Smoking and the Increased Risk of Contracting Spontaneous Pneumothorax

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The relation between smoking habits and the occurrence of spontaneous pneumothorax (SP) was studied in a Swedish population, predominantly urban. The study group consisted of a consecutive series of 138 patients admitted to Huddinge University Hospital over ten years for treatment of their first spontaneous pneumothorax. Their smoking habits were routinely analyzed. The sample consisted of 15,204 persons domiciled in the same circumscribed area (County of Stockholm). The annual incidence of first SP in the admission area is 6/100,000 for women and 18/100,000 for men. The study showed that smoking increased the relative risk of contracting a first spontaneous pneumothorax approximately ninefold among women and 22-fold among men and that there is a striking, statistically significant ($p<0.001$) dose-response relationship between smoking and the occurrence of SP. The life span risk of contracting SP among lifelong heavily smoking men is roughly estimated to be 12 percent but only 1/1,000 among never smokers.

The incidence of recorded spontaneous pneumothorax (SP) has increased around the world.[1-4] In the past decades the possible association between SP and emphysema, a smoking-dependent disease, has been discussed.[5-7] It has been observed by some investigators that many SP patients are smokers,[8,9] but only Nakamura et al[10] have reported that the proportion of heavy smokers was more pronounced among SP patients than in the total population of Japan. Jansveld[9] proposed that smoking may be involved in the pathogenic mechanism of SP.

In a previous study of 96 patients with SP we found that the condition seemed to be related to smoking.[11] This finding indicated a need to study the possible role of smoking in this disease and the smoking habits of a large number of patients who were admitted consecutively for their first episode of SP.

The aim of the present investigation was to evaluate the effects of smoking on the relative risk of contracting the first SP and, by comparing the smoking habits of SP patients with those of a reference population, to determine whether there is a dose-response relationship between smoking and SP.

Material and Methods

Ninety-five percent of all persons afflicted and diagnosed with SP in the County of Stockholm are registered and treated in hospital. This county is a geographically and administratively well-defined region, which is dominated by an urban population. The annual incidence (number of cases/100,000 inhabitants/year) of SP increased in this county between 1970 and 1984 among men from 19 to 28 and among women from 3 to 10.[4]

In this region there are three university hospitals with specialized pulmonary departments and several local hospitals where SP patients are treated. University hospitals have a defined admission area with indirect responsibility over other institutions over a corresponding population according to their size (total county population, approximately 1.5 million). Inhabitants domiciled in the direct admission area have direct access to the services of the pulmonary as well as other departments of university hospitals.

This retrospective study population consisted of a consecutive series of 138 patients (35 women, 103 men) admitted from the direct admission area of the Department of Lung Medicine of Huddinge University Hospital and treated there between 1975 and 1984 for a first episode of SP. They are distributed by sex and smoking habits in Table 1.

Criteria for the exclusion of patients were signs of malignant, inflammatory, or cardiopulmonary disease or any reason to suspect catamenial pneumothorax.

The reference group was a contemporary, randomly selected sample consisting of 7,469 men and 7,735 women of the population of the County of Stockholm (Table 2). The dropout in the reference material amounted to 10 to 15 percent.[12]

The smoking habits within the County of Stockholm seem to be uniform. Thus, with respect to lung cancer, the age standardized incidence rate per 100,000 for the period 1977-82 in the two municipalities (Huddinge, Botkyrka)—dominating the direct admission area of the Department of Lung Medicine of Huddinge University Hospital—is of the same magnitude as in the whole county. This suggests that the smoking habits in the admission area are similar to those of the whole county.[13]

In SP air accumulates in the intrapleural cavity with no known cause. The partial or total pressure equilibration between the intrapleural cavity and the ambient air results in a partial or total collapse of the lung.

The diagnosis of SP was confirmed by frontal and lateral chest roentgenograms in every patient who had symptoms such as breathlessness, coughing, or thoracic pain.

Information concerning the smoking habits of the patients was

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Table 1—*Distribution by Sex, Age, and Smoking Habits of 138 Patients, 1975-84*

No. of Cigarettes/day	Women, Age, yr				Total	Men, Age, yr				Total
	18-24	25-34	35-54	55-70		18-24	25-34	35-54	55-70	
0	1	1	4	1	7	4	3	1	2	10
1-12	—	2	3	1	6	1	5	1	4	11
13-22	1	6	5	4	16	4	11	17	13	45
>22	1	1	2	2	6	1	14	15	7	37
	3	10	14	8	35	10	33	34	26	103

*Patients from Botkyrka Brännkyrka Huddinge Hägersten Skärholmen.

Table 2—*Estimated Percentage Distribution of Reference Material with Respect to Smoking Habits*

	Women, Age, yr					Men, Age, yr				
No. of cig/day	18-24 (n=950)	25-34 (n=1,762)	35-54 (n=2,902)	55-70 (n=2,121)	Total (n=7,735)	18-24 (n=1,050)	25-34 (n=1,686)	35-54 (n=2,823)	55-70 n=1,910)	Total (n=7,469)
0	64.8	61.7	68.4	82.0	70.2	74.7	65.5	69.1	76.5	70.9
1-12	18.2	19.3	14.4	10.7	14.9	10.8	12.1	10.2	12.8	11.4
13-22	15.7	17.6	15.3	6.7	13.5	12.8	19.0	16.1	9.1	14.5
>22	1.3	1.4	1.9	0.6	1.4	1.7	3.4	4.6	1.6	3.2
Total	100	100	100	100	100	100	100	100	100	100

obtained from their hospital records. The data included the number of cigarettes actually smoked daily, the time for starting smoking, and any change of smoking habits in time as stated by the patients.

The smoking habits of the reference group were studied by interviewing 1,000–2,000 randomly selected persons annually during 1975 to 1984.[12]

Statistical Methods

The smoking habits of the SP patients, as expressed by the number of cigarettes smoked daily, were compared with those of the reference group after due consideration to sex and age. Smokers were compared with nonsmokers by estimating risk ratios. An overall estimation of the effect of smoking on SP was obtained, and a significance analysis based on ratios of Poisson distributed numbers was carried out.

Results

Data on 138 patients (103 men, 35 women) admitted for their first SP between 1975 and 1984 are displayed in Table 1, distributed by sex, age groups, and smoking habits. Seventeen of the 138 patients were nonsmokers at the time of their first SP.

Table 2 shows the reference group from the County of Stockholm distributed and stratified on the same basis. The reference material had a daily mean cigarette consumption of 3.65 cigarettes/day, 3.9 for men and 3.4 for women. Table 3 shows the age distribution of the patients from the direct admission area of the Department of Lung Medicine which differs from the age distribution of the reference subjects from the County of Stockholm.

Table 3—*Age Distribution on Admission By 1980 Census*

Age, yr	Females	Males
18–24	9,242	9,140
25–34	14,458	14,054
35–54	22,177	22,118
55–70	11,929	11,224
Total	57,806	56,536

Table 4 presents the estimated risk of contracting a first SP over a period of ten years. In calculating the rate presented in Table 4, the numerator was the number of patients presented in Table 1, and the denominator was obtained by multiplying the population figures presented in Table 3 by the percentage distribution of smoking habits within age and sex groups presented in Table 2. The risk rate for ten years in the direct admission area amounts to 0.18 percent for men and 0.06 percent for women. The risk rates are generally higher for men than for women and higher for heavy smokers than for nonsmokers. There is a remarkably high percentage at risk of contracting SP over ten years for male smokers, varying from 0.04 to 4 percent. The latter figure concerns heavy smokers in the oldest-age group who smoked more than 22 cigarettes/day.

In Table 5 the relative risk of a first SP is put equal to 1 for nonsmokers in each age group for both sexes. It is evident that the risk was substantially higher for smokers and particularly for heavy smokers. A comparison of smokers with nonsmokers showed that smokers have an increased relative risk to suffer a first SP. That relative risk is increased ninefold for women and 22-fold for men for smokers vs nonsmokers.

The relative risk of contracting SP calculated on the total material is presented in Figure 1 for men and women. The increase of the relative risk is remarkable, especially between nonsmokers and heavy smokers. There is a dose-response relationship between the smoking habits and the relative risk of a first SP. The

Table 4—*Ten-year Risk Rates 0/00 by Age, Sex, and Smoking Habits*

No. of cig/day	Women, Age, yr					Men, Age, yr				
	18-24	25-34	35-54	55-70	Total	18-24	25-34	35-54	55-70	Total
0	0.2	0.1	0.3	0.1	0.2	0.6	0.3	0.1	0.2	0.3
1-12	0.0	0.7	0.9	0.8	0.7	1.0	2.9	0.4	2.8	1.7
13-22	0.7	2.4	1.5	5.0	2.0	3.4	4.1	4.8	13	5.3
>22	8.5	4.9	9.8	27	7.4	6.4	29	15	40	20
Total	0.3	0.7	0.6	0.7	0.6	1.1	2.3	1.5	2.3	1.8

Table 5—*Relative Risk of Spontaneous Pneumothorax in Nonsmokers By Age and Sex*

No. of cig/day	Women, Age, yr					Men, Age, yr				
	18-24	25-34	35-54	55-70	Total	18-24	25-34	35-54	55-70	Total
0	1	1	1	1	1	1	1	1	1	1
1-12	0	6.4	3.6	7.7	3.8*	1.7	9.0†	6.8	11.9†	6.9†
13-22	3.6	21.0†	5.6*	49.0†	11.1†	5.8*	12.7†	72.7†	54.9†	21.3†
>22	51.2	43.5	18.1*	268†	41.8†	10.9	88.9†	225†	171†	80.5†
0	1	1	1	1	1	1	1	1	1	1
1-	3.7†	14.5‡	5.4‡	31.7‡	8.8‡	4.4‡	19.0‡	74‡	39‡	22.3‡

*p<0.05.
†p<0.01.
‡p<0.001.

level of statistical significance is marked by footnotes in Table 5; what is significant in Table 5 also is significant on the same level in Table 4.

The relative risk of SP for a hypothetical person who smokes more than 22 cigarettes/day and aged 18 to 24 years, 25 to 34, 35 to 54, and 55 to 75 is 0.5 percent, 2.3 percent, 3 percent, and 6 percent, respectively. Such a risk of life extrapolated to a life span between ages 18 to 75 years is 12 percent for a man (Table 6). This risk of life for women seems to be half as high. This high life risk may be reduced to 7 percent by random (95 percent CI lower limit).

Discussion

The smoking habits of 138 SP patients compared with those of the reference group has shown that smoking increases the relative risk of contracting a first SP. This increase is of the same order of magnitude as smoking increases the risk of developing lung cancer. The relative risk for a hypothetical person who smoked more than 22 cigarettes/day between 18 and 75 years was 12.3 percent.

As far as we know this is the first documented evidence on a dose-response relationship between SP and smoking. Especially remarkable is the extremely high risk among heavy smokers. The relative risk of getting SP is higher in men than in women.

It is evident from Figure 1 that some kind of dose-response relationship exists between smoking and the relative risk of SP. The observation that men run a higher risk of contracting SP may be explained in the following way:

On the average, women reported that they smoked less and started smoking later than men. The length of exposure may be an important factor. Exposure to 200 cigarette/years (number of cigarettes smoked daily × number of smoke-years) may differ according to the age at which the subjects became smokers, the length of exposure, and the number of cigarettes smoked daily. If age is regarded as a proxy of the length of the smoking habits, this hypothesis is supported by the finding that the interaction between age and smoking is considerable.

Table 6—*Estimated Risk of Spontaneous Pneumothorax per 1,000 Persons Aged 18 to 70 Years*

Group	No. of Cigarettes/Day	Women	Men
A Nonsmokers		0.9±0.7	1.2±0.8
B Smokers	1-12	3.8±3.4	8.7±5.4
C	13-22	13±8.2	35±12
D	>22	61±60	123±51
		C-A†	B-A†
		C-B*	C-A‡
			D-A‡
			C-B‡
			D-B‡
			D-C†

Sex differences	
Regarding nonsmokers	NS
Smokers of 1-12 cig/day	NS
Smokers of 13-22 cig/day	† (p<0.01)
Smokers of 22 cig/day	NS

Sex difference only in one of the group of smokers
*p<0.05.
†p<0.01.
‡p<0.001.

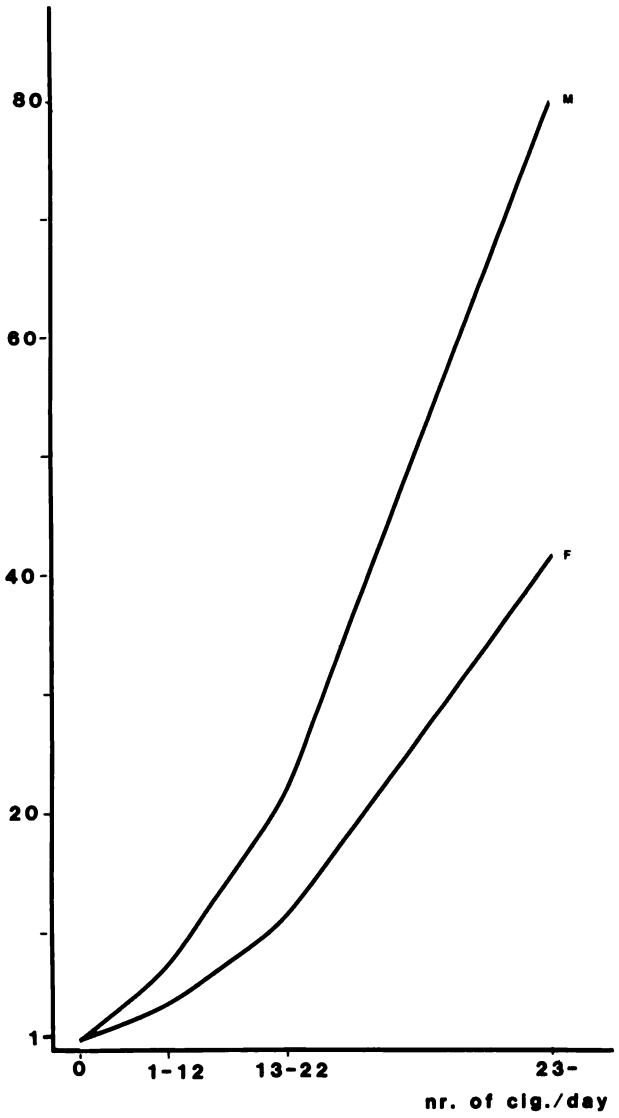

FIGURE 1. Relative risk of spontaneous pneumothorax for males and females based on total population according to daily cigarette consumption. For nonsmokers, relative risk considered to be 1.

There is also a biologic, sex-dependent explanation. Women have larger airways than men, as concluded by Taussig.[14] Airway obstruction, which is characteristic of SP,[15] may therefore become manifest in the smaller airways of males at an earlier stage. The relationship between smoking and the incidence of SP seems to be exponential.

These relative risks (9 and 22) suggest that smoking contributes to the majority of all SP cases. Thus, if the risk for smokers were reduced to the same level as for nonsmokers, the number of SP cases in Table 1 is estimated to be reduced from 35 to 10 for women and from 105 to 14 for men; *ie*, 80 percent of all SP seem to be attributable to smoking.

CONCLUSION

Patients with spontaneous pneumothorax are heavier smokers and are consequently much more exposed to the damaging effect of smoking. Smoking increases the relative risk of contracting a first SP approximately ninefold in women and 22-fold in men. The increase is especially large among heavy smokers.

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