RENAL DYSFUNCTION IS NOT ONLY A RISK FACTOR BUT ALSO A SURROGATE MARKER FOR LONGER HOSPITAL STAY IN AN ACUTE GENERAL MEDICAL UNIT

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Abstract - *Objective:* *To assess the relationship between renal function and the length of hospital stay in patients admitted to Acute Medical Unit (AMU).* *Methods: We evaluated all patients admitted to the AMU of a tertiary hospital between August to September 2011. Patients were categorised into two groups according to their renal function on admission. Group 'A' patients had an estimated glomerular filtration rate (eGFR) greater than 60ml/min and Group 'B' had an eGFR of less than 60ml/min. We analysed and compared the mean length of stay (LOS) and the clinical outcome between these two groups of patients.* *Results:* *608 patients with mean age of 75.4 +/- 16.7 were admitted during the study. Out of the 608 patients, 338 were female and 270 were male. 337 patients (55%) were classified as Group A and the remaining 47% were in group B according to their admission renal function. Group A patients were significantly younger (70.3 ± 18.6) than group B (81.7 ± 10.9) with P<0.01. 71.5% of patients in group B had stage 3 chronic kidney disease. Independent of the underlying medical conditions, group B patients had a 20% increase in hospital stay compared to group A (hazard ratio = 1.20, 95% CI = 1.01-1.43, p <0.04). Among group B patients, a 50% increases in hospital stay was observed for those who made a significant recovery in their renal function (hazard ratio 1.50, 95% CI = 1.15-1.99, p < 0.003). Patients with worsening renal dysfunction after admission did not predict longer hospital stay (hazard ratio 1.23, 95% CI = 0.84-1.87, p= NS). The presence of bacteriuria was not associated with increased LOS (95% CI: -2, 42; p=0.09). No association was detected between LOS and either age or gender.* *Conclusion:* *Nearly half of the patients presented to the acute medical unit had various degree of renal dysfunction. Elderly patients with renal dysfunction had a 20% increase in hospital stay. The presence of bacteriuria was not associated with a longer hospital stay. Non-dialysis renal dysfunction patients who made a significant renal recovery during their hospital stay had a 50% longer hospital stay. The finding suggests renal dysfunction is not only an independent risk factor but also a surrogate marker reflecting the severity of the underlying medical condition in predicting patient length of hospital stay especially in elderly patients with significant recovering renal function.*

Key Words: general medicine, kidney function, eGFR, length of stay, chronic kidney disease

I. INTRODUCTION

The presence of renal impairment is defined when a person's estimated glomerular filtration rate (eGFR) is less than 60ml/min/1.73m [1], and it is associated with poorer patient outcomes in the hospital and in the outpatient setting [1,2]. Up to 28% of patients admitted to hospital present with some degree of renal impairment [3]. In patients with Acute Kidney Injury (AKI), a moderate increase in serum creatinine level is associated with increased length of stay and increased risk of mortality [4,5]. The presence of Chronic Kidney Disease (CKD) in special patient groups such as stroke, cardiac bypass and heart failure is independently associated with increased length of stay and risk of mortality [6-8]. Despite extensive studies into renal impairment, there are few studies that address its impact in general medical patients who are generally older and present with numerous co-morbid conditions. Therefore we examined the role of impaired renal function in patient length of stay in those admitted to acute medical unit.

II. METHODS

Data Collection

Data was collected from all patients that presented to the AAU between August and September 2011. Patients that were admitted more then once were only recorded for their first admission. Patients on dialysis were excluded from analysis. Data including basic demographic data, co-morbid illness, length of stay (LOS) and renal function were collected from electronic hospital records. The presence of bacteriuria (Asymptomatic or symptomatic) was also recorded based on urine culture and microscopy results.

Assessment and Classification of Renal Function

The Modified Diet in Renal Disease (MDRD) formula (table 1) was used to calculate the estimated Glomerular Filtration Rate (eGFR) of subjects involved in this study. Serum creatinine was collected from the hospital's computer database. The use of the MDRD to determine renal function reflected local medical practice, where the Cockroft-Gault

formula was rarely, if ever used, in approach to general medical patients, an observation found in other studies[9]. Patients were divided into two groups based of their admission eGFR: The first group (group A) had normal renal function as defined by eGFR greater then $>60\text{ml/min}/1.73\text{m}^2$ (CKD Stage I/II). The second group (Group B) had impaired renal function as defined as an eGFR below $60\text{ml/min}/1.73\text{m}^2$. Patients in Group B were further divided into CKD stage 3-5 depending on their admission eGFR (table 1). Trends in renal function were assessed and classified as transitions between difference CKD stages, if any. If there were less than three measurements of creatinine, the first/second measurement was carried forward.

Table 1: Modified Diet in Renal Disease Formula (MDRD)[10] and Chronic Kidney Disease (CKD) Stages [1]	
MDRD 4: 186 x (serum creatinine umol/L)$^{1.154}$ x (age)$^{0.203}$ x (0.742 if female and 1.000 if male).	
CKD Stage I	$>90\text{ml/min}/1.73\text{m}^2$
CKD Stage II	$60\text{-}89\text{ml/min}/1.73\text{m}^2$
CKD Stage III	$30\text{-}59\text{ml/min}/1.73\text{m}^2$
CKD Stage IV	$15\text{-}29\text{ml/min}/1.73\text{m}^2$
CKD Stage V	$<15\text{ml/min}/1.73\text{m}^2$

Assessment of Bacteriuria

Bacteriuria was defined by the presence of significant bacterial growth ($>10^8$ colony forming units/Litre) on appropriate culture medium, and associated with either a positive nitrite of leucocyte esterase result on dipstick. The presence of multiple epithelial cells (>100) suggested an inappropriate sample and was not included in analysis.

Outcomes

The outcomes in this study included patient length between the two groups, and in Group B, the impact of changing renal function in length of stay.

Statistical Analysis3

Demographic variables were analysed using a Welch 2 sample T-Test to determine significance where appropriate. Linear Regression was used to determine statistical significance of renal function, UTI and changes in renal function as risk factors for length of hospital stay.

III. RESULTS

608 patients' data were analysed. The mean age was 75.3± 18 years. 55% of subjects were female. 273 patients (45%) presented with renal dysfunction; and on average were older then those presenting with normal renal function (81.7 ±15 years vs. 70.3±15 years p<0.01). Characteristics of both groups are shown in Table 2.

Table 2: Characteristics of General Medical Patients Stratified by Renal Function on Admission (Group A $>60\text{ml/min}/1.73\text{m}^2$, Group B $<60\text{ml/min}/1.73\text{m}^2$)			
	Group A	Group B	p
No. (%)	335 (55)	273 (45)	
Mean Age (years)	70.3	81.7	<0.05
Length of Stay (Hours)	119.6 (95% CI 106.8-134.6)	143.5 (95% CI 120.79-171.02)	<0.04

Impaired renal function on admission ($<60\text{ml/min}/1.73\text{m}^2$) was associated with a 20% increase in mean length of stay (119.6 versus 143.5 hours p<0.04). In Group B patients, any deterioration in renal function as defined by transition to a higher CKD stage (for example stage 3 to 4, or 4 to 5) during the hospital stay was not associated with a mean increase in the length of stay (p> 0.1 Table 3).

Table 3: Mean Length of Stay (hours) correlated against declining CKD stage in patients admitted with impaired renal function ($<60\text{ml/min}/1.73\text{m}^2$)		
	Length of Stay (Hours)	p
Baseline	143	
2nd eGFR	168	0.504
3rd eGFR	171.6	0.313

An improvement of renal function as defined by transition to a lower CKD stage (Table 3) was significantly associated with an increased in the mean length of stay (43 vs. 214.5 hours, p<0.03).

The presence of bacteriuria on admission was not associated with an increased length of stay (164 versus 192 hours, p <0.09).

IV. DISCUSSION

This study showed that a significant number of patients (45%) admitted under acute medical unit presented with some degree of renal dysfunction with an eGFR$<60\text{ml/min}/1.73\text{m}^2$, a finding that is substantially higher than other studies involving general medical patients (17-30%)[3,9,11]

Table 4: Mean Length of Stay (hours) correlated against declining CKD stage in patients admitted with impaired renal function ($<60\text{ml/min}/1.73\text{m}^2$)		
	Length of Stay (Hours)	P
Baseline	143	
2nd eGFR	168	0.504
3rd eGFR	171.6	0.313

The presence of renal dysfunction on admission lead to a significant, mean 20% increase in patient length of stay. In patients admitted with renal dysfunction, any improvement in renal function was associated with a significantly longer hospital stay. This contradicts the findings of most other studies, which show longer hospital stays in deteriorating renal function, particularly in the setting of patients admitted for cardiovascular-associated conditions[6,7]. The exact reason for this contradiction remains unknown but it is our belief that patients with improving renal function were likely a reflection on the severity and extent of their underlying medical conditions that required an extended period of care in the hospital. This is especially in the elderly patients who often had multiple co-morbid medical conditions.

This study does not differentiate between Acute Kidney Injury (AKI), CKD or AKI in CKD in analysis of patients. The use of MDRD in this study was to reflect the general acceptable clinical practice at the time of data collection,

where the eGFR using the MDRD formula is provided when measuring serum creatinine. However, it has been shown the MDRD can overestimate renal function by as much as 12% in older patients (69-92 years of age). Inevitably this means that some patients in our study classified as having "normal" renal function would, in reality, have some degree of renal impairment [12].

The presence of bacteriuria was *not* associated with a significantly increased length of stay (164 versus 192 hours p <0.09), and this result likely reflects a high proportion of patients presenting with asymptomatic bacteriuria, which is generally accepted as common, and not requiring active management [13]. Sub-group analysis, differentiating between asymptomatic and symptomatic UTI's may delineate a difference in mean length of stay.

V. CONCLUSION

In conclusion this study showed that almost half of patients presenting to our acute medical unit had some degree of renal dysfunction. In those patients with renal dysfunction, the average length of stay was 20% greater then those without renal failure. In the setting of renal dysfunction, improving renal function was associated with an increased length of stay.

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