Survival in long-term haemodialysis patients: results from the annual survey of the Japanese Society for Dialysis Therapy


Abstract The prognosis for haemodialysis patients is reported to be more favourable in Japan than in Europe or North America. Consequently, evaluation of the death predictors for haemodialysis patients in Japan is of considerable interest outside Japan. The Patient Registration Committee of the Japanese Society for Dialysis Therapy annually surveys the individual patient case mix, laboratory data and important events occurring in the previous years. Thus, using case mix data and laboratory data (including \( Kt/V \) and protein catabolic rate) from the 1993 questionnaire survey and the individual patients' life/death statistics from the 1994 questionnaire survey, a logistic regression analysis was conducted on 53,867 patients. The analysis indicated that important death risk predictors were: (i) advanced age, (ii) occurrence of diabetes mellitus, (iii) male sex, (iv) \( Kt/V \) lower than 1.8, (v) duration of haemodialysis sessions less than 5 h, (vi) protein catabolic rate less than 0.9 g/kg/day, and (vii) percentage body weight decrease less than 4% and more than 8% during the first haemodialysis session of the week.

Key words: haemodialysis; renal failure; mortality; nutrition; diabetes mellitus

Introduction

The prognosis for haemodialysis patients in Japan is reported to be more favourable than in Europe or North America [1]. Thus, determining the death predictors for haemodialysis patients in Japan would provide worthwhile information not only for nephrologists in Japan, but for the nephrological community around the world.

In the present study, using material from the 1993 and 1994 surveys of the Patient Registration Committee of the Japanese Society for Dialysis Therapy, logistic regression analysis was carried out on patients receiving thrice-weekly centre-based haemodialysis to characterize potential predictors for death, based on case mix and laboratory data.

Subjects and methods

Survey methods [2]

The Patient Registration Committee of the Japanese Society for Dialysis Therapy performs annually a nationwide survey on the individual patient case mix and laboratory data and important events occurring during the previous year. For the present investigation, we used the case mix and laboratory data obtained from the 1993 survey and information on patient deaths occurring in the 1994 survey year. Completed survey forms were obtained from 2478 (93.8%) of the 2641 institutions surveyed in 1993. In 1994, the survey forms were mailed out to 2759 institutions of which 2616 (94.8%) replied.

Patient sample

Of the 131,492 patients on whom information was acquired with regard to the type of renal replacement therapy in the 1993 survey, 121,569 (92.4%) were centre-based haemodialysis patients. Information on the number of haemodialysis sessions per week was not given for 19,713 of the centre-based haemodialysis patients. After exclusion of such patients, the majority underwent haemodialysis three times per week, i.e. 88,693 among the total of 101,847 (87.1%) for whom such information was given. Among these patients receiving three weekly centre-based haemodialysis, case mix and/or laboratory variables were not satisfactorily clear for analysis in 16,947 patients. Excluding these patients, 71,746 remained who received thrice weekly centre-based haemodialysis.

To calculate \( Kt/V \) and protein catabolic rate (PCR) correctly, it is necessary to know the value of the residual renal urea clearance. Unfortunately, this was not among the items surveyed. Thus, assuming that it can be ignored in patients who had been on haemodialysis treatment for more than 2 years, some 15,315 patients who had been on haemodialysis for less than 2 full years were further eliminated from the cohort.

According to the 1994 survey, of the 56,431 patients selected for analysis in the 1993 survey, some 50,765 were alive and still on haemodialysis as of the end of 1994, 3192 had died, 1182 were on renal replacement therapies other than centre-based haemodialysis, such as continuous ambu-
latory peritoneal dialysis or haemodiafiltration, and 1382 were lost to follow-up. In the logistic regression analysis, the 2564 (4.5%) patients who were on therapies other than centre-based haemodialysis or who were lost to follow-up as of the end of 1994 were excluded (censored cases). As a result, there were 53867 patients available for final analysis. The attributes of the sample are summarized in Table 1 (see footnote).

Assessment of the risk of death

A baseline analysis was performed using a stepwise logistic regression procedure to evaluate case mix variables such as age, sex, haemodialysis time, and occurrence of diabetes mellitus. Case mix variables found to be significantly associated with the probability of death were then fixed, and laboratory variables were added to this logistic regression model.

The $K_t/V$ and PCR were both considered 'laboratory variables'. For the sake of convenience, haemodialysis time and body weight decrease during haemodialysis were also included among the laboratory variables. Table 2 indicates the case mix and laboratory variables analysed in the present study. In the analyses, the Statistical Analysis System version 6 [3] was employed.

Calculation of $K_t/V$ and PCR

$K_t/V$ and PCR were determined according to the procedure of Shinzato et al. [4]. The $K_t/V$ or PCR value determined by this method is virtually identical with that calculated by the three-point method of Gotch et al. [5].

Besides Shinzato et al., Daugirdas et al. [6] have reported methods to calculate $K_t/V$ from the pre- and postdialysis serum urea nitrogen (SUN) levels. To compare the $K_t/V$ parameters obtained by the methods of Shinzato et al. [4], Gotch et al. [6] and Daugirdas et al. [7], we randomly selected 2000 patients from the present group of subjects. Among these patients, the $K_t/V$ values determined using the methods of Shinzato and Daugirdas were virtually the same.

In addition to the method of Shinzato to determine PCR from the pre- and postdialysis SUN levels, the method of Depner et al. [7] can be used. Using the above 2000 patients randomly selected from the present subjects, a comparison was made between the PCR values obtained by Depner's and Shinzato's methods. The result indicated that PCR values obtained by the two methods were completely identical ($r=1.000; P<0.0001$).

Results

Assessment of case mix variables with the probability of death

Table 3 presents the results of the stepwise logistic regression analysis of the case mix variables. The age-related $\chi^2$ values were the highest of all the case mix variable $\chi^2$ levels. This shows that age indeed was the most important death risk predictor. With every 10-year increase in age, the risk of death rose 1.81-fold (95% confidence limits 1.76–1.86). Next to age, diabetes was the most important death predictor. The relative risk of death for diabetic patients was 3.13 (95% confidence limits 2.82–3.48). Moreover, the risk
Survival in haemodialysis patients

4.10
-3 0 3.5 4 0 4.5 5.0 5.5 60-
Hemodialysis time (hour)

Fig. 2. Relative risks of different haemodialysis time. There was a progressive decrease in the probability of death as the haemodialysis time grew longer until it reached 5 hours. *: P < 0.05; **: P < 0.01; ***: P < 0.0001

sessions. Thus, we attempted to assess the importance of the decrement in body weight during haemodialysis sessions. This was expressed as the ratio of the difference in weight before and after haemodialysis relative to the weight after the treatment (i.e., percentage weight decrease). Figure 4 shows the adjusted relative risk of death for patient groups with different percentage decrease of body weight during the first haemodialysis session of the week. Values of 2–4% were taken as the reference range. As shown in the figure, both a small percentage weight decrease (less than 2%) and a large decrease (more than 8%) were associated with a greater risk of death.

Fig. 4. Relative risks of different percent body weight decreases during haemodialysis session. Both a small weight decrease of less than 2% and a large decrease of more than 8% were associated with greater risk of death. *: P < 0.01; **: P < 0.0001

Discussion

Some 92.8% of the dialysis facilities in Japan cooperated in the 1993 survey on the individual patient case mix and laboratory data, conducted by the Patient Registration Committee of the Japanese Society for Dialysis Therapy. Therefore, it is not unreasonable to consider that most Japanese dialysis patients were covered. As of 31 December 1993, among the patients treated in dialysis facilities which reported the weekly number of dialysis sessions, some 87.1% of the total 88,693 patients underwent haemodialysis three times per week. For the present analysis, any patient who had been on haemodialysis for less than 2 years was censored. Thus, 53,867 patients were finally available for evaluation. They represent 44.3% of all patients undergoing centre-based haemodialysis at the time specified. This is considered to be a meaningful fraction. To date there has been no report in the literature in which statistical indices regarding haemodialysis prescription (i.e., Kt/V, PCR etc.) have been gathered for more than 50,000 haemodialysis patients and analysed in terms of death risk.

In the present analysis, among case mix variables, male sex, advanced age and occurrence of diabetes were significant factors related to the risk of death. These results agree with those reported by other investigators [8,9]. In the present analysis, the Kt/V was significantly greater in females than in males, possibly because of the smaller body size of females (data not shown). Nevertheless, even when the risk of death associated with sex difference was adjusted for Kt/V, the risk was still lower in females than in males, indicating the lower risk of death in females is not caused by greater Kt/V (data not shown).

Kt/V is widely acknowledged as a useful index of the quantity of haemodialysis delivered. In the present
analysis, the death risk decreases progressively up to a $Kt/V$ of 1.8, is in agreement with the findings of Charra et al. [10]. He reported that survival was better in patients whose $Kt/V$ (by the Daugirdas method) was over 1.6 compared with patients whose $Kt/V$ was lower. Moreover, the present results do not contradict the report of Nakai et al. [11], that the risk of hospitalization was greater in patients whose $Kt/V$ (by the Shinzato method) was less than 1.4, compared with those whose $Kt/V$ was higher.

The present analysis suggests that short duration of haemodialysis sessions is associated with a greater risk of death. This corroborates the findings of Laurent et al. [12] and of Held et al. [13] who reported that the risk of death is lower in patients given haemodialysis for more than 4.25 h. Nevertheless, one cannot exclude the possibility that the higher risk of death associated with shorter duration of haemodialysis sessions is attributable to the lower $Kt/V$. However, even when the risk of death associated with shorter duration of haemodialysis sessions was adjusted for the $Kt/V$, there was no change in the risk of death (data not shown).

Numerous reports pointed to an association between low PCR and greater risk of hospitalization or death [14,15]. The present results indicate that patients with a PCR of less than 0.9 g/kg/day have a greater risk of death than patients with a PCR greater than 0.9 g/kg/day.

We assume that the decrease in body weight during haemodialysis sessions reflects the increase in body weight between haemodialysis sessions. In our analysis, patients with a weight decrease of less than 2% have a greater risk of death than patients with a weight decrease of 2-4%. It seems possible that among patients with a low body weight decrease during haemodialysis, at least some consume an insufficient amount of food and therefore of water and salt. Thus, the high risk of death in patients with a body weight decrease of less than 2% during haemodialysis sessions may in part be attributable to malnutrition. On the other hand, patients whose body weight decrease exceeded 8% also had a higher risk of death, supporting the idea that excessive water and salt intake is an important risk factor.

In order to eliminate the influence of diet on the risk of death associated with greater or less body weight decrease during haemodialysis, the risk was adjusted for PCR. As a result, in patients with a body weight decrease of less than 2%, the risk was no longer significant, whereas in those experiencing body weight decrease of over 8%, it became greater (data not shown). Thus, the higher risk of death associated with a body weight decrease of more than 8% may be underestimated because of the positive effect of greater protein intake.

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Note

The mean $Kt/V$ and haemodialysis time of the subjects of the present study differ from those elsewhere reported for haemodialysis patients in Japan because patients on haemodialysis for less than 2 years were excluded from the present study.

References


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