Efficacy of an inpatient smoking cessation program at a single regional cancer center
A prospective observational study

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Abstract

Smoking is the leading cause of preventable death and a risk factor for cancer, but smoking cessation is difficult even in patients who need hospitalization. This study aimed to investigate the usefulness of an inpatient smoking cessation consultation program and to analyze the clinical factors associated with abstinence. In this observational study, patients received regular counseling for 6 months, and abstinence was objectively assessed via urine and exhaled carbon monoxide testing. Cessation rates were assessed at 4 weeks and 6 months, and clinical characteristics associated with cessation success were investigated. Of the 571 patients referred to participate in the program, 170 (29.8%) were enrolled, and only 2 (1.2%) used smoking cessation drugs in addition to counseling. The smoking cessation rate was 77.6% after 4 weeks and 59.1% after 6 months. The cessation rates were significantly higher in patients with cancer than in those without cancer at both timepoints (63.8% vs 21.9%, P < .001, 53.6% vs 12.5%, P < .001), and they were also higher in the first admission group than in the re-admission group (87.4% vs 74.7%, P = .033, 88.5% vs 76.1%, P = .037). In patients with lung cancer, progression-free survival and overall survival tended to be better in those enrolled in the program (P = .158, P = .183). In conclusion, the inpatient smoking cessation program was associated with a high abstinence rate. Most patients maintained cessation without medication, suggesting that initial admission, along with a cancer diagnosis, can provide enough motivation to abstain from smoking. In addition, the smoking cessation effort showed potential to improve survival during lung cancer treatment.

Abbreviations: BMI = body mass index, EMR = electronic medical records, IRB = institutional review board, NO = nitric oxide, OS = overall survival, PFS = progression-free survival.

Keywords: cancer, inpatients, lung neoplasm, smoking cessation

1. Introduction

Cigarette smoking is the leading cause of preventable death globally, being responsible for nearly 6 million deaths per year and causing an economic burden of hundreds of billions of dollars worldwide. At least 30% of all patients who die from cancer and nearly 80% who die from chronic obstructive pulmonary disease are smokers; smoking is also a risk factor for early cardiovascular disease and death. Several studies have shown that continuing smoking after a cancer diagnosis increases overall mortality and increases postoperative complications. Patients with lung cancer who continued smoking after tumor resection surgery were reportedly at a 2.9-fold higher risk of overall mortality, a 1.9-fold higher risk of recurrent cancer, and were 2.3 times more likely to develop a secondary tumor than those who discontinued smoking. Despite these risks, many patients who are diagnosed with cancer continue to smoke. According to the National Health Screening Cohort database of the Korean National Health Insurance Service, among 4657 pre-diagnosis smokers, nearly half continued to smoke after being diagnosed with cancer.

Hospilation and disease diagnosis have been shown to motivate individuals to adopt risk-reducing or health-protective behaviors, including smoking cessation, in what has been referred to as “teachable moments.” Regarding smoking, teachable
moments present patients with evidence that smoking following cancer treatment causes adverse outcomes. Patients are also provided the option to undergo cancer treatment via a smoking cessation support program. Factors that have significantly affected smoking cessation rates in previous studies include sex, age, age at smoking initiation, previous attempts to quit, nicotine dependency, alcoholism, education level, and income level.[8,13–19] A national health insurance policy supporting therapeutic smoking cessation was implemented in Korea in 2015; it comprises 2 types of short-term hospitalization programs. One is a professional therapeutic camp consisting of 4 nights and 5 days, which was modified from the residential nicotine dependence program at Mayo Clinic in Rochester, MN.[20] The other is an inpatient smoking cessation program with intensive in-person and telephone counseling to assist smokers who are hospitalized with other illnesses.

Although most smokers have tried to quit smoking[21] and over 90% of physician know the adverse effect of smoking, only 39% of physician actively provide cessation assistance.[22] And most smokers’ quit attempts fail. Therefore, this study will emphasize the necessity of healthcare providers’ smoking cessation education during hospitalization and give better treatment outcome for current smoke.

In the present study, smoking cessation education and counseling were offered to patients who had been admitted to a cancer-specialized hospital but continued to smoke, and clinical characteristics associated with smoking cessation were investigated. The primary aim of the current study was to evaluate outcomes associated with this inpatient smoking cessation program, while the secondary aim was to perform a survival analysis of patients with lung cancer according to program participation.

2. Materials and methods

2.1. Study design and procedure

The study included patients who were admitted to Chonnam National University Hwasun Hospital, a regional cancer center in Korea, and were referred to the inpatient smoking cessation program by hospital professionals using the electronic medical record (EMR) system (Fig. 1). All participants provided written informed consent for participating in the Korean Tobacco Control Program. The study was approved by the independent institutional review board (IRB) of Chonnam National University Hwasun Hospital (IRB approval number: CNUHH-2020-038).

Between January 2018 and December 2018, participants received bedside counseling administered by a trained nurse. They were asked to fill out a questionnaire that evaluated nicotine dependency via the Fagerström Test for Nicotine Dependence. The questionnaire also asked patients about the age at which they began smoking, how long they had been smoking, and daily tobacco consumption amounts. Additionally, the counseling nurse explained about the various diseases caused by smoking and the benefits of smoking cessation. The nurse also provided advice about managing withdrawal symptoms and suppressing the desire to smoke. In addition, if needed, patients could receive pharmacological help to stop smoking or nicotine replacement therapy.

After hospital discharge, program participants received regular counseling for 6 months: 4 times in person and 5 times by telephone. They were asked if they maintained smoking cessation and the severity of their withdrawal symptoms and cravings. In addition, they were advised on how to control their symptoms again. In addition, the side effects of medication use were monitored. The success of the program was objectively determined through urine cotinine and exhaled carbon monoxide levels. Cessation rates were assessed at 4 weeks and 6 months. Clinical characteristics associated with success rates were assessed using information obtained from the EMR system. In patients with lung cancer for whom the program was recommended, the clinical characteristics and survival rates were compared between patients participating in the program and those not participating.

2.2. Statistical analysis

Relationships between clinical characteristics and the program’s success were examined using Fisher’s exact test and the t-test for independent samples, as appropriate. In the subgroup analysis of patients with lung cancer patients, the Kaplan–Meier method was used to evaluate relationships between clinical characteristics, survival rates, and the registration status. Statistical analyses were performed using IBM SPSS version 23 (IBM Corp., Armonk, NY), and $P<.05$ was deemed to indicate statistical significance.

3. Results

3.1. Baseline demographics

Of the 571 patients who were referred for the program, 170 (29.8%) were enrolled (Fig. 2; Table 1); the median age was 62.0 ± 10.5 years. Most patients were male (158/170; 92.9%), and the mean level of smoking was 39.2 ± 21.0 pack-years. The mean body mass index (BMI) was 23.8 ± 3.3 kg/m². Chronic diseases
were prevalent (106/170; 62.4%) and included hypertension, diabetes, chronic kidney disease, cardiovascular disease, cerebral infarction, and chronic hepatitis. The mean age at the initiation of smoking was 20.0 ± 5.6 years, and the mean Fagerström score was 3.83 ± 2.43. Most patients were non-drinkers upon admission to the program (118/170; 69.4%). Regarding the patients’ educational level, 55 (32.3%) had attended middle school, 47 (27.6%) had attended high school, and 54 (31.8%) had attended university, and 14 refused to answer (8.2%).

Most patients had been first admitted to this particular hospital for any reason (139/170; 81.8%), and most (138/170; 81.2%) had been diagnosed with cancer or treated for cancer during admission. Of the cancer patients, lung cancer was noted in 52.9% (73/138), followed by gastric cancer (19/138; 13.8%), colorectal cancer (9/138; 6.5%), hepatic cancer (9/138; 6.5%) and other cancer (28/138; 20.3%). Lung cancer was the most frequent diagnosis, accounting for 52.9%, followed by gastric cancer (13.8%). A total of 18.1% (25/138), 20.3% (28/138), 31.9% (44/138), 28.3% (39/138), and 1.4% (2/138) of patients had stage I, II, III, IV cancer, and unclassified respectively. Only 2 patients (1.2%) concurrently received smoking cessation drugs such as varenicline in conjunction with the counseling program.

3.2. Clinical characteristics of patients who successfully stopped smoking

The smoking cessation rates were 77.6% at 4 weeks and 59.1% at 6 months. At 4 weeks, the median age in the successful and failed cessation groups was 62.0 ± 10.49 and 59.0 ± 11.7 years, respectively. At 6 months, the respective median ages were 61.9 ± 9.2 and 59.6 ± 11.4 years (Table 2). Former smoking levels were greater in the success group than in the failure group at 4 weeks (42.13 ± 20.74 vs 35.5 ± 21.05, P = .908) and 6 months (42.59 ± 21.89 vs 36.34 ± 20.03, P = .640), but the difference was not significant at either timepoint. There were no significant differences in chronic diseases, age at the time of smoking initiation, or alcohol consumption between the success and failure groups at either timepoint. Chronic disease consisted of hypertension, diabetes, chronic kidney disease, cardiovascular

| Table 1 |
| --- |
| Baseline demographics and characteristics of patients who were enrolled. |
| Characteristics | n = 170 |
| Age, median | 62.0 ± 10.49 |
| Sex (M/F) | 158/12 |
| Pack-years, mean | 39.21 ± 21.01 |
| BMI (kg/m²), mean | 23.79 ± 3.34 |
| Chronic disease*, n (%) | 106 (62.4%) |
| Yes | 64 (37.6%) |
| No | 20.00 ± 5.55 |
| Fagerström score, mean | 3.83 ± 2.43 |
| Alcohol drinker, n (%) | 52 (30.6%) |
| Yes | 118 (69.4%) |
| No | 138 (81.2%) |
| Malignancy, n (%) | 32 (18.8%) |
| Yes | 73 (42.9%) |
| No | 2 (1.5%) |
| Primary site of cancer, n (%) | 19 (13.8%) |
| Lung | 9 (6.5%) |
| Esophagus | 9 (6.5%) |
| Stomach | 4 (2.9%) |
| Colon and rectum | 6 (1.4%) |
| Pancreas and biliary system | 4 (2.9%) |
| Head and neck | 2 (1.2%) |
| Bladder and prostate | 11 (7.8%) |
| Others | 25 (14.7%) |
| Stage | 28 (16.5%) |
| I | 44 (25.9%) |
| II | 39 (22.9%) |
| III | 16 (9.4%) |
| IV | 11 (6.5%) |
| Education level, n (%) | 55 (32.3%) |
| < Middle school | 47 (27.6%) |
| High school | 54 (31.8%) |
| ≥ University | 25 (14.7%) |

* Chronic disease consisted of hypertension, diabetes, chronic kidney disease, cardiovascular disease, cerebral infarction, and chronic hepatitis.
Table 2
Clinical characteristics of patients with smoking cessation.

| Characteristics                      | Success 4 wk | Failure 4 wk | P value | Success 6 mo | Failure 6 mo | P value |
|--------------------------------------|--------------|--------------|---------|--------------|--------------|---------|
| Age, median                          | 61.97 ± 9.28 | 59 ± 11.72   | .143    | 61.94 ± 9.21 | 59.58 ± 11.42 | .101    |
| Sex (M:F)                            | 91:4         | 67:8         | .134    | 75:3         | 85.9         | .132    |
| Pack-years, mean                     | 42.13 ± 20.74| 35.5 ± 21.05 | .908    | 42.59 ± 21.89| 36.34 ± 20.03| .640    |
| BMI (kg/m²), mean                    | 23.46 ± 3.01 | 24.21 ± 3.705| .074    | 23.52 ± 3.07 | 24.02 ± 3.56  | .178    |
| Chronic disease, n (%)               | 62 (65.3%)   | 44 (58.7%)   | .427    | 50 (64.1%)   | 56 (60.9%)   | .655    |
| 1st Admission, n (%)                 | 83 (87.4%)   | 56 (74.7%)   | .033    | 69 (88.5%)   | 70 (76.1%)   | .037    |
| 1st smoking age, mean                | 20.79 ± 5.66 | 20.99 ± 5.46 | .713    | 21.21 ± 5.34 | 20.69 ± 5.74 | .383    |
| Fagerström score, mean               | 3.45 ± 2.42  | 4.31 ± 2.38  | .971    | 3.83 ± 2.47  | 3.83 ± 2.41  | .626    |
| Alcohol drinker, n (%)               | 30 (31.6%)   | 22 (29.3%)   | .867    | 26 (33.5%)   | 26 (28.3%)   | .474    |
| Cancer, n (%)                        | 75 (88.2%)   | 60 (84.5%)   | .001    | 64 (94.1%)   | 71 (80.7%)   | .015    |

| Stage, n (%)                        | .27         |
| I                                   | 14 (15.9%)  | 11 (22.0%)  | .114    | 14 (21.9%)   | .127    |
| II                                  | 21 (23.9%)  | 7 (14.0%)   | 18 (24.3%)| 10 (15.6%)   | .865    |
| III                                 | 33 (37.5%)  | 11 (22.0%)  | 29 (39.2%)| 15 (23.4%)   | .021    |
| IV                                  | 18 (20.5%)  | 21 (42.0%)  | 14 (16.9%)| 25 (39.1%)   | .021    |
| Education level, n (%)              | .316        |
| ≤Middle school                      | 34 (37.8%)  | 28 (38.1%)  | 28 (38.3%)| 34 (37.7%)   | .085    |
| High school                         | 22 (24.4%)  | 26 (35.6%)  | 19 (26.0%)| 28 (31.1%)   |         |
| ≥University                         | 34 (37.8%)  | 20 (27.4%)  | 26 (35.6%)| 28 (31.1%)   |         |

NH= national health insurance.

3.3. Subgroup analysis of patients with lung cancer according to participation in the program

Of the 571 patients recommended, 155 who had lung cancer were referred to the smoking cessation program (Table 3). Their median age was 68.0 ± 7.3 years, and most were male (147/155; 94.8%). Their mean smoking amount was 44.8 ± 19.7 pack-years, and the mean BMI was 22.4 ± 3.4 kg/m². Most of these 155 patients had a chronic disease (109; 70.3%), and their cancer types included adenocarcinoma (41; 26.5%), squamous carcinoma (56; 36.1%), small cell lung cancer (49; 31.6%), and other subtypes (9; 5.8%). Most patients had stage III (41.9%) or stage IV (41.3%) cancer. Thirty-one of the 155 patients with lung cancer underwent surgery (20.0%), 102 underwent chemotherapy (65.8%), and 76 underwent radiotherapy (49.0%). Responses to chemotherapy and radiotherapy included complete response (5; 10.4%), partial response (20; 41.7%), stable disease (15; 31.3%), progressive disease (4; 8.3%), and non-evaluable (4; 8.3%). Thirty patients died during the follow-up period (19.4%).

Of the 155 lung cancer patients referred to the smoking cessation program, 73 (47.1%) were enrolled and 82 (52.9%) declined to participate. The reasons for declining were they had already stopped smoking (34.2%), they had no intention of quitting (7.1%), participation was declined by a family member on their behalf (4.5%), and ignoring the referral (45.8%). The median age of the enrolled and non-enrolled patients was 66.8 ± 7.1 and 68.2 ± 7.4 years, respectively. There were no significant differences in the smoking level or BMI between these 2 groups.

The program enrolment rate in the group that underwent surgery was higher than that in the non-surgical group (64.5% vs 42.7%, P = .043) but lower in the chemotherapy group than in the non-chemotherapy group (41.2% vs 58.5%, P = .044). The program enrolment rate was higher in the early stage cancer group than in the advanced stage cancer group (83.3% vs 34.4%, P = .11); however, there were no significant differences in the cancer type or treatment response categories between these 2 groups. The mean progression-free survival (PFS) and overall survival (OS) tended to be better in patients who enrolled in the program, but not significantly (Fig. 3).

4. Discussion

The abstinence rate in the current study (59.1%) was higher than that in the residential nicotine dependence program at Mayo Clinic (45.0%) [20] and comparable to the Korean professional therapeutic camp (66.2%). [21] Moreover, most patients in the present study stopped smoking while receiving counseling alone and did not require cessation drugs. The cessation rate was significantly higher in the first admission group than in the re-admission group. Further, the smoking rates in patients with cancer were significantly higher than those in patients without cancer at 4 weeks and 6 months. This suggests that a patient’s first
Table 3

Clinical characteristics of lung cancer patients according to the program participation.

| Characteristics                      | Total (n = 155) | Enrolled (n = 73) | Declined (n = 82) | P value |
|--------------------------------------|-----------------|------------------|-------------------|---------|
| Age, median, years                   | 68.00±7.26      | 66.82±7.06       | 68.20±7.42        | .875    |
| Sex (M/F)                            | 147/08          | 67/6             | 80/2              | .149    |
| Pack-years, mean, packs              | 44.79±19.67     | 45.69±21.12      | 43.99±16.38       | .354    |
| BMI (kg/m²), mean                    | 22.44±3.37      | 23.29±3.46       | 21.67±3.12        | .338    |
| Chronic disease, n (%)               |                 |                  |                   |         |
| Yes                                  | 109 (70.3%)     | 54 (74.0%)       | 55 (67.1%)        | .382    |
| No                                   | 46 (29.7%)      |                  |                   |         |
| Cancer type, n (%)                   |                 |                  |                   | .439    |
| Adenocarcinoma                       | 41 (26.5%)      | 18 (24.7%)       | 23 (28.0%)        |         |
| Squamous carcinoma                   | 56 (36.1%)      | 29 (39.7%)       | 27 (32.9%)        |         |
| Small cell lung cancer               | 49 (31.6%)      | 24 (32.9%)       | 25 (30.5%)        |         |
| Others                               | 9 (5.8%)        | 2 (2.8%)         | 7 (8.5%)          |         |
| Stage, n (%)                         |                 |                  |                   | .111    |
| I                                    | 14 (9.0%)       | 7 (9.6%)         | 7 (8.5%)          |         |
| II                                   | 12 (7.7%)       | 10 (13.7%)       | 2 (2.4%)          |         |
| III                                  | 65 (41.9%)      | 34 (46.6%)       | 31 (37.8%)        |         |
| IV                                   | 64 (41.3%)      | 22 (30.1%)       | 42 (51.2%)        |         |
| Surgical treatment, n (%)            |                 |                  |                   | .043    |
| Yes                                  | 31 (20.0%)      | 20 (27.4%)       | 11 (13.4%)        |         |
| No                                   | 124 (80.0%)     |                  |                   |         |
| Chemotherapy, n (%)                  |                 |                  |                   | .044    |
| Yes                                  | 102 (65.8%)     | 42 (57.5%)       | 60 (73.2%)        |         |
| No                                   | 53 (34.2%)      |                  |                   |         |
| Radiotherapy, n (%)                  |                 |                  |                   | .384    |
| Yes                                  | 76 (49.0%)      | 37 (50.7%)       | 39 (47.6%)        |         |
| No                                   | 79 (51.0%)      |                  |                   |         |
| Response for chemotherapy or radiotherapy, n (%) |           |                  |                   | .425    |
| Complete response                    | 27 (17.4%)      | 17 (23.3%)       | 10 (12.2%)        |         |
| Partial response                     | 45 (29.0%)      | 21 (28.8%)       | 24 (29.3%)        |         |
| Stable disease                       | 41 (26.5%)      | 16 (21.9%)       | 24 (29.3%)        |         |
| Progressive disease                  | 9 (5.8%)        | 4 (5.5%)         | 5 (6.1%)          |         |
| Non-evaluable                        | 33 (21.3%)      | 15 (20.5%)       | 18 (22.0%)        |         |
| Expire, n (%)                        |                 |                  |                   | .211    |
| Yes                                  | 33 (21.3%)      | 13 (17.8%)       | 20 (24.4%)        |         |
| No                                   | 122 (78.7%)     |                  |                   |         |

Chronic disease consisted of hypertension, diabetes, chronic kidney disease, cardiovascular disease, cerebral infarction, and chronic hepatitis.

Figure 3. Progression-free (A) and overall survival (B) according to participation in the program in patients with lung cancer. The green and blue lines represent enrolled and non-enrolled patients, respectively.
hospitalization or cancer diagnosis can serve as a strong “teachable moment” with regard to smoking cessation, as naturally occurring health events are thought to motivate individuals to spontaneously adopt risk-reducing health behaviors.[9,10] 

Among patients with cancer, those at an earlier stage were more likely to stop smoking than those at a more advanced stage, suggesting that the severe stress of chemotherapy caused some patients at an advanced stage to continue smoking. In the lung cancer subgroup, approximately half of patients were enrolled in the program and half declined. Patients with early stage cancer were more likely to enroll than those with advanced stage, operated patients were more likely to enroll than non-operated patients, and patients undergoing chemotherapy were less likely to enroll than those not undergoing chemotherapy. The program may have been viewed as bothersome by patients who had advanced stage cancer and had gone through chemotherapy and more complicated treatments.

Smoking cessation among patients with lung cancer after diagnosis may increase OS.[24] In the present study, the mean PFS and OS tended to be higher in patients who enrolled than in patients who declined to participate in the program. One meta-analysis provided preliminary evidence that smoking cessation after early stage lung cancer diagnosis improves prognosis.[25] Survival curves revealed that the estimated number of deaths prevented was larger than that expected from the reduction in cardiorespiratory deaths after smoking cessation; thus, most mortality gains were likely caused by reduced cancer progression. These findings suggest that smoking cessation is more beneficial in patients with early stage lung cancer than in those with advanced stage lung cancer.

As mentioned previously, most physicians already know the adverse outcome of smoking after cancer diagnosis. But only 39% of them intervened and advised actively to stop smoking.[22] Our study can give significant message for healthcare provider. The timing of hospitalization and diagnosis of cancer is very important for smokers and smoking cessation program may survive patients who still smoke even after diagnosis of cancer.

The current study had several limitations. It involved a single program at a single institution with a limited sample size. With regard to the objective assessment of smoking cessation, urine cotinine tests generally do not yield accurate results for up to 5.5 days after quitting,[26] and this may have reduced the accuracy of smoking cessation evaluation in the present study. The relatively short period of 6 months between the program onset and the final follow-up timepoint negated the capacity to monitor the program’s success in the long term. There are also limitations to the conclusions that can be drawn from the survival analysis, given the relatively short follow-up period and the fact that the median value was not reached. Finally, as advanced cancer patients tended to refuse enrollment, these patients’ survival may be worse than that of the enrolled group.

In conclusion, the inpatient smoking cessation program used in the current study resulted in a high abstinence rate in hospitalized patients. Most patients maintained cessation without requiring medication, suggesting that for at least some patients the diagnosis of cancer and the first hospital admission may generate sufficient motivation to quit smoking. Lastly, the effort to stop smoking after diagnosis may have improved OS in patients with lung cancer. Therefore, smoking cessation program during hospitalization may change smoker’s future although further studies with long-term follow-up are necessary.

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