# Evaluation of postoperative complications associated with tobacco use in thoracic surgery patients

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## Abstract

**Introduction:** Tobacco products can make thoracic diseases more complicated by affecting their respiratory functions in a short or long time and can increase mortality and morbidity related to these diseases. While smoking causes many diseases that require surgical treatment, especially thoracic surgery, on the other hand, it affects surgical results. This study aims to determine the relationship between tobacco use and postoperative complications in thoracic surgery patients and contribute to public health by supporting tobacco cessation programs.

**Method:** Patient characteristics and tobacco use habits of the patients, and the types of tobacco they used were determined. Postoperative complications, admission to the intensive therapy unit, reintubation, death, and length of stay in hospital were defined as surgical outcomes. These results were compared and analyzed with tobacco use.

**Results:** Retrospectively, 754 patients consisting of 536 (71.1%) males and 218 (28.9%) females were evaluated. Tobacco use was more common in men (X2=223.216, p<0.001) and younger ages (X2=45.342, p<0.001). Complications occurred in 96 patients, 76 (79.2%) of whom used tobacco. Tobacco use (p<0.001, OR=3.547), ASA score (p=0.029, OR=2.004), major surgeries (p<0.001, OR=4.458), and minimally invasive surgeries (p=0.027, OR=2.323) are associated with complications. Length of hospital stay is related to the amount of tobacco (p <0.001, OR = 3.706), size of surgery (p <0.001, OR = 14.797), over 65 years (p <0.001, OR = 2.635), and infectious diseases (p = 0.039, OR: 1.939)

**Conclusion:** Tobacco use is related to poor outcomes in thoracic surgery patients, and it is a severe health problem, especially at young ages. Tobacco control programs should be supported to prevent the effects of tobacco use on thoracic diseases and postoperative complications.

**Keywords:** tobacco use, postoperative complications, thoracic surgery, tobacco products, pulmonary diseases, smoking.

## INTRODUCTION

Tobacco use is one of the causes of preventable mortality and morbidity[1]. Due to tobacco use in the world; 5.4 million people die every year. Smoking is a public health problem, and 20% of deaths in developed countries are associated with smoking [2]. In Turkey, tobacco use affects about a quarter of deaths [3].

People in the study area use a variety of tobacco products. These include cigarettes, wrapping tobacco, electronic cigarettes, hookahs, and *maras powder*. *Maras powder* or *Nicotiana rustica linn* is a type of smokeless tobacco widely used in the Eastern Mediterranean region of our country, especially in the province of *Kahramanmaras*. *Maras powder*; After the leaves of the plant, which is also called '*deli tütün*' in the region, are powdered, the ash obtained from oak, walnut, or grapevine is added in different proportions, crushed together, and prepared by moistening it slightly. *Nicotiana rustika linn*'s nicotine content is 6-10 times higher than *Nicotiana tobaccum*. Therefore, it is more harmful than *Nicotiana tobaccum*. Approximately one teaspoon of *Maras powder* is used by wetting it slightly, wrapping it in cigarette paper, or by absorbing it without paper, by placing it inside the lower or upper lip. According to a study conducted in the province of *Kahramanmaraş*, the rate of *maras powder* use is 16.8% (25.1% in men, 1.4% in women) [4,5].

The supply of oxygen, which is indispensable for our body to work, is done by the respiratory system, and the respiratory system is one of our most vital systems [6]. Tobacco products can make thoracic diseases more complicated by affecting their respiratory functions in a short or long time and can increase mortality and morbidity related to these diseases [7].

Surgical intervention may be mandatory for the treatment of some respiratory diseases. While smoking causes many diseases that require surgical treatment, especially thoracic surgery, on the other hand, it affects surgical results [8]. In addition to chronic changes in thoracic surgery patients, acute effects also occur due to the intervention. Therefore, pulmonary complications are more complicated in thoracic surgery patients than in other patients.

This study aims to determine the relationship between tobacco use and postoperative complications and prognosis in thoracic surgery patients. Thus, it is aimed to protect public health by contributing to the prevention of mortality and morbidity related to smoking.

METHODS

**Study design and tobacco use history**

The Clinical Research Ethics Committee of Kahramanmaras Sutcu Imam University Faculty of Medicine approved this study with the decision '02' on 18.03.2020.

Between October 2006 and October 2019, we scanned files of 2169 patients treated inpatients at thoracic surgery clinics in three different centers. Diseases due to external factors such as blunt and penetrating chest trauma were excluded from the study. In this study, data from 754 patients aged 18 to 95 years were evaluated retrospectively. Information about the tobacco use habits of the patients was obtained from the records. The tobacco products used by the patients and the daily amount of tobacco were learned from the records. The tobacco products used by the patients were cigarettes, electronic cigarettes, wrapped tobacco, hookahs, tobacco chewing, and maras powder. The study included current tobacco users as well as former users to assess the long-term effects of tobacco. Patients who have not used tobacco products for more than one year are considered former users. The daily number of cigarettes used for cigarette users and electronic cigarette users was calculated. Since other tobacco products do not have standard measurements, they are classified as 'light-users' and 'heavy-users'. For cigarette users and electronic cigarette users, less than 20 cigarettes per day were considered 'light-users', and 20 and above 'heavy-users'.

Since the number of patients using tobacco products other than cigarettes was low, tobacco products were classified as 'cigarettes' and 'other tobacco products' while performing the analysis.

Demographic data of the patients were evaluated. The patients were classified according to their gender. The patients were divided into three groups according to their age: 34 years and under, 35-64 years, and 65 years and over. Treatment methods were divided into three groups as minor surgeries, minimally invasive surgeries, and major surgeries. Patients were divided into diagnostic groups. Comorbidities were determined. The physical performance status of the patients was classified according to the American Society of Anesthesiologists (ASA) score [9].

Patients were analyzed according to the development of complications. Patients with complications were divided into tobacco users and non-tobacco users. The patients were analyzed according to the tobacco products they used and the amount of tobacco.

We did not include the intensive therapy unit (ITU) admissions planned for postoperative periods. Emergency admission to the intensive care unit, reintubation, and death were considered as poor prognosis criteria. Age, gender, tobacco use, diagnostic groups, types of surgery, and ASA status were considered as possible variables associated with these results. These variables were evaluated by logistic regression analysis.

The mean value of the length of stay in the hospital was calculated. The patients were divided into two groups according to their hospital stay. Hospital stays shorter than the mean value were considered as short stays, and those staying longer than the mean value as long stays. Patients in each hospitalization group

were evaluated according to their tobacco use status. To more accurately evaluate the relationship between tobacco use and hospital stay, logistic regression analysis was performed with other independent variables such as gender, age groups, types of surgery, ASA status, diagnostic groups, and comorbidities.

**Statistical analysis**

Statistical analysis was performed using SPSS 20.0 for Windows (SPSS, Inc.; Chicago, USA) package program. In the study, mean ± standard deviation, median, and minimum-maximum values for continuous numerical variables and number (n) and percentage (%) for categorical variables were used to present descriptive statistics. Chi-square test or Fisher's exact test was used to compare categorical variables in group comparison. The conformity of the obtained data to normal distribution was examined by Kolmogorov-Smirnov / Shapiro-Wilk tests. Normally distributed continuous variables were compared with parametric tests (paired-sample t-test and independent groups t-test), and non-normally distributed continuous variables were compared with nonparametric tests (Mann-Whitney U and Kruskal Wallis test). Post hoc tests were performed when necessary. The effects of variables ($p < 0.25$) determined by pairwise comparisons in predicting the presence of poor prognosis criteria and length of hospital stay were evaluated by logistic regression analysis. 'The enter method' was used in the logistic regression analysis. Hosmer-Lemeshow test was used to evaluate model fit. The statistical significance limit value was considered as p-value less than 0.05 ($p < 0.05$), and the confidence interval as 95%.

RESULTS

The 754 patients included in the study consisted of 423 (56.1%) tobacco users and, 331 (43.9%) tobacco nonusers. Fifty-one patients (12.05%) of the tobacco users were former tobacco users, while 131 (30.97%) of the current users were light-users and 241 (56.98%) were the heavy-tobacco users.

As tobacco products, 390 (92.2%) of the patients were using cigarettes, 17 (4.0%) of the patients were using maras powder, 9 (2.1%) of the patients were using wrapped tobacco, 4 (1.0%) of the patients were using hookahs, and 3 (0.7%) of the patients were using electronic cigarettes. Thus, 33 (7.8%) patients used tobacco products other than cigarettes.

The patients in the study consisted of 536 (71.1%) males and 218 (28.9%) females. Table 1 shows the patient characteristics by tobacco use. While the rate of tobacco use in males was 73.3%, it was 13.8% in females. This data showed that tobacco use was significantly more common in the male gender ($X^2$=223.216, p=0,001).

The mean age of patients was 46.91±22.07 (Min: 18 Max: 95). According to this study, tobacco use was more common in the 34 and under age group ($X^2$=45.342, p=0,001) (Table 1).

Comorbidity was present in 198 (26.25%) of the patients (Table 1). The most common chronic disease was congestive heart failure in 83 patients. Other common comorbidities were hypertension in 49 patients, chronic obstructive pulmonary disease in 47 patients, diabetes mellitus in 43 patients, and chronic renal failure in 24 patients. There was no significant relationship between tobacco use and comorbidities

There were 202 patients in the ASA I group, 456 patients in the ASA II group, 60 patients in the ASA III group, and 36 patients in the ASA IV group. The distribution of tobacco use, according to the ASA status of the patients, is shown in table 1. There was no significant relationship between tobacco use and ASA status.

We classified the patients according to diagnosis. Two hundred and seventy-four (36.3) patients were in the spontaneous pneumothorax group, 264 (35.0%) patients were in the benign diseases, 125 (16.6%) patients were in the benign diseases, and 91 (12.1%) patients were in the infectious diseases group.

The tobacco use rates of the patients in each surgical treatment group were compared, and no relationship was found between tobacco use and the type of surgery.

Complications developed in 96 of 754 patients included in the study (12.7%). The number of tobacco users in patients with complications is significantly higher than in non-tobacco user ($X^2$=23.765, p<0.001). Table

2 shows the relationship of complications with tobacco use. Tobacco use rates were significantly higher in patients who developed persistent air leaks, atelectasis, and pneumothorax as complications.

Of the 96 patients who developed complications, 20 (8.3%) did not use tobacco products, 72 (75.0%) were using cigarettes, and 4 (4.2%) were using other tobacco products. There was a significant difference between the groups ($X^2$=24.865, p<0.001). When the groups were compared in pairs, it was observed that the difference was due to the difference between cigarette users and non- tobacco users. There was no difference between cigarettes and other tobacco products in terms of complication development.

Of the 96 patients with complications, 8 (21.6%) were former users, 17 (17.7%) were light - users, 51 (53.1%) were heavy-users, and 20 (20.8%) were non- tobacco user.

Table 3 includes the evaluation of relationships of independent variables with the development of complications using logistic regression analysis. Compared to non-smokers, the risk of complications was 3.058 times higher in former users (p=0.029), 2.616 times (p=0.017) in low-users, and 3.547 times (p=0.001) higher in high-users. Patients with complications were associated with an ASA score of 3 and above, 2.004 times (p = 0.029) more than the ASA score I and II. In addition, the risk of developing complications is 2,323 times (p = 0.027) higher in minimally invasive surgery and 4.458 times (p <0.001) in major surgery compared to minor surgery.

Fifty (6.6%) of the patients were admitted to ITU for emergencies. Twenty- six (3.4%) of the patients had intubation, and 20 (2.6%) patients died. Fifty-five (7.3%) patients had at least one of these poor prognosis criteria. No significant relationship was found between tobacco use and ITU admission, intubation, and mortality. Logistic regression analysis was performed to reveal possible variables associated with poor prognosis factors (ITU admission, intubation, exitus). Table 4 includes the relationship of independent variables in predicting the poor prognosis outcomes by logistic regression analysis. Poor prognostic outcomes were 5,543 times (p = 0.002) more common in those 65 years and older than those under 35 years of age. Poor prognostic results were observed 2.015 times (p <0.001) more frequently in those with an ASA score of III and above than those with an ASA score below III.

For all patients, the mean length of stay in hospital was 8.86±6.95 days. In the short-stay group (8 days or less), 208 (48.3%) of 431 patients were using tobacco products, while 215 (66.6%) of 323 patients in the long-stay group (9 days or more) were using tobacco products. This result showed that the rate of tobacco use was significantly higher in the long-stay in hospital - group ($X^2$=25.116, p<0.001).

Table 5 includes the relationship between tobacco use and other possible independent variables with the length of stay in hospital by logistic regression analysis. The length of stay in hospital was 2.635 times higher in patients 65 years of age and over compared to patients under 35 years of age (p = 0.001). The length of stay in hospital was 1.948 times (p = 0.016) higher in patients who used low amounts of tobacco products than non-users and 3.706 times (p<0.001) higher in those who used high tobacco products than non-users. The length of stay in hospital was 2,839 times (p<0.001) higher in patients with an ASA score of III or more than those with an ASA score of less than III. Infectious lung diseases increase the length of stay in hospital by 1.929 times (p=0.039) according to benign causes. In addition, the length of hospital stay was 5.063 times (p <0.001) higher in patients with minimally invasive surgery than those who underwent minor surgery and 14.797 times (p <0.001) longer in patients who underwent major surgery than those who underwent minor surgery.

## DISCUSSION

This study showed that tobacco use was associated with young age, male gender, development of postoperative complications, and high length of stay in hospital in thoracic surgery patients. However, according to our study, there was no relationship between tobacco use and ITU admission, intubation, and mortality.

According to Turkey's data of the Global Adult Tobacco Survey of the World Health Organization (GATS), the tobacco use rate in Turkey was 31.6% in 2016 [10]. Among the cases hospitalized for pulmonary surgery in our study, the proportion of tobacco users was 56.1%. Accordingly, the rate of tobacco users was higher

in the group hospitalized due to pulmonary surgical diseases. This result shows the relationship between tobacco use and surgical lung diseases.

Global Adult Tobacco Survey of the World Health Organization (GATS), according to Turkey's data, 44.1% of men in Turkey in 2016, 19.2% of women were using tobacco [10]. In our study, 73.1% of men and 13.9% of women use tobacco. The rate of total smokers is higher than the general population. This difference is due to the higher tobacco use among men, as female tobacco use is similar to the general population. The rate of male patients in our study is also higher than female patients. In our series, the higher rate of tobacco use in men compared to the general population may be attributed to the higher incidence of diseases such as primary spontaneous pneumothorax [11], which are more common in smoking men.

The mean age of smokers and non-smokers in different studies was at various rates [7,12,13]. In these studies, smokers are younger than non-smokers are. In our study, 62.8% of patients under the age of 65 were tobacco users, while 37.2 were not tobacco users. In one study, 63.9% of patients under the age of 65 were in the smoker group, while 36.1% were in the non-smoker group [14], and the findings are consistent with our results.

Spontaneous pneumothorax was the most common diagnosis in the study. Previous studies show that there is a strong relationship between smoking and spontaneous pneumothorax [11,15]. Similarly, previous studies revealed that the use of tobacco products increases the risk of developing cancer [7,16,17]. These diseases may be responsible for the high rate of tobacco use among the patients in our study.

Tobacco products affect pulmonary complications in two ways; one of these is the acute exposure of the lung to toxins in tobacco, and the other is the accumulated chronic effects on the lung due to smoking for years [12].

Thoracic surgery disrupts respiratory functions in the postoperative period and increases the risk of postoperative complications [18]. Thoracic surgery is an independent risk factor even [19], as it is performed directly to the respiratory system. The postoperative complication development rate after thorax surgery varies between 12% and 50% [20]. In our study, complications developed in 12.73% of our patients. Most of the patients who developed complications were using tobacco products, and there was a statistically significant relationship between tobacco use and the rate of postoperative complications.

Although there are some studies about that maras powder, one of the tobacco products, is more harmful than cigarettes [4,5], in our study there was no significant relationship between tobacco products other than cigarettes and postoperative pulmonary complications. According to our study, cigarette increases the risk of postoperative pulmonary complications. The lack of a significant relationship with postoperative complications in our study may be attributed to the low number of these tobacco derivatives.

Pulmonary complications are common after surgical operations, and there are many scoring systems to identify and evaluate postoperative pulmonary complications. However, since there is no consensus on this issue, their clinical use is controversial [21].

When previous studies are examined, different findings have been reported as postoperative pulmonary complications in each study. Findings frequently reported as postoperative complications in the literature; pneumonia and other respiratory infections, atelectasis, PAL, need for intubation, pneumothorax, respiratory failure, pleural effusion, and bronchospasm [22-24]. The most common postoperative pulmonary complications in this study were PAL, atelectasis, pneumothorax, respiratory failure, pleural effusion and empyema, cardiac complications, surgical site infection, pneumonia, acute renal failure, and bronchospasm. These findings are complications in the literature at different rates.

Seok et al. reported PAL and atelectasis as the most common postoperative pulmonary complications in their study [21]. Similarly, the most common pulmonary complications in our study were PAL and atelectasis. PAL is defined as an air leak that lasts more than 5-7 days [25]. In this study, we found a significantly higher rate of PAL development in the male gender. There are studies evaluating smoking as a risk factor for PAL [26]. Similarly, in our study, there was a significant relationship between PAL and tobacco use.

Atelectasis is a common complication in thoracic surgery clinics. It is present in 90% of all patients in the postoperative period, even if it is not present on conventional chest radiography. It is more common in basal parts of the lung, and operated patients, especially in incisions close to the diaphragm [27]. Atelectasis developed in 3.18% of patients in our study, and it constituted 25% of patients who developed complications. There was a significant relationship between atelectasis and tobacco use.

When considered as a surgical complication, 2.65% of patients developed pneumothorax. One of the risk factors of spontaneous pneumothorax is tobacco use [28]. We found a statistically significant difference between tobacco use and the development of spontaneous pneumothorax as a complication. This result was consistent with the literature.

We did not find any significant relationship between other complications and tobacco use. However, since the number of these complications was low, we did not accept the results as reliable.

Logistic regression analysis was performed to evaluate possible factors associated with the development of complications together. Accordingly, the development of complications is significantly associated with tobacco use, ASA score, and type of surgery. The results of logistic regression analysis showed that pulmonary complications were seen more in former and current tobacco users compared to non-tobacco users. Major surgeries and minimally invasive surgeries are more associated with the development of complications, respectively than minor surgeries. The ASA score representing the physical performance of the patient was also found to be related to the development of complications.

The admission rate to ITU was significantly higher in patients over 65 years of age. This result is consistent with the results of the previous studies [14]. However, contrary to some studies, no relationship was found between intensive therapy unit admission and smoking [29,30]. The reason for this was that the patients using tobacco in our series were younger, whereas the patients who needed ITU were older.

We had to intubate 26 of the patients. The need for intubation was not associated with tobacco use, there was a significant relationship between intubation need and age, and it revealed that older patients needed more intubation.

While some studies have shown that smoking increases mortality [31,32], some studies have shown no relationship between smoking and mortality [33]. Twenty patients died, 10 of whom used tobacco, and 10 of whom did not. Accordingly, there was no relationship between tobacco use and mortality. However, there was a significant relationship between age and death, and most patients who died were over 65 years old. This result was not surprising considering that tobacco users are mostly young. Ten of the patients who died had infectious diseases and empyema, seven had malignant diseases, and three had pleural effusion due to congestive heart failure. Eight patients had comorbidities.

There are close relationships between admission to the ITU, intubation, and death. Some patients were included in more than one of these groups. Therefore, these three groups were evaluated together in the logistic regression model as a poor prognosis group. According to this; the development of poor prognostic outcomes was significantly associated with age and ASA score ($p < 0.05$). Poor physical performance and advanced age were associated with ITU admission, intubation, and death.

According to a study evaluating the relationship between hospital stay and smoking, the length of stay in hospital is higher in the smoker group [34]. In our study, the rate of tobacco use was higher in those who were hospitalized for more than 9 days. The relationship between the length of stay in hospital and tobacco use was consistent with the literature.

In order to evaluate the effect of smoking on the length of stay in hospital more accurately, the logistic regression analysis model was used together with other possible factors affecting the length of stay in hospital. According to logistic regression analysis results, Age, tobacco use, ASA score, diagnosis, and treatment methods were significantly related to the length of stay in hospital. According to the results of logistic regression analysis, the variable most associated with length of stay in hospital was the type of surgery. Major surgery and minimally invasive surgery, respectively, were more associated with length of stay in hospital

than minor surgery. The patient group with a high length of stay in hospital had a higher proportion of current tobacco users. Heavy tobacco users had more length of stay in hospital than light tobacco users. Former tobacco users and non-tobacco users were not associated with the length of stay in hospital. The physical performance status of the patients was found to be related to the length of stay in hospital. The length of stay was higher in patients with ASA III and above. A poor physical condition prolonged hospital stay. Length of hospital stay was longer in infectious diseases. The reason for this was thought to be that antibiotic treatment was given in infectious diseases in the preoperative period and, if necessary, in the postoperative period. In addition, the length of stay in hospital was found to be higher in elderly patients compared to younger ages.

In conclusion, the proportion of tobacco users was higher in patients with thoracic surgery than in those who did not. Tobacco use is associated with young age, postoperative complications, and length of hospital stay. Therefore, tobacco use is a severe health problem, especially at young ages. In the fight against tobacco, Emphasizing that tobacco use will have surgical consequences and a high probability of complications after surgery and supporting tobacco cessation programs will contribute to public health and prevent economic loss.

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**Table 1 Patient characteristics by tobacco use**

| **Characteristics** | **Tobacco amounts** | **Total** | **X²*** | **p*** |
|---|---|---|---|---|
| Non users | Former users | Light users | Heavy users | Total users |
| **Gender** | Male | N | 143 | 47 |
| % | 26.7 | 8.7 | 21.3 | 43.3 |
| Female | N | 188 | 4 | 17 |
| % | 86.2 | 1.9 | 7.8 | 4.1 |
| **Age** | [?]34 | N | 97 | 6 |
| % | 32.3 | 2.0 | 22.7 | 43.0 |
| 35-64 | N | 109 | 18 | 48 |
| % | 42.7 | 7.1 | 18.8 | 31.4 |
| 65[?] | N | 125 | 27 | 15 |
| % | 62.8 | 13,6 | 11.5 | 16.1 |
| **Comorbidities** | + | N | 118 | 23 |
| % | 59.6 | 11.6 | 11.1 | 17.7 |
| - | N | 213 | 28 | 109 |
| % | 38.3 | 5.0 | 19.6 | 37.1 |
| **ASA[a] Status** | 1 - 2 | N | 291 | 41 |
| % | 44.2 | 6.2 | 18.1 | 31,5 |
| 3[?] | N | 40 | 10 | 12 |
| % | 41.7 | 10.4 | 12.5 | 35.4 |
| **Surgery Types** | Minor | N | 230 | 39 |
| % | 44.7 | 7.5 | 17.3 | 30,5 |
| Minimally invasive | N | 31 | 7 | 17 |
| % | 39,7 | 9.0 | 21.8 | 29.5 |
| Major | N | 70 | 5 | 25 |
| % | 43.3 | 3,0 | 15.2 | 37.8 |
| **Total** | N | 331 | 51 | 131 |
| | | 43.9 | 6.7 | |
| % | 17,4 | 32.0 | 56.1 | 100.0 |

*Calculated by the Chi- square test or the Fisher exact test. [a] American Society of Anesthesiologists

**Table 2 Relationship of complications with tobacco use**

| **Complications** | **Tobacco+** | **Tobacco -** | **Total** | | **X²*** | **P*** |
|---|---|---|---|---|---|---|
| | N | % | N | % | N | % |
| **Persistent air leak** | 23 | 79.3 | 6 | 20.7 | 29 | 100.0 |
| **Atelectasis** | 21 | 87.5 | 3 | 12.5 | 24 | 100.0 |
| **Pneumothorax** | 16 | 80.0 | 4 | 20.0 | 20 | 100.0 |
| **Respiratory failure** | 3 | 60.0 | 2 | 40.0 | 5 | 100.0 |

| | | | | | | |
|---|---|---|---|---|---|---|
| **Pleural effusion** | 5 | 100.0 | 0 | 0.0 | 5 | 100.0 |
| **Surgical site infection** | 3 | 75.0 | 1 | 25.0 | 4 | 100.0 |
| **Cardiac arrhythmia** | 2 | 50.0 | 2 | 50.0 | 4 | 100.0 |
| **Pneumonia** | 1 | 33.3 | 2 | 66.7 | 3 | 100.0 |
| **Acute renal failure** | 1 | 100.0 | 0 | 0.0 | 1 | 100.0 |
| **Bronchospasm** | 1 | 100.0 | 0 | 0.0 | 1 | 100.0 |
| **TOTAL** | **76** | **79.2** | **20** | **20.8** | **96** | 100.0 |

*Calculated by the Chi- square test or the Fisher exact test

**Table 3 Evaluation of Relationships of Independent Variables with Development of Complication Using Logistic Regression Analysis**

| | B | Wald | p | OR | **CI 95%** |
|---|---|---|---|---|---|
| Min | Max | | | | |
| **Age groups** | | | | | |
| 35-64 years (ref.=<35 years) | 0.228 | 0.565 | 0.452 | 1.256 | 0.693 |
| >65 years (ref.=<35 years) | 0.519 | 1.671 | 0.196 | 1.680 | 0.765 |
| **Gender** | | | | | |
| Male (ref.=female) | -0.067 | 0.032 | 0.857 | 0.935 | 0.451 |
| **Comorbidities** | | | | | |
| + (ref.=(-)) | 0.255 | 0.606 | 0.436 | 1.291 | 0.679 |
| **Tobacco use** | | | | | |
| Former user (ref.=non-user) | 1.118 | 4.753 | **0.029** | 3.058 | 1.120 |
| Light-user (ref.=non-user) | 0.962 | 5.703 | **0.017** | 2.616 | 1.188 |
| Heavy-user (ref.=non-user) | 1.266 | 11.998 | **0.001** | 3.547 | 1.733 |
| **ASA score** | 0.695 | 4.770 | **0.029** | 2.004 | 1.074 |
| **Diagnosis** | | | | | |
| Malign diseases (ref.=benign diseases) | -0.042 | 0.010 | 0.919 | 0.959 | 0.432 |
| Infectious diseases (ref.=benign diseases) | 0.084 | 0.034 | 0.853 | 1.088 | 0.445 |
| Sp. pneumothorax (ref.=benign diseases) | 0.683 | 3.690 | 0.055 | 1.980 | 0.986 |
| **Surgery types** | | | | | |

| | | | | | |
|---|---|---|---|---|---|
| Minimally invasive (ref.=minor operations) | 0.843 | 4.886 | **0.027** | 2.323 | 1.100 |
| Major operations (ref.=minor operations) | 1.495 | 31.670 | **<0.001** | 4.458 | 2.649 |

OR=Odds Ratio, CI= Confidence Interval, Hosmer-Lemeshow p=0.528, $r^2$=0.180

**Table 4 Evaluation of the relationship of independent variables in prediction of poor prognosis criteria (admission to intensive care unite – intubation - mortality) by logistic regression analysis**

| | B | Wald | p | OR | CI 95% |
|---|---|---|---|---|---|
| Min | Max | | | | |
| **Age groups** | | | | | |
| 35-64 years (ref.=<35 years) | 0.836 | 2.483 | 0.115 | 2.308 | 0.815 |
| >65 years (ref.=<35 years) | 1.712 | 9.723 | **0.002** | 5.543 | 1.889 |
| **Gender** | | | | | |
| Male (ref.=female) | -0.071 | 0.038 | 0.846 | 0.932 | 0.456 |
| **Comorbidities** | | | | | |
| + (ref.=(-)) | -0.101 | 0.078 | 0.780 | 0.904 | 0.444 |
| **Tobacco use** | | | | | |
| Former user (ref.=non-user) | -1.332 | 2.785 | 0.095 | 0.264 | 0.055 |
| Light-user (ref.=non-user) | 0.082 | 0.030 | 0.864 | 1.086 | 0.425 |
| Heavy-user (ref.=non-user) | 0.079 | 0.031 | 0.861 | 1.083 | 0.445 |
| **ASA score** | 1.417 | 15.024 | **<0.001** | 4.125 | 2.015 |
| **Diagnosis** | | | | | |
| Malign diseases (ref.=benign diseases) | -0.076 | 0.040 | 0.842 | 0.927 | 0.439 |
| Infectious diseases (ref.=benign diseases) | -0.773 | 1.371 | 0.242 | 0.462 | 0.127 |
| Sp. pneumothorax (ref.=benign diseases) | -0.980 | 3.545 | 0.060 | 0.375 | 0.135 |
| **Surgery types** | | | | | |

| | | | | | |
|---|---|---|---|---|---|
| Minimally invasive (ref.=minor operations) | -0.273 | 0.323 | 0.570 | 0.761 | 0.297 |
| Major operations (ref.=minor operations) | -0.286 | 0.386 | 0.534 | 0.751 | 0.305 |

OR=Odds Ratio, CI= Confidence Interval, Hosmer-Lemeshow p=0.528, $r^2$=0.180

**Table 5 - Evaluation of the relationship of ındependent variables in predicting the length of stay in hospital with logistic regression analysis**

| | **B** | **Wald** | **p** | **OR** | **CI 95%** |
|---|---|---|---|---|---|
| Min | Max | | | | |
| **Age groups** | | | | | |
| 35-64 years (ref.=<35 years) | 0.383 | 2.628 | 0.105 | 1.466 | 0.923 |
| >65 years (ref.=<35 years) | 0.969 | 10.841 | **0.001** | 2.635 | 1.480 |
| **Gender** | | | | | |
| Male (ref.=female) | 0.139 | 0.333 | 0.564 | 1.149 | 0.717 |
| **Comorbidities** | | | | | |
| + (ref.=(-)) | -0.011 | 0.002 | 0.964 | 0.989 | 0.605 |
| **Tobacco use** | | | | | |
| Former user (ref.=non-user) | 0.443 | 1.405 | 0.236 | 1.557 | 0.749 |
| Light-user (ref.=non-user) | 0.667 | 5.763 | **0.016** | 1.948 | 1.130 |
| Heavy-user (ref.=non-user) | 1.310 | 24.683 | <**0.001** | 3.706 | 2.210 |
| **ASA score** | 1.043 | 13.220 | <**0.001** | 2.839 | 1.618 |
| **Diagnosis** | | | | | |
| Malign diseases (ref.=benign diseases) | -0.073 | 0.070 | 0.792 | 0.929 | 0.539 |
| Infectious diseases (ref.=benign diseases) | 0.657 | 4.252 | **0.039** | 1.929 | 1.033 |
| Sp. pneumothorax (ref.=benign diseases) | 0.431 | 2.588 | 0.108 | 1.539 | 0.910 |
| **Surgery types** | | | | | |
| Minimally invasive (ref.=minor operations) | 1.622 | 32.826 | <**0.001** | 5.063 | 2.907 |

| | | | | | |
|---|---|---|---|---|---|
| Major operations (ref.=minor operations) | 2.694 | 109.559 | **<0.001** | 14.797 | 8.934 |

OR=Odds Ratio, CI= Confidence Interval, Hosmer-Lemeshow p=0,372, $r^2$=0,352


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