transport of patients from the operating room to recovery room. The incidence of severe hypoxemia ($SpO_2 < 85\%$) was limited entirely to smoking group We have considered desaturation occurring anytime during induction or maintenance or recovery. We found that desaturation is more common in smokers with p value 0.0231. They have found that upper abdominal surgery was associated with a greater degree of desaturation which is holding well in this study also. Out of total 13 cases of desaturation in smokers, 9 cases were laparotomies. In non smoker group also out of 4 cases of desaturation, 2 were undergoing surgeries on chest or upper abdomen. Desaturation below 90% was recorded in 57% of the patients in that particular study by Madhusudhan Rao et al. in 2002 (18) when compared to 9% in non smokers. In present study we considered desaturation below 92% and the values were 14% and 2% respectively.

In most of the non smokers (90%) oral secretions at the time of extubation after giving reversal agent neostigmine 50 µg/kg along with glycopyrrolate 10µg/kg were mild to moderate which became dry by 2-3 suctioning (Grade II).Grade II oral secretions were seen in 40 % of non smokers. In smokers, most of them (20%) had copious amount of oral secretions at the time of extubation which required suctioning of more than 3 times to get dried (Grade III).4% of smokers had thick thready secretions (Grade IV) which was 2 % of non smokers. We did not restrict the patients' smoking habit pre operatively. In the present study, we have observed that as the chronicity of smoking habit is increased, incidence of complications is also increased. Extubation after anesthesia was always a challenge among smokers. As the chronicity of the smoking habit increases, the severity of changes occurring in the respiratory tract and lung also increases. This predisposes to higher incidence of complications. (6)

Smoking is definitely a risk factor for adverse pulmonary events in patients having surgery under general anesthesia. Regarding measures to minimize such adverse events in smokers, it would be advisable to consider the following steps in the light of our study.

1. Proper pre anaesthetic checkup among smokers to rule out any eventful out comes.
2. Pre medication with anti secretory and judicious use of opioids.
3. Pre oxygenation and supplemental oxygen after extubation and during transport of patients to post anaesthesia care unit (PACU) and during the stay in PACU is a must for smokers.
4. Meticulous oral suctioning should be done before extubation of the patients as there is definitely increase in the amount of oral secretions during recovery in smokers.
5. Avoidance of instrumentation of airway would contribute towards a safer perioperative period in these patients.
6. Last but not the least, all current smokers should be counseled and treated with appropriate techniques to quit smoking not only in the peri operative period but also for their entire lifetime as surgery is a special occasion to do so.

VI. Conclusion

Much less is known of the effects of stopping smoking than of continuing to smoke, and many of the studies on smoking cessation are concerned with long-term effects rather than effects within 48 hr. Studies con-

cerned with this period are required, especially in terms of postoperative respiratory morbidity, before an authoritative assessment can be made of the benefits and risks of stopping smoking in the short period before operation.

Present studies are convincing that great benefit will accrue in the cardiovascular system, mainly from carbon monoxide and nicotine elimination, after 12-24 h. A few days may greatly improve ciliary beating and 1-2 weeks provide a significant reduction in sputum volume. However, a minimum period of 4-6 weeks would seem appropriate to greatly influence postoperative respiratory morbidity, although the statement that "one needs 4-6 weeks to influence postoperative respiratory morbidity" must not be misapplied and become "there is no point in giving up smoking unless it is 4-6 weeks prior to operation." There are no proven disadvantages to the respiratory system from stopping smoking in the short term, and it seems unwise to sacrifice proven advantages for a theoretic consideration that sputum may become "stickier" and more difficult to clear.

Less is known with regard to the time course of offset of smoking effects on drug metabolism and the immune system, although 6-8 weeks would be expected to produce some benefit.

Positive benefits of continuing to smoke would seem to be a decreased incidence of DVT, although this must be confirmed on postoperative patients, the occasional patient who will start wheezing if he stops smoking and possibly some psychologic effects. We would contend that these effects can be reduced by nonsmoking, mean anticoagulants, bronchodilators, and anxiolytics and do not provide sufficient reason to continue smoking.

In view of the present study and comparing with other studies we can conclude that:

1. Adverse peri operative cardio pulmonary events were found to be 6.681 times significantly more in smokers group when compared to non smokers with chi square $\chi^2 = 17.361$ and $p \ll 0.05$.
2. The patients who were at more risk were found to be those who smoked more number of cigarettes per day than those who had the habit of smoking for more number of years.
3. Those who undergo upper abdominal surgeries where incision marked above the level of umbilicus had greater complication rates.
4. Apart from any standard anesthesia technique, anticipation of adverse events and measures to prevent them will definitely reduce the incidence of pulmonary complications in smokers undergoing general anesthesia. Regional anesthesia, whenever possible, should be the technique of choice in smokers, after proper counseling with regard to the higher incidence of complications in the perioperative period.

VII. Summary

Tobacco smoking has always been recognised as an important risk factor for peri operative complications. In the present study we observed the nature of adverse pulmonary events in smokers undergoing general anaesthesia with that in non smokers. After getting ethical clearance and patient consent, a standard general anaesthesia technique was used for all patients in the study. 50 consecutive patients who satisfied the inclusion criteria for smokers and 50 non smokers who were eligible to control group were studied. Only ASA I and II patients were considered in this study and any co morbid conditions (if any) were pre optimised before taking up for surgery. Pre operative fasting guidelines and pre medications were standardised. Induction and maintenance of anaesthesia was also standardised to all patients. Usual protocols were followed during reversal and recovery. Patients were comparable with respect to age, ASA status and type of surgery. All the patients in smokers group were males. The parameters considered in our study were incidence of arterial oxygen desaturation, laryngospasm, bronchospasm, severe coughing, re-intubation, naloxone use in recovery, incidence of pulmonary edema; any time during induction or maintenance or recovery of general anaesthesia. After analysis we have found that peri operative events were 6.68 times significantly more in smokers when compared to non smokers with chi – square $\chi^2 = 17.361$ $p \ll 0.05$. The amount of oral secretions was also found to be more in smokers during recovery from general anaesthesia when compared to non smokers.

Our observations were correlating with most of the other similar studies. In the light of the conclusions made out of this study we strongly recommend to anticipate increased incidence of adverse cardio pulmonary events in smokers and to take proper measures to tackle them. Apart from that all current smokers should be encouraged to stop smoking as early as possible before undergoing surgery and measures should be taken to motivate them to give up the habit for life.

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