Haemodynamic changes and oxygen saturation during general anaesthesia in smokers and non-smokers

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Abstract
Introduction and Objectives: Smoking and tobacco chewing causes many physiological changes in the body cardiovascular, cancer and pulmonary morbidity and mortality. The aim of this study is to evaluate the effect of smoking and tobacco chewing on cardio-respiratory system during preoperative and postoperative period.

Materials and Methods: The present study was conducted on patients of either sex ranging from 18-60 years of ASA (American Society of Anesthesiology) grade I and grade II scheduled for elective surgical procedures at Nehru Hospital, B.R.D. Medical College, Gorakhpur after the permission of ethical committee. Detailed history and physical examination was done. Arterial blood gas analysis was done and partial pressure of oxygen was recorded preoperatively and on postoperative day 1, 2 and 3. Patients were divided into three groups according to smoking and tobacco chewing habits. Statistical analysis was done using SPSS version 16.0 software. t-test, and Mann-Whitney test were applied according to the requirement. The level of significance was fixed at 95%. P < 0.05 was considered statistically significant.

Results: The proposed study was done on 50 patients of ASA grade I and II who were scheduled to undergo elective surgical intervention. Out of 50 patients 37 were male and 13 were female in the ratio of 2.84:1. Mean pulse rate was increased in all groups just after intubation and just after extubation but the amplitude of rise was maximum in Group-III. A significant rise in systolic blood pressure was observed in Group-I (control) just after intubation which came to basal value within 5 minutes of intubation. A significant rise in mean arterial blood pressure was observed in Group-I (control) just after intubation which came to basal value within 5 minutes of intubation.

Conclusion: Most of the smokers and tobacco chewers had significant reduction in preoperative bedside pulmonary function tests and associated decrease in partial pressure of oxygen. These patients required oxygen inhalation postoperatively to prevent hypoxia.

Introduction
Cigarette smoking and its consequences comprise a worldwide epidemic and is attributed to at least 20% of all deaths in developed countries.¹ Cigarette smoke contains over 4700 additional chemical compounds other than nicotine. It includes at least 43 carcinogens which collectively generate a very broad range of pathophysiological effects.² Failure to quit smoking before elective or emergency surgery is ill judged which can lead to subsequent risk of intraand postoperative complications.³ Smoking up to the time of any surgery increases cardiac and pulmonary complications, impairs tissue healing, and is associated with more infections and other problems at the surgical site.³,⁴ The relative risk of complications after surgery for smokers compared to nonsmoker has been reported to increase from 1.4-fold to 4.3-fold.⁵ These adverse effects compromise the intended procedural outcomes and increase the costs of care. The preoperative stage may offer an opportunity for smoking cessation in surgical patients. All available measures must be taken to help patients to stop smoking prior to surgery. It is both accountable and ethical to implement a policy that those unwilling or unable to stop should have low priority for, or be excluded from, certain elective surgical procedures.⁶ Nicotine also increases intracellular calcium during ischemia. This may exacerbate myocardial cell damage.⁷ In smokers, the plasma concentration of nicotine reaches 15-50 mg/ml. The half life of nicotine is 30-60 minutes.⁸ Nicotine is the principal ingredient responsible for tobacco's addictive character, which acts through the sympathoadrenergic system causing an increase in heart rate.⁹ Smoking and tobacco chewing causes many physiological changes in the body cardiovascular (atherosclerosis, hypertension, coronary artery disease, thromboembolism, peripheral vascular disease), cancer (oral, larynx, esophagus, pancreas, kidney) and pulmonary (chronic obstructive pulmonary disease, lung cancer) morbidity and mortality. Smokes have a high incidence of postoperative mortality.

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respiratory complication and although there is evidence of increased upper airway sensitivity, the assumption that smokers suffer stormy induction of anaesthesia seems unsubstantiated.10 The aim of this study is to evaluate the effect of smoking and tobacco chewing on cardio-respiratory system during perioperative and postoperative period.

Materials and Methods
The present study was conducted on patients of either sex ranging from 18-60 years of ASA (American Society of Anaesthesiology) grade I and grade II scheduled for elective surgical procedures at Nehru Hospital, B.R.D. Medical College, Gorakhpur after the permission of ethical committee. A thorough history including age, sex, smoking and tobacco chewing habits, if smoker number of bidi or cigarettes consumed per day, the number of years of smoking was taken. A day before operation thorough general and systemic examination was done. Those with known respiratory disease, recent upper respiratory tract infections, hypertensive, gastroesophageal reflux or those receiving medications affecting lung function were excluded. Arterial blood gas analysis was recorded preoperatively and on postoperative day 1, 2 and 3. Patients were divided into three groups according to smoking and tobacco chewing habits. Group I: Non-smokers (20 patients). Group II: Smokers- Patients who smoked more than 10 cigarettes or bidi per day were classified as smokers (20 patients) and Group III: Smokers and tobacco chewers (10 patients). The routine monitoring like pulse rate, blood pressure, electrocardiography, SpO2 recording were done throughout the surgery. At the end of surgery, the neuromuscular block was reversed with neostigmine and glycopyrrolate in appropriate dose. All the patients were monitored for pulse rate, systolic blood pressure, diastolic blood pressure, mean arterial blood pressure, partial pressure of oxygen every 8 hourly for 3 postoperative days.

Statistical Analysis
Statistical analysis was done using SPSS version 16.0 software. t-test and Mann–Whitney test were applied according to the requirement. The level of significance was fixed at 95%. P < 0.05 was considered statistically significant.

Result
The study included 50 patients undergoing elective surgery. The patients were divided into three groups. Group-I non-smokers, Group-II smokers and Group-II smoker and tobacco chewers.

Table 1 shows that most of the patients in the study were male which constitutes 37 out of 50 patients i.e. 74%. Male Female ratio was 2.84:1. Minimum age in study was 18 years and maximum were 70 years. Patients between 31-40 years were more in number which constitutes 14 out of 50 patients i.e. 28%. Above table shows distribution of cases in different groups according to various types of surgical procedures. Colostomy closure, cholecystectomy, nephrolithotomy, hernia repair were common operations done (Table 1).

Table 2 shows that mean pulse rate was increased in all groups just after intubation and just after extubation but amplitude of rise was maximum in group-III and most highly significant in group III. Significant rise in mean pulse rate was recorded just after intubation in Group-I (from 88.65±13.38 to 96.70±10.71; p<0.05). The mean pulse rate came to basal value with in 5 minutes of intubation (93.37±10.37; p>0.05) and persisted before extubation. There was a significant rise in mean pulse rate just after extubation (97.34±12.34; p<0.05). No significant changes were observed on consecutive 3 postoperative days. In Group-II (smokers) there was highly significant rise in the mean pulse rate per minute just after intubation (93.32±15.34 to 107.64±14.32; p<0.01). This value returned to basal value after 5 minutes of intubation and showed no significant rise before extubation. There was highly significant rise in mean pulse rate per minute just after extubation (106.43±15.32; p<0.01). There was no significant change on postoperative day 1, day 2 and day 3. In Group-III (smokers and tobacco chewers), most highly significant rise in mean pulse rate was observed just after intubation (96.32±12.21 to 119.43±13.21; p<0.001). After 5 minutes of intubation, the mean pulse rate came to basal value and persisted just before extubation. After extubation again there was most highly significant rise in mean pulse rate (116.34±13.23; p<0.001). There was no significant change on postoperative day 1, 2 and 3. (Table 2).

Table 3 shows that mean systolic blood pressure was increased in all groups just after intubation and just after extubation but amplitude of rise was maximum in Group-III and most highly significant in group III. A significant rise in systolic blood pressure (120.6±10.32 to 128.2±11.21; p<0.05) was observed in Group-I (control) just after intubation which came to basal value with in 5 minutes of intubation (123.43±9.21; p>0.05). A significant rise in mean systolic blood pressure was also observed just after extubation (129.54; p<0.001). There was no significant change in mean systolic blood pressure on postoperative day 1, 2 and 3. In Group-II (smokers) there was highly significant rise in the mean systolic blood pressure per minute just after intubation (123.2±4.916 to 132.2±4.916; p<0.01). This value returned to basal value after 5 minutes of intubation and showed no significant rise before extubation. There was highly significant rise in mean systolic blood pressure just after extubation (133.32±12.21; p<0.01). There was no significant change observed on postoperative day 1, day 2 and day 3 in both groups. In Group-III (smokers and tobacco chewers), most highly significant rise in mean systolic blood pressure was observed just after intubation (128.42±9.05 to 149.32±10.32; p<0.001). After 5 minutes of intubation the mean systolic blood pressure came to basal value and persisted till extubation. After extubation again there was most highly significant rise in mean systolic blood pressure (153.32±9.43; p<0.001). There was no significant change observed on postoperative day 1, 2 and 3. (Table 3)
Table 4 shows that mean diastolic blood pressure was increased in all groups just after intubation and just after extubation but amplitude of rise was most highly significant in group III. A significant rise in mean diastolic blood pressure (90.03±7.31 to 96.43±10.42; p<0.05) was observed in Group-I (control) just after intubation which came to basal value within 5 minutes of intubation (93.32±10.27; p<0.05). A significant rise in mean diastolic blood pressure was also observed just after extubation (93.93±4.28; p<0.05). There was no significant change observed on postoperative day 1, 2 and 3. In Group-II (smokers) there was highly significant rise in mean diastolic blood pressure just after intubation (95.48±5.98 to 104.34±10.43; p<0.01). This value returned to basal value after 5 minutes of intubation and showed no significant rise before extubation. Again, there was highly significant rise in mean diastolic blood pressure just after extubation (102.20±8.82; p<0.01). There was no significant change observed on postoperative day 1, 2 and day 3. In Group-III (smokers and tobacco chewers), most highly significant rise in mean diastolic blood pressure was observed just after intubation (86.50±7.76 to 113.70±10.27; p<0.001). After 5 minutes of intubation the mean diastolic blood pressure came to basal value and persisted till extubation. After extubation there was most highly significant rise in mean diastolic blood pressure (127.85±7.70; p<0.001). There was no significant change observed on postoperative day 1, 2 and 3. (Table 4)

Table 5 shows that mean arterial blood pressure was increased in all groups just after intubation and just after extubation but the amplitude of rise was most highly significant in group III. A significant rise in mean arterial blood pressure (92.83±7.31 to 98.65±10.54; p<0.05) was observed in Group-I (control) just after intubation which came to basal value with in 5 minutes of intubation (95.43±7.54; p<0.05). A significant rise was also observed just after extubation (98.50±8.65; p<0.05). There was no significant change observed on postoperative day 1, 2 and 3. In Group-II (smokers) there was highly significant rise in the mean arterial blood pressure just after intubation (95.48±5.98 to 103.23±8.65; p<0.01). This value returned to basal value within 5 minutes of intubation and showed no significant rise before extubation. There was highly significant rise in mean arterial blood pressure just after extubation (103.42±9.75; p<0.01). There was no significant change observed on postoperative day 1, day 2 and day 3. In Group-III (smokers and tobacco chewers), most highly significant rise in mean arterial blood pressure was observed just after intubation (101.15±7.58 to 131.53±10.08; p<0.001). After 5 minutes of intubation the mean arterial blood pressure came to basal value and persisted till extubation. After extubation again there was most highly significant rise in mean arterial blood pressure (127.85±7.70; p<0.001). There was no significant change observed on postoperative day 1, 2 and 3. (Table 5)

Table 6 shows mean changes in mean oxygen saturation in percentage with standard deviation at different intervals in each group and there was no change in mean oxygen saturation in all groups except there was a decrease just after extubation in Group-II and Group-II and the amplitude of reduction was most highly significant in group III. There was no significant change in any of the group during general anaesthesia. But just after extubation there was a highly significant fall in mean oxygen saturation in Group-II (smokers) and most highly significant reduction in Group-III (smokers and tobacco chewers). There was significant reduction in mean oxygen saturation in Group-II (97.30±2.10 to 94.0±4.34; p<0.01) and most highly significant reduction in Group-III (96±1.15 to 1.15 to 90.3±1.69; p<0.001). (Table 6)

Table 1: Showing distribution of patients according to age, gender and surgical Procedure in different groups

| Age (Years) | Group-I % | Group-II % | Group-III % |
|-------------|-----------|------------|-------------|
| 10-20 | 05.0 | 05.0 | - |
| 21-30 | 25.0 | 20.0 | 30.0 |
| 31-40 | 30.0 | 35.0 | 10.0 |
| 41-50 | 25.0 | 15.0 | 20.0 |
| 51-60 | 10.0 | 10.0 | 40.0 |
| 61-70 | 05.0 | 15.0 | - |

| Gender | Group-I % | Group-II % | Group-III % |
|--------|-----------|------------|-------------|
| Male | 75.0 | 75.0 | 70.0 |
| Female | 25.0 | 25.0 | 30.0 |

| Surgical Procedure | Group-I | Group-II | Group-III |
|--------------------|---------|---------|----------|
| Colostomy closure | 15.0 | 15.0 | 20.0 |
| Cholecystectomy | 15.0 | 15.0 | 10.0 |
| Vaginal hysterectomy | 10.0 | 10.0 | 10.0 |
| Nephrolithotomy | 20.0 | 10.0 | 10.0 |
| Suprapubic prostatectomy | 05.0 | 15.0 | 20.0 |
| Hernia repair | 15.0 | 15.0 | 10.0 |
| Abdominal hysterectomy | 15.0 | 10.0 | 10.0 |
| Orthopaedic surgery | - | 05.0 | 10.0 |
| Mastectomy | 05.0 | 05.0 | - |
Table 2: Showing means pulse rate in minute with standard deviation at different intervals in different groups

| Group | Pre operative | Just after intubation | 5min. after intubation | 30min. after intubation | Before extubation | Just after extubation | Post operative day 1 | Postoperative day 2 | Postoperative day 3 |
|-------|---------------|-----------------------|------------------------|-------------------------|-------------------|-----------------------|----------------------|---------------------|---------------------|
| Group-I | 88.65±13.38 | 96.70±10.71 | SIG (93.37±10.34) | INS (88.15±9.932) | INS (90.95±10.80) | INS (97.34±12.34) | SIG (93.57±10.17) | INS (92.40±9.83) | INS (93.60±9.72) |
| Group-II | 93.32±15.34 | 107.64±14.32 | HS (96.23±11.20) | INS (95.6±11.44) | INS (99.45±13.35) | INS (106.43±15.32) | HS (101.1±12.78) | INS (95.5±12.34) | INS (95.5±12.34) |
| Group-III | 96.32±12.21 | 119.43±13.21 | MHS (110.32±13.21) | INS (103.4±10.34) | INS (105.7±13.23) | INS (116.34±13.23) | MHS (97.2±10.70) | INS (93.2±10.06) | INS (99.6±10.30) |

INS (>0.05) = Insignificant; SIG (<0.05) =Significant; HS (>0.01) = highly significant. MHS (<0.001) = Most Highly Significant

Table 3: Showing means systolic blood pressure changes in mmHg with standard deviation at different intervals in different groups

| Group | Pre operative | Just after intubation | 5min. after intubation | 30min. after intubation | Before extubation | Just after extubation | Post operative day 1 | Postoperative day 2 | Postoperative day 3 |
|-------|---------------|-----------------------|------------------------|-------------------------|-------------------|-----------------------|----------------------|---------------------|---------------------|
| Group-I | 120.6±10.32 | 128.21±11.21 | SIG (123.4±9.21) | INS (121.70±5.88) | INS (122.7±5.52) | INS (129.54±14.21) | SIG (125.90±5.67) | INS (126.7±5.63) | INS (125.90±5.64) |
| Group-II | 123.2±9.16 | 132.20±10.32 | HS (126.2±10.32) | INS (124.25±6.08) | INS (123.8±7.77) | INS (133.32±12.21) | HS (125.90±8.72) | INS (127.5±8.41) | INS (128.7±8.06) |
| Group-III | 128.42±9.05 | 149.32±10.32 | MHS (137.3±11.32) | INS (132.70±8.85) | INS (129.2±8.95) | INS (153.32±9.43) | MH (131.00±5.98) | INS (130.4±6.65) | INS (128.4±7.41) |

INS (>0.05) = Insignificant; SIG (<0.05) =Significant; HS (<0.01) = highly significant. MHS (<0.001) = Most Highly Significant

Table 4: Showing mean diastolic blood pressure changes in mmHg with standard deviation at different intervals in different groups

| Group | Pre operative | Just after intubation | 5min. after intubation | 30min. after intubation | Before extubation | Just after extubation | Post operative day 1 | Postoperative day 2 | Postoperative day 3 |
|-------|---------------|-----------------------|------------------------|-------------------------|-------------------|-----------------------|----------------------|---------------------|---------------------|
| Group-I | 90.03±7.31 | 96.43±10.42 | SIG (93.32±10.27) | INS (94.46±5.08) | INS (81.05±3.86) | INS (93.93±4.28) | SIG (84.60±2.98) | INS (84.90±2.71) | INS (84.80±3.31) |
| Group-II | 95.48±5.98 | 104.3±10.43 | HS (99.5±7.88) | INS (95.98±6.84) | INS (81.25±5.69) | INS (102.2±8.82) | SIG (83.30±4.88) | INS (84.30±3.79) | INS (84.7±3.74) |
| Group-III | 86.5±7.76 | 113.7±10.27 | MHS (93.6±9.54) | INS (91.10±5.82) | INS (85.50±5.79) | INS (107.4±10.61) | HS (86.00±4.11) | INS (86.20±4.04) | INS (85.4±5.08) |

INS (>0.05) = Insignificant; SIG (<0.05) =Significant; HS (<0.01) = highly significant. MHS (<0.001) = Most Highly Significant

Table 5: Showing mean of arterial blood pressure changes in mmHg with standard deviation at different intervals in different groups

| Group | Pre Operative | Just after intubation | 5min. after intubation | 30min. after intubation | Before extubation | Just after extubation | Post operative day 1 | Postoperative day 2 | Postoperative day 3 |
|-------|---------------|-----------------------|------------------------|-------------------------|-------------------|-----------------------|----------------------|---------------------|---------------------|
| Group-I | 92.83±7.31 | 98.65±10.54 | SIG (95.45±7.54) | INS (94.46±5.08) | INS (95.43±7.54) | INS (98.50±8.65) | SIG (94.30±7.32) | INS (93.20±6.24) | INS (94.50±8.20) |
| Group-II | 95.48±5.98 | 103.23±8.65 | HS (99.54±7.65) | INS (95.95±6.58) | INS (95.42±6.14) | INS (103.4±9.756) | HS (98.60±4.90) | INS (98.66±4.90) | INS (99.33±4.36) |
| Group-III | 101.15±7.58 | 131.5±10.08 | MHS (106.32±8.34) | INS (103.5±4.28) | INS (100.0±6.29) | INS (127.8±7.70) | MHS (101.6±4.80) | INS (103.9±4.37) | INS (99.59±5.50) |

INS (>0.05) = Insignificant; SIG (<0.05) =Significant; HS (<0.01) = highly significant. MHS (<0.001) = Most Highly Significant
Table 6: Showing mean oxygen saturation changes in percentage with standard deviation at different intervals in different groups

| Group   | Pre operative | Just after intubation | 5min. after intubation | 30min. after intubation | Before extubation | Just after extubation |
|---------|---------------|-----------------------|------------------------|-------------------------|-------------------|----------------------|
| Group-I | 98.70±0.57    | 97.30±1.10            | SIG 98.60±0.93         | INS 99.60±0.50          | INS 99.10±0.56    | INS 98.45±0.60       |
| Group-II| 97.30±2.10    | 96.20±1.12            | HS 98.54±0.65          | INS 98.90±0.68          | INS 98.06±1.20    | INS 94.00±4.34       |
| Group-III| 96.00±1.15   | 94.60±1.72            | MHS 97.32±0.64         | INS 97.40±0.42          | INS 97.20±1.31    | INS 90.30±1.69       |

INS (>0.05) = Insignificant; SIG(<0.05) = Significant; HS(<0.01) = highly significant. MHS (<0.001) = Most Highly Significant

Discussion

Over 1000 component of cigarette smoke have been identified with wide ranging effects on the cardiovascular, respiratory, immune systems, haemostasis, drug metabolism and patient psychology. The proposed study was done on 50 patients of ASA grade I and II who were scheduled to undergo elective surgical intervention. Out of 50 patients 37 were male and 13 were female in the ratio of 2.84:1. Maximum cases were in fourth decade comprising 14 patients i.e. 28%. Colostomy closure, cholecystectomy, nephrolithotomy, hernia repair were the common operations done in various groups. The haemodynamic variables were compared statistically with the preoperative (basal) value just after intubation, at 5 minutes after intubation, 30 minutes after intubation, before extubation, just after extubation, postoperative day 1, day 2 and day 3. Mean pulse rate was increased in all groups just after intubation and just after extubation but the amplitude of rise was maximum in Group-III. A significant rise in mean arterial blood pressure was observed in Group-I (control) just after intubation which came to basal value within 5 minutes of intubation. Thus, we have seen that all patients were haemodynamically stable during perioperative period. There was significant haemodynamic change only after intubation and extubation which was most exaggerated in smokers and tobacco chewers. No significant change in any of the group during general anaesthesia. But just after extubation there was a highly significant fall in mean oxygen saturation in Group-II (smokers) and most highly significant reduction in Group-III (smokers and tobacco chewers). In concord, Dennis et al (1994) studied the effect of smoking on induction of anaesthesia on 120 patients undergoing elective surgery and concluded that the reduction in SpO2 was also greater in those with adverse events during induction. Furthermore, perioperative smoking cessation seems to be an effective tool to reduce postoperative complications even if it is introduced as late as 48 hours before surgery for cardiovascular and wound related benefits. Thus, we have seen that haemodynamic changes and perioperative and postoperative complications were more common in smokers and tobacco chewers followed by smokers.

Conclusion

All the patients were haemodynamically stable except a heightened haemodynamic response to laryngoscopy just after intubation and just after extubation was observed in all groups, maximum smokers and tobacco chewers followed by smokers. Most of the smokers and tobacco chewers had significant reduction in preoperative bedside pulmonary function tests and associated decrease in partial pressure of oxygen. These patients required oxygen inhalation postoperatively to prevent hypoxia.

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