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Comparison of Hospital Utilization among Chronic Dialysis Patients in Diabetics and Non-Diabetics

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INTRODUCTION

The number of patients with End Stage Renal Disease (ESRD) and total cost of ESRD care in the United States have been increasing over the past decade. Inpatient hospital care accounts for 41% of ESRD cost (1), and has been the target of study whereby determining the underlying primary cause of admission and attempting to prevent unnecessary hospitalization. In comparison to the general population, patients on chronic dialysis have increased morbidity, primarily from cardiovascular and infectious causes (2). Certain forms of morbidity, for example those resulting from complications of dialysis or from dialysis vascular access complications, are unique to the dialysis populations and are the frequent cause of hospitalization (3-6). Several studies have used hospitalization as an index of morbidity and have established a relationship of hospital utilization to referral pattern, anemia, diabetes, ischemic heart disease (IHD) and temporary vascular access placement during ESRD (2, 6-31).

In a preliminary report, we studied rate, causes and outcomes of hospitalizations in hemodialysis patients with and without diabetes mellitus, during the year elapsed between 2001 and 2002 (32). The main findings of this small study was that the frequency and, marginally, the annual duration of hospitalizations were greater in the patients with diabetes mellitus than non-diabetics and that the two major causes of hospitalization, in terms of both frequency and duration, were complications of dialysis vascular access and complications of severe peripheral vascular disease in the lower extremities, rather than cardiac causes, which are reported as the major cause of hospitalization nationally (2). Mix and colleagues reported similar findings in which diabetics showed trends for greater hospitalization rates with regard to infectious disease compared to causes from congestive heart failure (28). However, the differences in our preliminary study could be caused by the relatively small number of patients, brief observation period, by

population differences (veterans on dialysis at the New Mexico VAHCS are almost exclusively male, elderly, often of low economic status, and have a frequency of diabetes mellitus that is higher than the frequency reported in the national registry), or by differences in overall medical care.

We therefore conducted a retrospective analysis of veterans who have been on chronic dialysis for at least 6 months at the New Mexico VAHCS and observed trends in hospitalizations over an 11 year span. Our aims were to determine 1) whether a substantial fraction of hospitalizations in patients on chronic hemodialysis are the results of potentially preventable conditions; 2) whether the pattern of hospitalizations of veterans dialyzed at the New Mexico VAHCS is characterized by a predominance of dialysis vascular access complications and severe peripheral vascular disease events rather than by cardiovascular problems; and 3) whether there are qualitative and quantitative differences in hospitalization patterns between those with and those without diabetes mellitus.

METHODS

Data were obtained from the electronic medical records at the New Mexico Veterans Affairs Health Care System (VAHCS). Clinical information including date of birth, gender, presence or absence of diabetes, date of onset of follow-up in the VA computer, date of onset of hemodialysis, dates of admission, cause of admission, surgical interventions, outcome (discharge from survival versus death) and last day of follow-up while on dialysis were obtained from the discharge summaries and electronic records.

The study population was composed of veterans with ESRD who have been on chronic dialysis, hemodialysis or peritoneal dialysis, for at least 6 months at the New Mexico VAHCS between January 1, 1995 and June 30, 2005. We selected patients during this time period secondary to the VAHCS maintaining computerized discharge summary records dating back to 1995. Subjects were divided into two groups based on the co-morbidity of diabetes. Patients were characterized as having diabetes as co-morbidity if they had: 1) diabetes as the primary cause of ESRD or 2) have diabetes as a pre-existing condition despite whether cause of renal failure was due to another etiology. Overall and cause specific hospitalization and impatient days were determined for each patient and group. Hospitalization (inpatient) days were calculated as number of hospital days in each admission. Outpatient visits and hospital visits <24 hours were excluded from data set.

Reason for hospitalization was ascertained from the discharge summary and designated appropriate principal diagnosis codes from the International Classification of Diseases, Ninth

Revision, Clinical Modification (ICD-9-CM). Principal diagnoses were then classified into broad categories and restricted to those deemed most likely to be impacted on by complications of chronic kidney disease. Categories included one of the following: 1) cardiovascular; 2) dialysis access-related; 3) infection unrelated to dialysis access; 4) other, 5) peripheral vascular disease complications.

The study period for each patient was defined by the scope of availability of hospital discharge summaries. These included all hospitalizations during the period January 1st 1995 to June 30th 2005.

All pertinent information was collected in an electronic (EXCEL) spread sheet that was created in the VA computer located in the office of the principal investigator. The electronic spreadsheet containing the data that was analyzed was maintained in the principal investigator's VA computer and contained only a code number for each patient with no way to identify individuals in this spreadsheet. The principal investigator also maintained, in a secured place (locked drawer in his VA office), a hand-written list without a title of code numbers (the first letter of the last name and the last four digits of the social security number) of each patient that allowed direct linkage of this list to the electronic spreadsheet.

Univariate comparisons for continuous variables will be carried out using parametric (paired on non-paired t-test) and nonparametric (Wilkoxon sign rank test) depending on whether the distribution of the data is normal or not. Univariate comparison of categorical variables will be done by chi-square or Fisher's exact test.

RESULTS

Patient Population

Two hundred and forty four patients enrolled in the study, of which 146 were diabetic and 146 were non-diabetic. The mean age was comparable between diabetics and non-diabetics (63 and 64 years of age, respectively), with more than half the cohort (59%) having diabetes. Number of women in both groups, non-diabetic and diabetic, was comparable (N=4, N=6; respectively) and a small percentage in perspective to the study population.

Overall Hospitalizations and Inpatient Day Rates

Total number of hospital admissions amongst the cohort was 1473. Table 1 lists patient characteristics, overall hospitalization admissions, and inpatient day rates. Number of hospitalizations from all causes was 602 in the non-diabetic patients and 871 in those with diabetes. Total number of hospitalization days and inpatient day rates, defined as number of hospital days per number of admissions, were highest in diabetics (9595, 10.99; respectively) compared with non-diabetics (5326, 8.85; respectively).

Cause Specific Admissions, Hospitalization Days and Inpatient Rates

Table 2 lists cause specific hospitalization days and inpatient day rates. Subjects with diabetes exhibited increased number of hospital admissions in each group compared with those without diabetes. Figure 2 illustrates the number of admissions per group in non-diabetics and diabetics. Amongst cause specific etiologies related to duration in the hospital, quantified in days, non-diabetics were highest for infectious disease related causes (N=2677 days) and for other causes (N=3569 days) not attributable to other respective groups, this pattern was also

exhibited for the diabetic population (N=2526, and 1225 days respectively). Figure 3 graphically illustrates the number of hospital days per group in the two respective populations. Conversely, inpatient day rates were highest amongst infectious disease causes in both non-diabetics (N=9.65) and diabetics (N=13.52) followed by other causes in non-diabetics (N=10.48) and peripheral vascular disease causes in diabetics (N=15.07). There was a statistically significant difference in the diabetic population compared with non-diabetics amongst cause specific hospitalizations in the cardiovascular disease group ($p<0.05$), dialysis vascular access group ($p<0.05$) and peripheral vascular disease group ($p<0.001$). No difference existed in the infectious disease group and complications attributable to other etiologies. Table 3 summarizes cause specific number of hospitalizations in non-diabetics and diabetics.

DISCUSSION

Hospitalization during end stage renal disease (ESRD) has not been thoroughly evaluated as a function of existing co-morbidities such as the presence and absence of diabetes, and factors associated with hospitalizations have been poorly evaluated (33-35). The current study, composed of patient records spanning 11 years, provides new information regarding the pattern, frequency and duration of hospital stay in patients with ESRD. Previous studies have shown increased hospitalization rates in patients with ESRD and the co-morbidity of diabetes (1,15,28). Total number of hospitalizations in our study was 1472, with the diabetic population having increased proportion of hospitalizations (60%). This supports the notion of diabetes acting as a risk factor for hospital utilization and replicates similar findings in our preliminary study in which annual duration of hospitalizations were greater in the patients with diabetes mellitus than non-diabetics.

Cause specific duration of hospital stay and number of admissions was greater in all groups in those with diabetes compared with non-diabetics, the infectious disease group being the prominent factor. This is contrary to previous studies in which dialysis vascular access complications and cardiovascular complications are the majority of cause specific hospitalizations (3-6). Our study supports that dialysis access related complications represents a substantial proportion of inpatient hospital stay but not to the extent of 25 to 31% documented in previous studies (1,3,28,33). Furthermore, previous studies have exhibited cardiovascular causes as a leading cause of hospitalization amongst ESRD patients receiving dialysis (1-4, 28,33,36). However, no statistical difference was observed in frequency of hospitalization in the infectious

disease group. Along these lines, if we eliminate causes of inpatient presentation unrelated to ESRD, cardiovascular etiologies and peripheral vascular disease complications are the second and third leading cause of frequency of hospitalization in both diabetic and non-diabetic populations, respectively, both statistically greater in the diabetic population. This is consistent with the literature in which diabetics had more frequent and more prolonged hospitalizations than non-diabetics.

Mean days per admission were higher in the population with diabetes in the infectious disease and peripheral vascular disease groups. This finding confirms the findings of studies which show increased hospitalization rates related to infectious disease in diabetics (28,33). Our study demonstrates that ESRD patients with diabetes suffer increased days for resolution of ailments. Given the pathophysiology of diabetes and complications such as decreased wound healing secondary to peripheral vascular disease, complications in such a category would be observed in greater numbers in patients with diabetes.

Given that our study exhibits large numbers of hospital admissions due to cardiovascular causes, peripheral vascular disease complications and dialysis vascular access complications; such admissions can be truncated given our focus of prevention of diabetic complications. It is well established that patients with diabetes or cardiovascular disease incur higher cost compared to those who have no diabetes or cardiovascular disease, respectively. If we screen for complications of peripheral vascular disease such as ulcers, decreased peripheral circulation and wound healing, etc. during frequent dialysis appointments, we may dramatically curtail the number of admissions and duration of stay due to these ailments.

Our results do however have limitations. Duration of stay maybe skewed based one patient's prolonged hospitalization in a single admission, this maybe the cause of no statistically significant difference between hospitalizations due to infectious disease. Furthermore, we did not include modality of dialysis used, hemodialysis or peritoneal dialysis, at onset of renal failure in our study. Murphy and colleagues have exhibited an increase in hospital admissions in patients treated with peritoneal dialysis compared with hemodialysis (15). Similarly, number of admissions has been correlated to time period status post dialysis onset; 3 months after initiation of dialysis exhibiting the majority of hospital admissions (1). Future goals of our study are to include date of onset of dialysis, thereby evaluating the pre and post dialysis period, cause specific hospital admissions and duration, and rate calculation (number of hospital admissions per patient month and year at risk). We intend to investigate various pre and post dialysis durations with respect to cause specific etiologies of presentation in both non-diabetic and diabetic populations.

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Table 1. Patient demographics and overall hospitalization characteristics

Characteristic	Diabetic (N=146)	Non-Diabetic (N=98)
Age (years)	64	63
Women	6	4
Hospitalization Days	9595	5326
Number of Admissions	871	602
Inpatient Day Rates	10.99	8.85

Table 2. Cause specific hospitalization days and days per admission

Characteristic	Diabetic (N=146)	Non-Diabetic (N=98)
Hospitalization Days		
Group 1	2677	1225
Group 2	1900	1081
Group 3	364	389
Group 4	3569	2526
Group 5	1085	105
Days per Admission		
Group 1	13.52	9.65
Group 2	10.38	6.76
Group 3	5.78	6.17
Group 4	10.00	10.48
Group 5	15.07	9.55

Table 3. Cause specific number of admissions with p-values

Characteristic	Diabetic (N=146)	Non-Diabetic (N=98)	p-value
Number of Admissions			
Group 1	197	127	0.522
Group 2	183	160	<0.05
Group 3	63	63	<0.05
Group 4	356	241	0.787
Group 5	72	11	<0.001

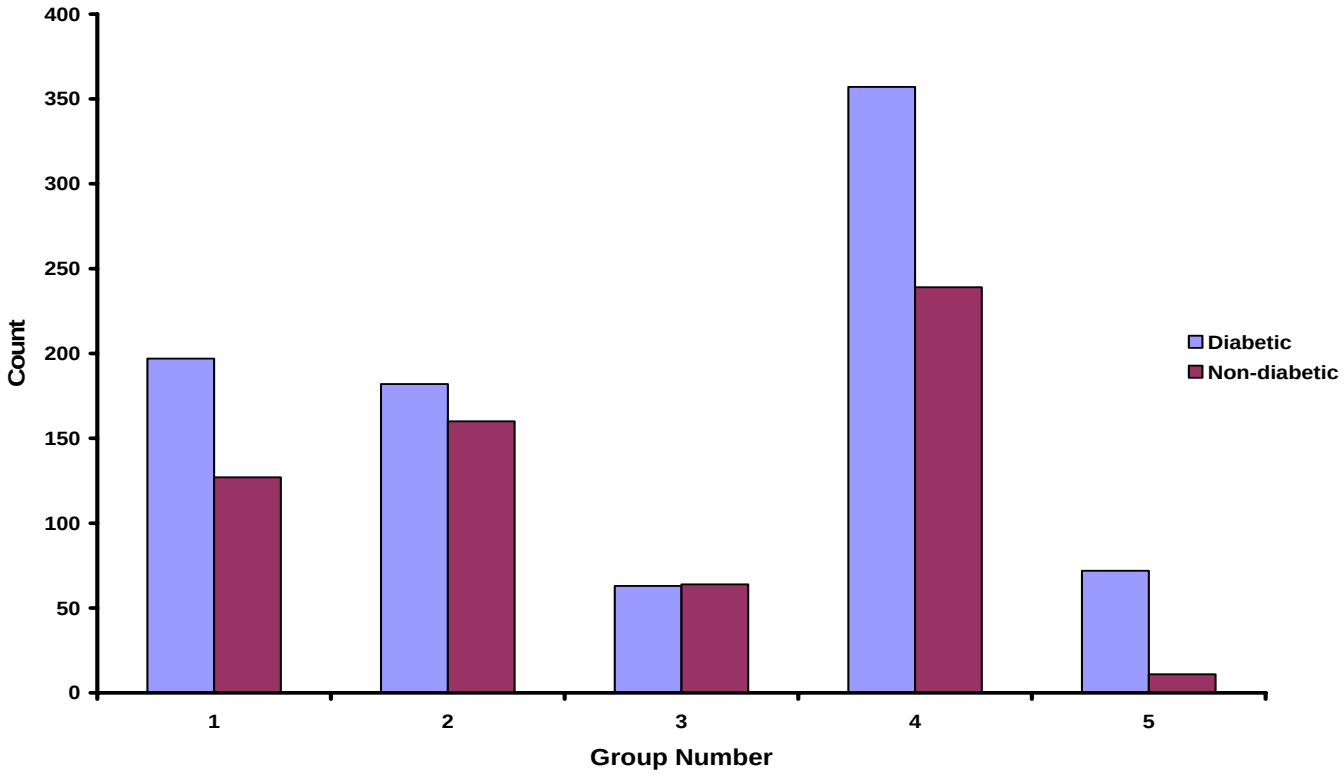

Figure 1. Number of admissions per group in non-diabetics and diabetics

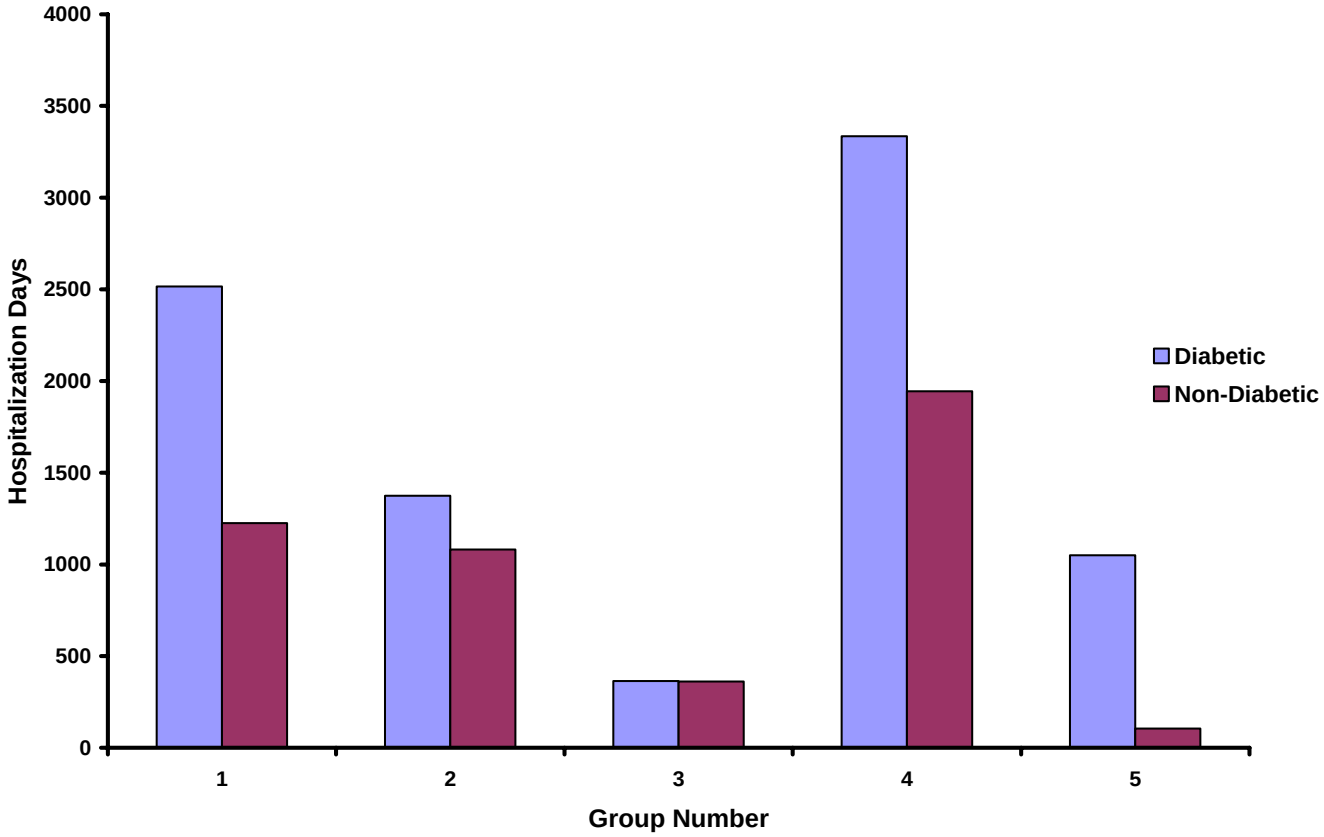

Figure 2. Number of hospitalization days per group