Original Article

Survival Rate and Predictors of Mortality among Hemodialysis Patients in West of Iran, 1996–2015

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Abstract

Background: Hemodialysis (HD) is one of the treatments provided to end-stage renal disease (ESRD) patients. A few studies have investigated the survival rate of HD patients in Iran. Hence, we decided to investigate the survival rate and it is predictors among Iranian ESRD patients. **Methods:** This is a retrospective cohort study conducted in 165 HD patients in Tuyserkan city (Hamadan province) during 20 years from 1996 to 2015. The checklist used to gather information was comprised of patients' demographic and clinical information. The analysis was performed using Kaplan–Meier curves, log-rank test, and cox regression model. **Results:** The most prevalent cause of ESRD was reported to be high blood pressure (32.7%). The probability of survival rate at the end of 1st, 5th, and 10th year was 0.65, 0.16, and 0.05, respectively. Results of multivariate cox regression showed that old age, catheter vascular access, and high hemoglobin level have a negative significant effect on survival of HD patients ($P < 0.05$). **Conclusions:** Overall, the survival of HD patients seems to be low in Tuyserkan as compared to other studies. Age, ESRD cause, vascular access, marital status, and hemoglobin level among other factors are proved to have a significant effect on survival probability.

Keywords: *Cox regression models, end-stage renal disease, hemodialysis patients, survival*

Introduction

Chronic kidney disease considered a general term for heterogeneous disorders affecting the structure and functions of the kidney and characterized by the failure of kidneys to function properly above 50% of their normal capacity.[1] If glomerular filtration rate became <15 mL/min/1.73 m², or the need for treatment with dialysis or transplantation, the so-called end-stage renal disease (ESRD) occurs.[2]

Against the USA, Western European countries, and other developed countries, developing countries like Iran have experienced increasing trend of ESRD in the recent decade.[3] Increase in the prevalence of diabetes mellitus and hypertension as the most leading causes of ESRD, as well as an increase in the number of hemodialysis (HD) centers and increase in the detection rate of patients can be in relation to this increasing trend in Iran.[4,5] It should be noted that nearly 50% of the ESRD patients in Iran are treated with HD and the remaining are undergone transplantation and peritoneal dialysis (PD).[6] In the United States, the 1- and 5-year survival rate of patients HD is 79% and 34%, respectively.[7] Few studies in Iran have investigated the survival rate of HD patients as well. Montaseri *et al*. showed that the overall 1-, 2-, 3-, and 5-year survival rates for HD patients are 75%, 63%, 50%, and 23%, respectively.[8] Furthermore, Beladi Mousavi *et al*. have reported that patient's survival rates at 1, 3, and 5 years is 89.2%, 69.2%, and 46.8%, respectively.[9] Several factors for such a high mortality including advanced age, diabetes mellitus, adult dominant polycystic kidney disease, high blood pressure (BP), glomerulonephritis, low body mass index, homocysteine, creatinine, albumin, dialysis adequacy, method of renal replacement therapy, and etiology of kidney failure have been reported.[9-13] Among all the aforementioned factors, cardiovascular disease is the leading cause of death in ESRD patients.[10] Although there is growing evidence of HD survival in developed countries, evidence in developing countries like Iran is rarely available. Therefore to reach better understanding predictors of survival rate for HD patients, we decided to investigate the survival rate and it's predictors among HD patients in the western part of Iran.

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Methods

Study design and participants

We performed a historical cohort study on 165 HD patients in Tuyserkan county (Hamadan province) in the western part of Iran. At the 2011 census, the county's population was 103,786 (https://www.amar.org.ir/english). This study was approved by the Ethics Committee of Tehran University of Medical Sciences (TUMS. SPH. REC. 1395.1300). To provide a homogenous cohort we excluded patients with acute renal failure receiving transient HD, emigrants, undergone transplantation, or deceased by causes other that renal failure and patients on maintenance HD for ESRD at the Valiasr Hospital between 20 years of follow up between the years of 1996 and 2015 were included in the study.

Study measurement tool

Data were gathered by a checklist on hospital records of all ESRD patients. The checklist used in this study was comprised of patient's demographic information (including age, sex, residence area, educational level, the history of tobacco use or substance abuse, the date of discontinuation the therapy, the date of death if occurred, blood type and RH), and clinical information (including hemoglobin, creatinine, and blood urea nitrogen levels before the dialysis procedure, number of weekly dialysis sessions, the type of intravenous access, and background diseases such as cardiovascular diseases).

Statistical analysis

To define the time scale, we considered the time interval between the first sessions of HD to the time of patient's death. Patients, who they were changed to peritoneal dialysis therapy, were transferred to another dialysis unit or received kidney grafts were considered to be censored.

The log-rank test was used to comparison median of survival between subgroups. Schoenfeld's residual test was used to test the proportional hazards (PHs) assumption and uni- and multi-variable (adjusted by other variables in the model) cox PH with a 95% confidence interval was used to identify the significant predictors of survival rate for HD patients. The level of 0.05 was considered statistically significant for all statistical tests. We used the Stata software version 12 (Stata Corp., College Station, TX, USA) to perform all the analytical operations.

Results

Table 1 describes the main characteristics of the patients. Totally 165 HD patients were studied, of whom 56.4% were male and 52.7% were urban citizens. Hemoglobin level in most of these patients did not exceed 10 mg/dl. In addition, the most prevalent cause of ESRD was reported to be High BP (32.7%). The median survival rate for patients with diabetes, BP, and others (urology, Polycystic, and Glomerulonephritis) ESRD cause were 21, 20.9 and 30.46 months, respectively. However, these differences in survival by ESRD cause were not significant ($P = 0.61$).

The probability of survival rate at the end of 1st, 5th, and 10th year was 0.65, 0.16, and 0.05, respectively. Moreover, Table 1 shows that the only significant differences in survival time were found for marriage categories (66.9 months in singles vs. 20.3 in married and vs. 20 in bigamy, $P = 0.02$), and hemoglobin levels (23.8 in ≤10 mg/dl vs. 21.2 in >10 mg/dl, $P = 0.03$).

The results of the uni- and multi-variable analysis using the Cox's PHs model are demonstrated in Table 2. Based on the multivariable results, in comparison to patients with <45 years of age patients with 45–60 and >60 year had 2.9 and 5.54 higher risk of death ($P < 0.01$). Patients with the hemoglobin level over 10 mg/dl as compared to who's with lower than that, have a 74% lower risk of decrease (HR = 1.74, $P = 0.018$). In addition, patients with catheter as vascular access had 3.6-fold higher risk of death 3.6 (HR = 3.6, $P < 0.001$). Patients with BP as ESRD cause had a higher risk of death compared patients with diabetes as ESRD cause (HR = 1.73, $P = 0.049$).

Discussion

In this retrospective study, the median of survival time was 22.4 months, whereas the survival probability in 1st, 5th, and 10th years were 65%, 16%, and 5%, respectively. High BP was the most prevalent cause of ESRD in 32.7% of patients. The old age, catheter vascular access, High BP as an ESRD cause, and high hemoglobin level has a negative effect on survival of HD patients.

Our results showed a lower survival rate in comparison to the patients in other parts of the country. For instance, the 5-year survival of HD patients was found to be 48.6% in Southern Iran,[9] and 23% in the Northern part of Iran.[7] The result of the study in Brazil revealed that overall survival of HD patients were 84.71% and 63.32% in 1 and 5 years, respectively.[14] Studies have shown that age, undoubtedly, is one of the significant risk factors for survival.[11,15] In the present study, age had a statistically significant impact on survival of patients. Therefore, one possible explanation for observing such high mortality results in the study could be referred to the fact that over half of our sample comprised of patients aged above 60-year-old.

In addition, it was found that males had a higher risk of mortality compared to females though not significant, which is consistent with prior reports.[11,16,17] This finding, however, does not agree with the results of Depner *et al*.[18] Another study showed that although HD women had more depression-related score, but have better survival than men.[19] Better compliance of women may in connect with their better survival.

Moreover, there was a significant difference in marriage categories in terms of survival, so that single patients have

Table 1: Descriptive statistics of hemodialysis patients in Tuyserkan

Variable	*n* (%)	Number of death	Median of survival (IQR) (month)	*P* (log-rank)
Gender				
Male	93 (56.40)	61	20.94 (19.4)	0.43
Female	72 (43.60)	44	24.5 (24.13)	
Age group (year)				<0.001
<45	38 (23.03)	12	33 (39.76)	
45-60	39 (23.64)	21	25.7 (36.56)	
>60	88 (55.33)	72	14.27 (23.86)	
Residency				
Urban	87 (52.70)	53	20.33 (17.30)	0.86
Rural	78 (47.30)	52	23.8 (27.9)	
Marriage status				
Single	17 (10.30)	7	66.90 (30.46)	0.02
Married	120 (72.70)	77	20.30 (19.62)	
Bigamy	28 (17.00)	21	20.00 (21.80)	
Blood group				
A	54 (32.70)	32	23.10 (21.10)	0.78
B	34 (20.60)	24	21.20 (22.83)	
AB	11 (6.70)	8	18.00 (26.07)	
O	66 (40.00)	36	24.50 (19.50)	
BP status				
Yes	107 (64.80)	69	23.10 (21.30)	0.57
No	58 (35.20)	36	20.00 (18.90)	
Smoking status				
Yes	34 (20.60)	21	24.50 (31.90)	0.43
No	131 (79.40)	84	21.20 (20.16)	
Level of hemoglobin				
≤10	121 (73.30)	77	23.80 (26.20)	0.03
>10	44 (26.70)	28	21.20 (16.98)	
ESRD cause				
Diabetes	38 (23.00)	23	21.00 (19.73)	0.61
BP	54 (32.70)	42	20.93 (20.66)	
Other	73 (44.20)	40	30.46 (26.73)	

BP=Blood pressure, ESRD=End-stage renal disease, IQR=Interquartile range

the highest median survival between all categories. The higher median survival in single patients can be related to the fact that single patients are typically younger [Table 1]. Several studies have shown that younger patients have better survival, either because of the slow progression of background disease or favorable physical conditions.[20,21] It seems that social support performs through marital status and we cannot deduce any causal relationship merely based on marital status.

Consistent with the results of other study[14] and in contrast United States, which approximately 44% of ESRD cases caused by diabetes mellitus,[22] It was found that hypertension was the major comorbidity associated with ESRD, Our results also showed that high BP along with diabetes mellitus are the dominant prognostic factors for low survival, whereas polycystic kidney diseases and glomerulonephritis were associated with highest duration of survival in HD patients, respectively. These findings are in agreement with other studies.[11,23,24] On the other hand, the results revealed that age could be considered as a confounder since over 60% of the diabetic patients aged up to 60 years (data were not shown). Furthermore, due to sparse data and low sample size for polycystic kidney diseases and glomerulonephritis this finding is not reliance.

Results of this study showed that vascular access using catheter accompanied with increased risk of death. In fact, limiting the use of catheters minimized the infectious complications in patients, this result is consistency with findings of Matos *et al.* in Brazil,[25] and Shibiru *et al*. in Ethupia.[26] Our finding demonstrated that dialysis duration is in relation with the risk of death in patients, studies had conflicting result in this regard. Some observational studies[27,28] demonstrated a lower mortality risk associated with higher HD dose; in contrast, result of one randomized controlled trial had contradicted result.[29] However, some confounders such as body size and nutritional status can affect this relationship.

One of the limitations of this study was missing data due to the migration of patients, incomplete hospital records, or

Table 2: The result of uni- and multi-variate Cox proportional hazards survival analysis in hemodialysis patients

Variable	*n* (%)	Crude HR	*P*	95% CI	Adjusted HR[a]	*P*	95% CI
Age group (year)							
<45	38 (23.03)	1			1.00		
45-60	39 (23.64)	2.64	0.008	1.29-5.39	2.9	0.007	1.32-5.89
>60	88 (55.33)	4.15	<0.001	2.23-7.70	5.56	<0.001	2.81-10.97
Level of hemoglobin							
≤10	121 (73.33)	1.00	-	-	1.00		
>10	44 (26.67)	1.60	0.036	1.00-2.50	1.74	0.018	1.09-2.76
Vascular access							
Fistula	135 (81.82)	1.00			1.00		
Catheter	30 (18.18)	2.78	<0.001	1.64-4.73	3.60	<0.001	2.08-6.23
ESRD cause							
Diabetes	38 (23.00)	1.00			1.00		
BP	54 (32.70)	1.22	0.36	0.73-2.07	1.73	0.049	1.00-3.01
Others	73 (44.20)	0.78	0.44	0.47-1.31	1.52	0.13	0.88-2.64
Dialysis duration (h)							
3	60 (36.36)	1.00			1.00		
3.5	47 (28.48)	1.69	0.03	1.05-2.71	2.09	0.003	1.28-3.41
4	58 (35.15)	1.14	0.59	0.77-1.81	1.51	0.11	0.91-2.49

[a]Adjusted for other variables in the model. HR=Hazard ratio, CI=Confidence interval, BP=Blood pressure, ESRD=End stage renal disease

unwillingness to participate. Therefore, further studies with prospective follow-up are imperative. In addition, the small sample size limits the power of the study to determine potential risk factors.

Conclusions

Overall, we found that age, dialysis duration, ESRD cause, vascular access, hemoglobin level, and marital status are possible factors affecting the survival of HD patients. Considering the low survival probability of these patients, efforts should be made to the real-time diagnosis of the cause of renal diseases. In addition, since age is an important prognostic factor of survival, developing new screening strategies targeting high-risk groups to find the background causes of renal disease should be encouraged.

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Conflicts of interest

There are no conflicts of interest.

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