

Original Article

## Smoking behaviour of patients before and after renal transplantation

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### Abstract

**Background.** Smoking is the most important remediable cardiovascular risk factor, and an independent risk factor for the progression of renal diseases. To date, only limited information about changes in cigarette-smoking habits before and after renal transplantation is available.

**Methods.** In a comprehensive cross-sectional single centre study, we analysed smoking habits of patients registered on the waiting list for renal transplantation and patients that had received an allograft.

**Results.** Of 230 patients (76.1%), 175 on the waiting list and of 264 allograft recipients (87.5%), 231 were non-smokers at the time of investigation ( $P < 0.01$ ). Among the non-smoking waiting list patients, only 71 (30.9%) had never smoked, whereas 108 (40.9%) patients of the allograft recipients were never-smokers. Of former smoking patients, 27.6% ( $n = 34$ ) had stopped smoking after transplantation. Patients  $< 55$  years of age and females were more likely to stop smoking than patients  $> 55$  years of age or males. A data analysis revealed that smokers had a significantly lower probability to attain renal transplantation.

**Conclusion.** We conclude that renal transplantation is a strong incentive for patients to stop smoking. Reasons for changes in smoking behaviour after renal transplantation may be an intense contact of the patients with their physicians, the fear of a premature loss of the transplanted organ with continued smoking and the psychological support during post-transplantation patient care.

**Keywords:** dialysis; renal transplantation; smoking; waiting list

### Introduction

It is widely appreciated that smoking is the most important remediable cardiovascular risk factor [1]. In contrast, the fact that smoking is also an important remediable renal risk factor is less known among physicians. Smoking

has been associated with an increased rate of progression of renal insufficiency in patients with biopsy-proven primary glomerulonephritis, autosomal dominant polycystic kidney disease, diabetic nephropathy (both in type 1 and type 2 diabetes) and patients with severe essential hypertension. Furthermore, in non-diabetic and non-hypertensive individuals, smoking is independently associated with microalbuminuria and an increased risk of ESRD (for review see [2]).

Recently, it has been discussed that the nephrotoxic properties of smoking are also affecting renal transplants [3]. In a cohort study of 645 adult renal allograft recipients, pre-transplant smoking was significantly associated with reduced overall graft and death-censored graft survival. Reduced graft survival in pretransplant smokers could not be accounted for by differences in acute rejection episodes. While performing a multivariate analysis, pretransplant smoking was associated with a relative risk of 2.3 for graft loss [3].

Sufficient information about the smoking history and smoking habits of patients on the waiting list for renal transplantation and the influence of renal transplantation on their smoking behaviour is lacking. Such information is needed to develop a tobacco cessation programme specifically adapted to this patient group. In this context, it is astonishing that no studies investigating the effectiveness of different smoking cessation strategies in renal patients are available. We are aware of only one report about the implementation of a clinical practice guideline for treating tobacco use and dependence within a kidney and pancreas transplant programme [4].

Therefore, in the present study we investigated the smoking habits of dialysis patients registered on the waiting list for renal transplantation and potential changes of smoking behaviour after transplantation. It was our aim to interview all patients on the waiting list for a donor kidney and all transplanted patients treated at the transplant centre of the University Hospital of Regensburg, Germany, with regard to past or present tobacco consumption. The quantities and the types of tobacco consumed (e.g. cigarette smoking, pipe smoking, snuff tobacco) were assessed. Besides getting information about smoking habits in renal patients on the transplant list and after transplantation, we were interested in whether the start of renal replacement therapy

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or renal transplantation prompted patients to discontinue smoking. Our hypothesis was that these important changes concerning the health situation and quality of life would lead to a significant change in lifestyle including cessation of smoking.

## Subjects and methods

### *Study design*

A cross-sectional study was conducted to assess the smoking history and habits of dialysis patients on the waiting list for renal transplantation, and patients with a renal allograft at the transplantation centre of the University Hospital of Regensburg, Germany. The study was performed in accordance with the rules of the local ethics committee and the Declaration of Helsinki for clinical studies [5].

### *Assessment of smoking habits*

The smoking habits of each patient were assessed using a standardized questionnaire. Contact was made by mail, asking the patients whether they agreed to participate in a study on smoking habits in renal patients. The questionnaire was included in the letter to standardize the assessment of smoking habits and to avoid interviewer bias. Patients were not informed about the background and aim of the study. This procedure was chosen to avoid recall bias for self-reported data, i.e. smoking history and habits. For ethical reasons, the physicians of our transplant centre informed all current smokers enrolled in the study about the adverse cardiovascular and renal effects of smoking after the completion of the questionnaire.

The questionnaire included questions related to smoking habits, e.g. type of smoking, quantity, and questions about the dialysis modality and transplantation characteristics, e.g. haemodialysis versus peritoneal dialysis and time since transplantation (Table 1). Smoking status was self-reported as current smoker or current non-smoker (subdivided into former smoker or never-smoker). Lifetime consumption was estimated in pack-years (1 pack-year = smoking of an average of one pack of cigarettes/day during 1 year). Pack-years were calculated by dividing the mean number of cigarettes smoked/day by 20 and multiplying with the number of smoking years.

### *Study population*

In February 2004, a total of 560 questionnaires were mailed to all patients on the waiting list ( $n = 264$ ) and all renal allograft recipients ( $n = 296$ ) at the transplantation centre of the University Hospital of Regensburg, Germany. A summary of the questions raised in the questionnaires is given in Table 1. Participation in the study was on a voluntary basis. Of 560 questionnaires, 496 (88.5%) were returned. The response rate was very similar for patients on the waiting list and renal allograft recipients: 494 patients (230 patients waiting for a donor kidney corresponding to 87.1% of all patients on the waiting list and 264 patients after renal transplantation corresponding to 89.1% of all

transplanted patients, respectively) answered all questions completely and were included in the study.

### *Statistical analysis*

SPSS software (version 12.0, SPSS Inc., Chicago, IL, USA) was used for statistical analysis. Comparisons of continuous variables between groups were performed by non-parametric tests and of categorical variables by the two-sided  $\chi^2$  or two-sided Fisher's exact test, where applicable.

## Results

### *Data acquisition and patient characteristics*

Two hundred thirty patients (males  $n = 164$ , females  $n = 66$ ) waiting for a donor kidney and 264 patients after transplantation (males  $n = 173$ , females  $n = 91$ ) were interviewed by the questionnaire concerning their tobacco consumption habits, i.e. smoking status of current and former smokers, quantity and type of smoking. The resulting patient characteristics are shown in Table 2 and 3.

### *Types of tobacco consumption in the different groups*

There were only slight differences in the type of tobacco consumption between the different groups. More than 98% of smokers in all groups were cigarette smokers. Former and current female smokers smoked cigarettes only, whereas some currently smoking males on the waiting list added pipes (5%) and snuff tobacco (2.5%) to their cigarette consumption. Due to the small number of pipe smokers and snuff tobacco users, this type of tobacco consumption was disregarded in the further analysis. Thus, in the following, data will only be referring to cigarette smoking.

### *Never-smokers, former smokers and current smokers among waiting list patients and transplant recipients*

Whereas on the waiting list 76.0% of the patients (175 of 230 patients) were actual non-smokers, among the transplanted patients 87.5% (231 of 264 patients,  $P < 0.02$ ) did not smoke at the time of investigation. In the group of non-smoking patients registered on the waiting list, 30.8% ( $n = 71$ ) had never smoked before, whereas 45.2% ( $n = 104$ ) were former smokers. In the group of non-smoking renal transplant recipients, 40.9% ( $n = 108$ ) had never smoked, whereas 46.6% ( $n = 123$ ) were former smokers. Therefore, significantly more current smokers were seen on the waiting list in comparison to allograft recipients (i.e. 24% versus 12.5%,  $P < 0.001$ ) (Figure 1).

### *Dialysis regimen and duration of dialysis*

In males, the mean duration of dialysis was not significantly different between smokers ( $4.3 \pm 2.6$  years), former smokers ( $4.5 \pm 3.7$  years) and never-smokers ( $4.5 \pm 2.2$  years). Time on dialysis tended to be longer in women compared to men; currently smoking females had the longest dialysis time ( $6.2 \pm 5.3$  years) followed by former smoking

**Table 1.** Questionnaire summary of the questionnaire mailed to all patients on the waiting list for kidney transplantation and all patients after renal transplantation

Questions for patients on the waiting list	Questions for transplanted patients
(1) Date of birth	(1) Date of birth
(2) Sex (male/female)	(2) Sex (male/female)
(3) Duration of dialysis	(3) Date of transplantation
(4) Dialysis treatment: haemodialysis versus peritoneal dialysis	(4) Non-smoker, smoker (current or former)
(5) Non-smoker, smoker (current or former)	(5) Former smoker—when did they stop smoking
(6) Former smoker—when did they stop smoking	(6) Duration of smoking in years
(7) Duration of smoking in years	(7) Type of tobacco consumption (cigarettes, pipes, snuff tobacco)
(8) Type of tobacco consumption (cigarettes, pipes, snuff tobacco)	(8) Average number of cigarettes per day
(9) Average number of cigarettes per day	

**Table 2.** Patient characteristics: waiting list patients

	Current non-smokers ( <i>n</i> = 175)				Current smokers ( <i>n</i> = 55)		All patients ( <i>n</i> = 230)			
	Never-smokers ( <i>n</i> = 71)		Former smokers ( <i>n</i> = 104)		Men ( <i>n</i> = 40)	Women ( <i>n</i> = 15)				
	Men ( <i>n</i> = 42)	Women ( <i>n</i> = 29)	Men ( <i>n</i> = 82)	Women ( <i>n</i> = 22)						
Age (yrs)	51.7 ± 11.6	52.4 ± 12.8	<i>P</i> = 0.67	55.7 ± 11.0	46.7 ± 7.6	<i>P</i> < 0.001	47.8 ± 13.2	45.3 ± 11.2	<i>P</i> = 0.31	51.6 ± 12.1
Smoking cessation (years ago)				13.9 ± 11.4	9.6 ± 8.3	<i>P</i> = 0.98				
Amount of smoking (pack-years)				27.8 ± 27.3	14.5 ± 11.5	<i>P</i> = 0.021	17.0 ± 12.4	14.5 ± 10.2	<i>P</i> = 0.72	
Duration of dialysis (years)	4.5 ± 2.2	5.3 ± 3.5	<i>P</i> = 0.273	4.5 ± 3.7	5.8 ± 5.3	<i>P</i> = 0.247	4.3 ± 2.6	6.2 ± 5.3	<i>P</i> = 0.083	4.8 ± 3.6
HD versus PD (%)	85.7/14.3	79.3/20.7	<i>P</i> = 0.447	92.7/7.3	68.0/32.0	<i>P</i> = 0.006	90.0/10.0	86.7/13.3	<i>P</i> = 0.72	89.1/10.9

HD = haemodialysis; PD = peritoneal dialysis. Data are given as mean ± SD. Patient's age, time since smoking cessation, pack-years, duration of dialysis and time after transplantation related to the time point of survey.

**Table 3.** Transplanted patients

	Current non-smokers <i>n</i> = 231				Current smokers ( <i>n</i> = 33)		All patients ( <i>n</i> = 264)			
	Never-smokers ( <i>n</i> = 108)		Former smokers ( <i>n</i> = 123)		Men ( <i>n</i> = 24)	Women ( <i>n</i> = 9)				
	Men ( <i>n</i> = 56)	Women ( <i>n</i> = 52)	Men ( <i>n</i> = 93)	Women ( <i>n</i> = 30)						
Age (years)	50.2 ± 12.1	53.9 ± 13.6	<i>P</i> = 0.099	53.8 ± 11.6	52.0 ± 12.4	<i>P</i> = 0.37	41.7 ± 12.4	47.0 ± 5.8	<i>P</i> = 0.32	51.5 ± 12.7
Smoking cessation (years ago)				12.8 ± 10.8	17.0 ± 13.2	<i>P</i> = 0.913				
Amount of smoking (pack-years)				19.9 ± 20.2	13.5 ± 13.1	<i>P</i> = 0.121	15.1 ± 13.0	15.3 ± 9.2	<i>P</i> = 0.68	
Time after Tx (years)	3.6 ± 2.3	4.3 ± 2.8	<i>P</i> = 0.24	3.4 ± 2.1	3.7 ± 2.2	<i>P</i> = 0.5	4.2 ± 1.9	3.6 ± 2.0	<i>P</i> = 0.33	3.7 ± 2.3

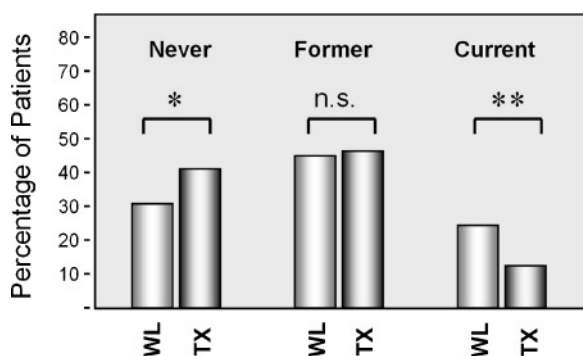
Tx = renal transplantation. Data are given as mean ± SD. Patient's age, time since smoking cessation, pack-years, duration of dialysis and time after transplantation related to the time point of survey.

(5.8 ± 5.3 years) and never-smoking females (5.3 ± 3.5 years). However, statistical significance was not reached (Table 2).

In men, the mode of dialysis (i.e. haemodialysis versus peritoneal dialysis) was not significantly different between

smokers (90.0%, *n* = 36), former smokers (92.7%, *n* = 76) and never-smokers (85.7%, *n* = 36) (Table 2).

The number of females on peritoneal dialysis was higher compared to men, but smoking females were less likely to be on peritoneal dialysis (13.3%, *n* = 2) versus



**Fig. 1.** Actual smoking habits of renal patients on the waiting list and after renal transplantation at the time of investigation. Never = patients that had never smoked, current = currently smoking patients, former = patients that have stopped smoking. Statistical significances are depicted as \*  $P < 0.05$ , \*\*  $P < 0.01$ .

never-smoking (20.7%,  $n = 6$ ) and former smoking (32%,  $n = 7$ ) females (Table 2). These differences did not reach statistical significance, however.

#### Quantification of smoking

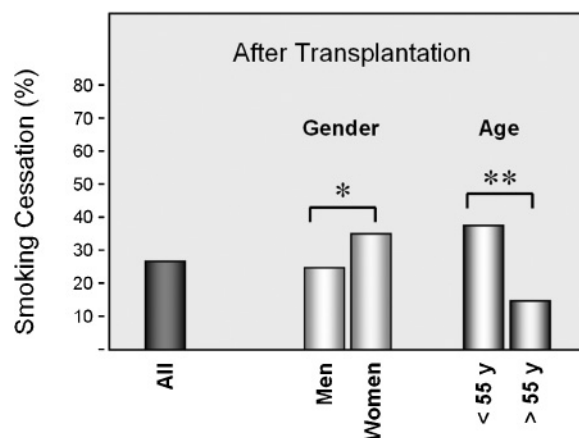
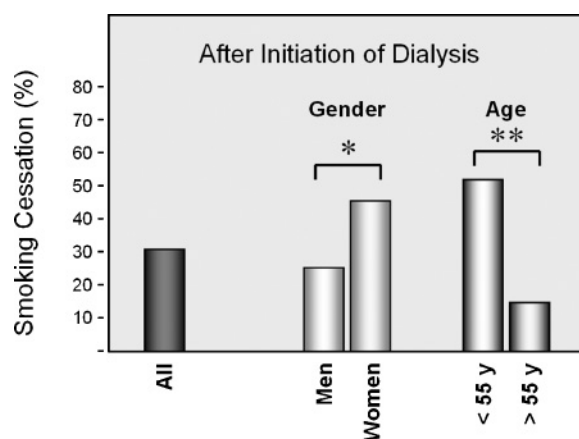
A high percentage of patients both on the waiting list and among allograft recipients were heavy smokers. At the time of investigation, men did not smoke significantly more than women. Currently smoking males on the waiting list had reached a cumulative cigarette consumption of  $17.0 \pm 12.4$  pack-years; females reported  $14.5 \pm 10.2$  pack-years (Table 2). Similar results were seen among the transplanted patients; currently smoking males had consumed  $15.1 \pm 13.0$  pack-years and females  $15.3 \pm 9.2$  pack-years (Table 3).

#### Differences in smoking history according to sex

Smoking history differed between males and females: 43.9% ( $n = 29$ ) of the women on the waiting list had never smoked, in comparison to only 25.6% ( $n = 42$ ) of men ( $P < 0.01$ ). A similar result was seen for transplanted patients: 57.1% ( $n = 52$ ) of the female patients did never smoke, whereas only 32.4% ( $n = 56$ ) of men reported themselves as never-smokers ( $P < 0.001$ ). In contrast, the ratios of female former smokers were 33.3% ( $n = 22$ ) on the waiting list [and 33.0% ( $n = 30$ ) among transplanted patients] compared to 50% ( $n = 82$ ) [and 53.8% ( $n = 93$ )] for male patients ( $P < 0.03$ ) (and  $P < 0.001$ ). However, no major differences between female and male current smokers were seen for both waiting list and transplanted patients (Tables 2 and 3).

#### Discontinuation of smoking

Since we were interested in whether dialysis and/or transplantation may give an impulse to stop smoking, the subgroups of former smokers were further analysed. Former smoking waiting list patients ( $n = 104$ ) had stopped smoking on average  $13.0 \pm 10.9$  years prior to the study. Of these patients, 16.3% ( $n = 17$ ) stopped smoking within 6 months after the initiation of dialysis treatment. A further 13.7%



**Fig. 2.** Influences of sex and age on smoking cessation before and after the initiation of renal replacement therapy and renal transplantation, respectively. (A) Percentages of patients that have stopped smoking after the initiation of dialysis. (B) Percentages of patients that have stopped smoking after transplantation. Statistical significances are depicted as \*  $P < 0.05$ , \*\*  $P < 0.01$ .

( $n = 14$ ) had stopped smoking in more than 6 months after the start of dialysis treatment (with a mean of 5.1 years after the start of dialysis).

Regarding the age of the patients, 50.9% ( $n = 28$ ) of patients younger than 55 years ( $n = 55$ ) had stopped smoking after the initiation of dialysis treatment. In contrast, older patients had quit smoking less frequently (14.3%,  $n = 7$ ). Comparing men and women, we found that women were much more likely to quit smoking after the initiation of dialysis. Whereas only 25.6% of former smoking males ( $n = 21$ ) had stopped, 45.5% of women ( $n = 10$ ) did.

Formerly smoking renal transplant recipients had stopped smoking on average  $14.4 \pm 11.5$  years before this survey was done. A marked percentage, i.e. 27.6% (34 of 123 patients), in this group stopped smoking after transplantation. As with dialysis patients, we found that significantly more patients younger than 55 years (i.e. 38.6%; 27 out of 70 patients) had stopped smoking after transplantation as compared to patients older than 55 years (13.2%; 7 of 53 patients). And, whereas only 24.7% of men ( $n = 23$ ) stopped smoking after transplantation, 36.7% of women ( $n = 11$ ) did (Figure 2).

## Discussion

In the present cross-sectional study, we investigated the smoking history and habits of all patients registered on the waiting list for renal transplantation and all renal transplant recipients of our transplant centre. Data analysis revealed a major impact of both initiation of dialysis and time point of transplantation on cigarette-consumption behaviour in our patients. Of former smokers on the waiting list, 29.8% had stopped smoking after the start of their dialysis treatment. Of former smoking allograft recipients, 27.6% stopped smoking after transplantation. These figures are far above what is achieved with nicotine replacement therapy using a nicotine patch in the context of a controlled clinical trial, where the abstinence rate at 12 months is 16.4%, and get close to an intensive combined pharmacologic approach using the antidepressant bupropion plus a nicotine patch (the abstinence rate after 12 months being 35.5%) [6]. It can be assumed that the dramatic changes in health and personal situation were the reasons to prompt 16.3% of the patients to stop smoking within only 6 months of initiation of dialysis treatment, and this figure even further increased in the long term. In the case of renal transplant recipients, the fear of a premature graft loss might also play an important role. Thus, similar to patients with a myocardial infarction or stroke [7], a major event affecting the patient's health status may be motivating to live a healthier life style. This change in behaviour is indeed welcome, but the discontinuation rates are still insufficient against the background of the adverse health effects of smoking. Studies investigating the added benefit of professional counselling and pharmacological interventions on smoking discontinuation rates in renal patients after the initiation of dialysis or renal transplantation are therefore sorely needed. To date, no studies about such interventions are available in patients with renal disease.

The observations in our study that (i) females are more likely to discontinue smoking than males and (ii) that patients younger than 55 years are more likely to discontinue smoking compared to those older than 55 years of age may be of importance when adapting a tobacco cessation programme for renal patients. The fact that the number of patients who stopped smoking after the initiation of renal replacement therapy decreases with age is possibly because older patients are less likely to change their life style and/or are more addicted to cigarettes.

Whereas in males the percentage of former smokers was higher than that of never-smokers, the opposite was true in females. This reflects that, at least in the past, it was less common for women to smoke. However, looking at the percentages of currently smoking patients, our cross-sectional study confirms that today females are not smoking less than males. This parallels the situation in the general population of most western countries.

The assumption that smoking cessation before renal transplantation has beneficial effects on graft survival is of major importance for the management of patients with ESRD who are considered for renal transplantation. Of importance, our data clearly indicated that patients who never smoked do have a higher probability of attaining a renal allograft. Whereas the percentage of never-smokers was 30.9% on the waiting list, among the allograft recipients they represented 40.9% of the population. A possible explanation for this observation may be the overall better health status in non-smoking individuals, thus increasing the likelihood to be on the waiting list and to be transplanted.

In conclusion, we have shown that the number of current smokers is significantly higher before as compared to after renal transplantation. Approximately 30% of the smoking patients taken care of by our transplant centre stopped smoking after transplantation. This is a higher percentage than had been reported for patients who had a stroke (21.7%) [7]. The main reason for this change in smoking behaviour is probably a more intense contact of the patients with their treating physicians, fear of the patients of a premature loss of the transplanted organ with continued smoking and psychological support during the hospital stay. We speculate that this situation is the perfect basis for a professional smoking cessation programme that should result in high smoking discontinuation rates. Such a programme, adapted to the special situation of renal patients, should be implemented in all large nephrology units. It is sensible to assume that such a programme, provided that it is successful, drastically reduces cardiovascular morbidity and mortality and prolongs renal graft survival in patients with a renal transplant.

*Conflict of interest statement.* None declared.

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