Survival Analysis of Taiwan Renal Registry Data System (TWRDS) 2000-2009

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Abstract

The increasing dialysis population is a global phenomenon. Taiwan still sat on the top of list regarding to dialysis prevalence, although incidence rate continuously fell in 2009 analysis. It is very interesting to ask the reason of dissociation between prevalence and incidence, and the survival trends of modern era. The purpose of this short review is to present trends of prevalence and survival after nationwide implementation of continuous quality improvement measurements since 2005. The 2009 data from TWRDS suggested 2 interesting finding and 1 prediction. First, the patient survival was reduced in the modern cohort in comparison to 1990-2001 cohorts. Second, the demographic characteristics of patients entering dialysis are changing. There are more diabetic and elderly patients in 2000-2009 cohorts than older cohort. This ultimate phenomenon may contribute in part to the decrease survival of modern cohort. The current nationwide epidemiological data analysis suggested tentative prediction of future dialysis trend. Approximately 100 patients per million population increase in ESRD prevalence would be expected if the practice pattern and patient demography kept the same pace. Further effort should be given to slow down the increase of ESRD prevalence.

KEY WORDS: hemodialysis, outcomes, peritoneal dialysis, survival, TWRDS

Dialysis Therapy in Taiwan

The increasing dialysis population is a global phenomenon. Taiwan is on the stream of this global tendency (1). The data from United States Renal Data System (USRDS) 2011 international comparison report indicated that Taiwan still sat on the top of list regarding to dialysis prevalence, although incidence rate continuously fell in 2009 analysis (2). It is very interesting to ask the reason of dissociation between prevalence and incidence. The separation of the incidence and prevalence curves suggested simultaneous decrease of inflow and outflow in dialysis population pool of Taiwan. The decrease of patients entering dialysis program might come from generalized improvement of countrywide medical care, the introduction of multi-disciplinary pre-dialysis education program and official prohibition of herbal medications containing aristolochia spp. in Taiwan since 2003 (2-4). The outlets of dialysis population include mortality and kidney transplantation. The average number of donated kidney is approximately 200 annually in Taiwan (5). Comparing to annual incidental dialysis patients, which is around 10,000 in 2008 (2), the number of transplant is too small to have any impact on the change of epidemiology of dialysis population. The dialysis patient survival might be the major determinant of this change of trend of prevalence and incidence in Taiwan.

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Survival Analysis of Dialysis Therapy in Taiwan

Survival rate is always one of the major key performance indicators (KPIs) in dialysis therapy (6-8). Previous survival analysis report of Taiwan Renal Registry Data System (TWRDS) can be traced back to 2008 (9). The report described the survival status of 1990-2001 dialysis cohorts. The first year dialysis survival can be as good as 85% in the analysis (9), which is thought to be one of the best performance nations among the world (1, 9-11). The excellent survival might come from the exclusion of elderly and diabetic patients before the initiation of whole nation full coverage National Health Insurance (NHI) policy, which has started since 1995 (12). On the other hand, multi-disciplinary pre-dialysis education program has initially been started in 6 key hospitals since 2003 in Taiwan under the design and surveillance of Taiwan Society of Nephrology (TSN) (13). The multi-disciplinary pre-dialysis education program proposed a standard care protocol and annual reporting system. The program extended gradually around the country with 19 hospitals in 2005, 44 hospitals in 2006, 89 hospitals in 2009, and up to 126 hospitals in 2011 (2). The nationwide program does not only delay dialysis initiation in late stage chronic kidney disease (CKD), but also decrease first year post-dialysis mortality in a multi-center controlled study (4). Furthermore, there is tremendous improvement in dialysis therapy, both in hemodialysis and peritoneal dialysis therapy, since 2001 (14, 15). The epidemiology of dialysis therapy in Taiwan also changes gradually during the last decade with more diabetic, more elderly patients, and more peritoneal dialysis therapy than previous decades (2). With this changing background, a re-analysis of survival is necessary to reflect the current status of dialysis therapy in Taiwan.

TWRDS and Methods

TWRDS

TWRDS had been established since 1987. The data system is initially established for accreditation of dialysis therapy, audited by Department of Health of Taiwan. The accreditation is aimed to continuously improve quality of dialysis therapy (12). All the dialysis units are obligatory to report the data for TWRDS for NHI quality reimbursement. The reported rate is approaching 100%. The data in TWRDS forms a solid base for continuous quality control at national level, which is thought to be one of the best models of dialysis patient care in the world (9, 11, 16, 17). The method to collect and analyze the data had been described in detail in previous report (2, 18). There are 158,251 dialysis patients entered this registry from 1990 to 2009. The survival analysis of cohort 1990-2001 has been demonstrated in our previous report (9). This review will focus on cohort 2000-2009, when many changes of dialysis therapy and CKD management have happened during this period.

Patients Enrollment

There were 543 hemodialysis (HD) units and 131 peritoneal dialysis (PD) units as of December 31, 2009. All the dialysis units have issued the annual and seasonal report to TWRDS. The following data are emerged from all data issued.

Patients registered in the TWRDS from 2000 to 2009 were included for analysis (n = 97,191). The patients stay on hemodialysis (HD) or peritoneal dialyses (PD) for more than 1 month were attributed to HD or PD group respectively. One hundred eighty-five patients were excluded from analysis due to invalid ID number, missing birthday, missing initial dialysis status and missing initial dialysis date. The eligible sample for analysis was 97,006 patients (Fig. 1). Of all, 88,576 patients (91.3%) chose HD and 8,430 patients (8.7%) chose PD as their initial modality for renal replacement therapy (RRT) in this 2000-2009 dialysis patient cohort.

Definitions

All-cause mortality is the end-point of patient survival analysis. The mortality was reported by every single dialysis unit and reconfirmed by national mortality file form department of health, Taiwan. Regarding to the modality subgroup analysis, we performed the survival analysis with intent to treat.
The analysis based on the initial treatment intent, not on the treatment eventually administered for a long term. ITT analysis is intended to avoid various misleading modalities change effect that can arise in the analysis. For this reason, this analysis is not eligible to compare the survival between dialysis modalities. Substantial proportion of cause of death was missing from the original registry records. The percentages of cause of death presented herein represent the descriptive proportion of certain cause of death. It was calculated by determining the proportion of each cause of death from a denominator, formed by summation of all available and identifiable cause of entire registry. The missing data was neglected from analysis and this adoption may reveal the true realism of current national registry, however, it also could lead to the underestimation of the importance of cardiovascular death because most of missing cause of death developed as consequence of sudden death outside hospital. The analysis results are only giving a general picture of survival in dialysis in a very unique medical environment like Taiwan.

**Statistical Methods**

Descriptive statistics were expressed as means ± standard deviation, median (range), frequency (percentage) where was appropriate. The calculation of survival rate was based on life-table methods, in which survival cases of the end of last year (S₀) were adopted as denominator and deaths during this year (D₁) were subtracted by survival cases of the end of last year (S₀) as numerator. The survival rate of this year is the ratio of numerator to denominator (q₁). Missing cases of the year are multiplied by 1/2 and subtracted by survival cases of last year to become the denominator of the year. The cumulative survival rate was calculated by multiplication of each survival rate from the initial year consecutively to the focal year (Sₜ = Π qₜ). The adoption of this method was used to provide better evaluation of censoring and missing cases in a dynamic cohort; in which a common problem is the misreading of case definition from processing of such a large national database. It can also avoid possible lead-time bias in survival estimation. Data were analyzed using the SPSS 17.0 software for Windows XP (SPSS Inc., Chicago, IL).

**Results**

**Patient Characteristics**

The average age at initiation of dialysis therapy was 65.7 ± 14.2 years-old for overall dialysis patients during period 2000-2009. The mean age entering the dialysis program for HD patients (66.6 ± 13.6 years-old) was older than that for PD patients (55.7 ± 16.2 year-old). The number suggested a much younger population in PD than in HD program in Taiwan. From Among overall patients, 48,762 (50.3%) were men and 42,004 (43.3%) had diabetes. The percentage of male gender in PD patients (54.3%) is higher comparing to HD patients (50.7%). However, the percentage of diabetes in PD patients (31.4%) is

<table>
<thead>
<tr>
<th>Variable</th>
<th>All n = 97,006</th>
<th>HD n = 88,576</th>
<th>PD n = 8,430</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>65.7 ± 14.2</td>
<td>66.6 ± 13.6</td>
<td>55.7 ± 16.2</td>
</tr>
<tr>
<td>Male, n (%)</td>
<td>48,762 (50.3%)</td>
<td>44,913 (50.7%)</td>
<td>4,581 (54.3%)</td>
</tr>
<tr>
<td>Primary disease, n (%)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CGN</td>
<td>36,377 (37.5%)</td>
<td>33,157 (37.4%)</td>
<td>3,220 (38.2%)</td>
</tr>
<tr>
<td>HTN</td>
<td>5,141 (5.3%)</td>
<td>4,644 (5.2%)</td>
<td>497 (5.9%)</td>
</tr>
<tr>
<td>DM</td>
<td>42,004 (43.3%)</td>
<td>39,357 (44.4%)</td>
<td>2,647 (31.4%)</td>
</tr>
<tr>
<td>URO</td>
<td>1,552 (1.6%)</td>
<td>1,434 (1.6%)</td>
<td>118 (1.4%)</td>
</tr>
<tr>
<td>Renovascular</td>
<td>194 (0.2%)</td>
<td>177 (0.2%)</td>
<td>17 (0.2%)</td>
</tr>
<tr>
<td>Hereditary</td>
<td>776 (0.8%)</td>
<td>649 (0.7%)</td>
<td>127 (1.5%)</td>
</tr>
<tr>
<td>Other/Unknown/Missing</td>
<td>10,962 (11.3%)</td>
<td>9,158 (10.3%)</td>
<td>1,804 (21.4%)</td>
</tr>
<tr>
<td>Cause of death</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cardiopulmonary</td>
<td>45.0%</td>
<td>45.3%</td>
<td>41.5%</td>
</tr>
<tr>
<td>CNS</td>
<td>5.7%</td>
<td>5.7%</td>
<td>5.1%</td>
</tr>
<tr>
<td>Infection</td>
<td>24.4%</td>
<td>24.0%</td>
<td>31.1%</td>
</tr>
<tr>
<td>Gastro/Liver</td>
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<td>5.9%</td>
<td>5.6%</td>
</tr>
<tr>
<td>Malignancy</td>
<td>7.3%</td>
<td>7.4%</td>
<td>4.6%</td>
</tr>
<tr>
<td>Others</td>
<td>11.7%</td>
<td>11.7%</td>
<td>12.1%</td>
</tr>
</tbody>
</table>
lower than HD patients (44.4%). The demographic data indicated a great difference between patients utilizing HD and PD as their initial dialysis therapy (Table 1). In comparison to 1990-1999 cohorts, the 2000-2009 cohorts have higher proportion of diabetic and elderly patients at the time of initiating dialysis therapy (Table 2).

Overall Patient Survival

In 1990-2001 cohorts, the first year mortality can be as low as 15%. The cumulative survival rates for all patients in 1990-2001 cohort at 12, 24 and 60 months were 85.1%, 74.6% and 53.7%, respectively, and was 35.0% at 120 months (9). On the other hands, the overall cumulative survival rate at 12, 24 and 60 months in 2000-2009 cohorts went down to 81.1%, 66.7% and 44.2%, respectively, and was 26.8% at 120 months (Fig. 2A).

Patient Survival in HD and PD Subgroups

We also plotted individual survival curves for patients who chose either HD or PD as their initial dialysis therapy. Shifting between modalities was not censored in the analysis. The Fig. 2B and 2C demonstrated the survival curves for these two modalities. The two curves did reveal difference in early survival, although it ends up almost the same in survival rate at 10 years. (Fig. 2B and 2C) The curves were not done to compare survival between two dialysis modalities, as great difference existed in patient background (Table 1) at the initiation of dialysis. The curves also suggested the possible impact of age and diabetes on patient survival. Further analysis according to age range and diabetes status might be necessary to demonstrate the effect of these two important prognostic factors on survival.

The long history of TWRDS suggests a vital role of this unique data system along the progression and improvement of dialysis therapy in Taiwan. Furthermore, Taiwan has its unique full-coverage dialysis policy. The national health insurance policy has its impact on the therapy (9). With this background, Taiwan’s dialysis practice pattern could provides an unique experience and serves as a model for free dialysis modality access and full coverage social security policy country. The experience will be informative for many countries on the way of full-coverage of dialysis cost.

Epidemiological and clinical studies have the ultimate goal to provide projection for future predictions of patient outcome. Based on the currently known national data, the formulation of prediction of dialysis trend is tentative. The average number of incidental patient is approximately 8,000 to 10,000 per year, while the number of mortality patients is around 6,000 to 6,500 per year in recent 3 years in Taiwan (2). The gap between the two numbers suggested a yearly 100 patients per million population increase.
of ESRD prevalence in Taiwan. The phenomenon was coherent to our previous observation (2). Taken together, the number further suggested that yearly decrease of 2,000 incidental ESRD patients is necessary to prevent increment of trend and to maintain the same ESRD prevalence in Taiwan.

The TWRDS system is established since 1987. The reporting system has been revised for several times. Initially, TWRDS was a manually reporting system. The computerized data collecting system had been introduced with additional data on co-morbidity, patient rehabilitation status, and key clinical performance indicators (including biochemical and hematological parameters, hepatitis profile, hypertension control, anemia management and mineral metabolism indices, etc.) since 1997. The data entry system is far from perfect at present. To improve the precision of the registry, there will be a major revision for the data entry system matching the recent rapid progress of informative science.

Conclusions

The 2000-2009 survival analysis from TWRDS revealed 2 interesting findings and one prediction. We found lower survival rate, more diabetes and aged patients in 2000-2009 cohorts comparing to previous cohort. We also predict 100 patients per million-population increase in ESRD prevalence with the current trend. Further CKD preventive effort should be implemented to slow down the increase of ESRD prevalence.

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References