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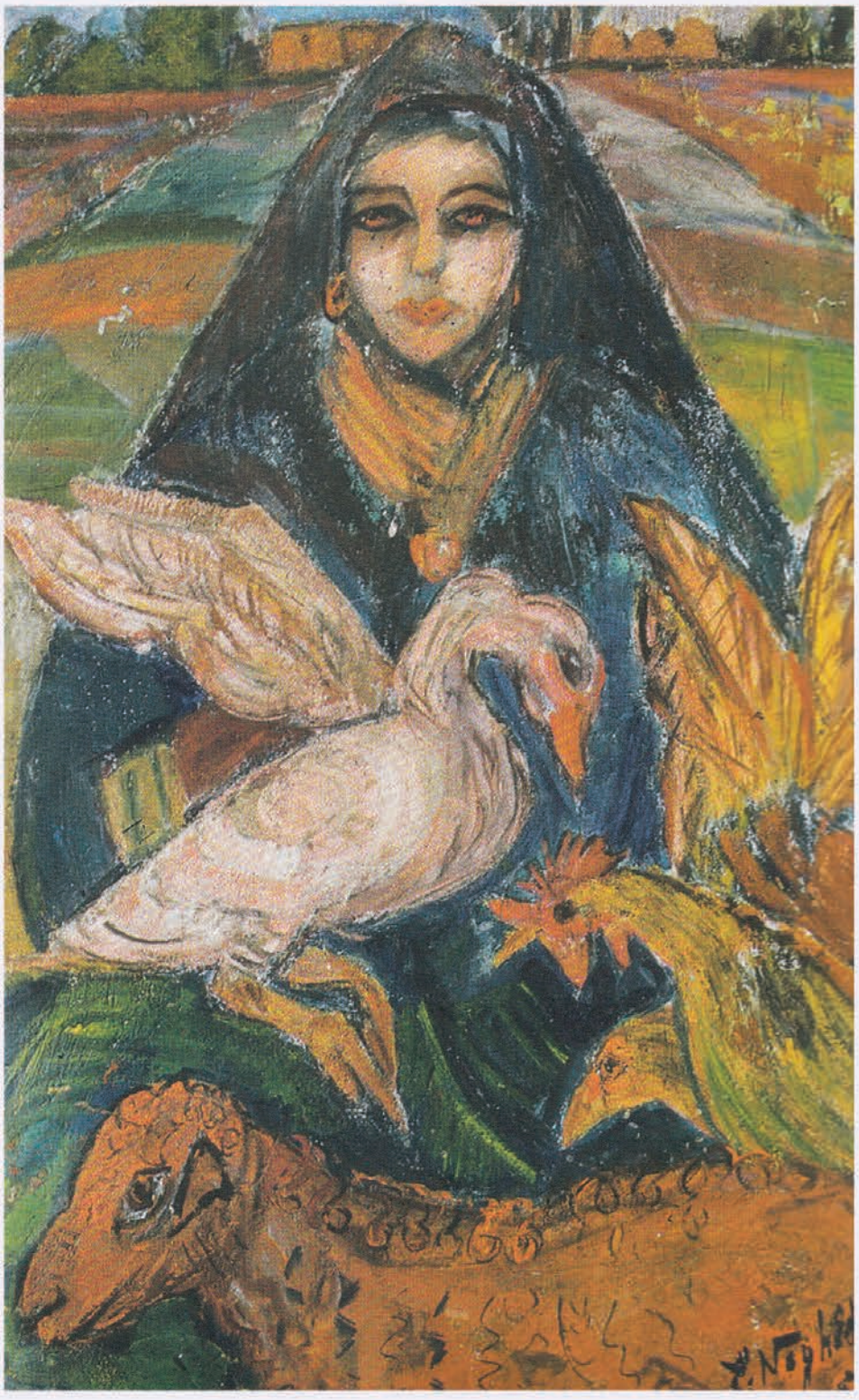

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Spectrum of renal diseases among patients admitted to the internal medicine unit through the emergency room and their outcomes: morbidity, mortality, and cost analysis

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Renal disease is a common health problem that is linked to excessive morbidity and mortality worldwide. It is crucial to know the etiology and clinical features of renal diseases to promote prevention strategies and adequate management resources. This study aimed to perform a comprehensive review the spectrum of renal diseases among patients admitted to one internal medicine unit (unit 6) through the emergency room. We evaluated total admission cases to the unit 6 through the emergency room in 1 year between July 2010 and July 2011. The total capacity of the unit is 24 beds. The total number of patients admitted during the study period was 571. Their mean age was 50.72 ± 14.15 years (range 14–95 years). A total of 51.66% were males and 48.44% were females. The average duration of hospital stay was 6.43 ± 3.57 days (range 1–30 days). There were 200 patients with renal diseases (35.02%). Their mean age was 46.73 ± 15.76 years (range 16–87 years). In all, 55% were females and 45% were males, and the average duration of hospital stay was 7.59 ± 3.89 days (range 1–23 days). In all, 33% of patients had acute kidney injury represented, 51.5% had chronic kidney disease, 7.5% had glomerular diseases (nephrotic and nephritic syndromes), and 8% had obstructive uropathy. Fifteen patients died during their hospital stay (7.5%); their average age was 49.87 ± 11.42 years (range 28–65 years). There were four statistically significant mortality predictors among patients with kidney diseases (total leukocyte count above 19.55 cm^2, serum potassium above 5.74 mEq/l, atrial fibrillation, and hypertension). The total cost of services provided for patients was 275 624 L.E. The total cost of services provided for patients with kidney diseases was 118 919.25 L.E. (43.15%).

Keywords:
acute kidney injury; chronic kidney disease, cost; morbidity; mortality

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Introduction

Renal disease is a common health problem that is linked to excess morbidity and mortality worldwide. Estimates of the global burden of disease indicate that diseases of the kidney account for ~830 000 deaths and 18 467 000 disability-adjusted life years annually, ranking them 12th among causes of death (1.4% of all deaths) and 17th among causes of disability (1.0% of all disability-adjusted life years) [1]. Lack of awareness and appropriate management of potential underlying kidney disease, even in high-risk patients, seems to be common in many parts of the world, even though many of the measures recognized to decrease the risk and slow the progression of kidney disease are most effective when initiated early [2].

Healthcare costs for these lethal diseases are huge, placing an enormous burden on society. As of 2005, the total annual cost of treating end-stage renal disease in the USA was about $33 billion [3]. The financial and human resources that will be needed to care for these patients in 2015 will be considerably greater than that in 2005 [4]. Acute renal failure (ARF) is a common health problem worldwide. ARF remains a significant cause of morbidity and mortality worldwide. The mortality rates vary from 25 to 90%. The mortality rate is 40–50% in general and 70–80% in ICU settings. Approximately 95% of consultations to nephrologists are related to ARF [5].

Glomerulonephritis remains a major cause of morbidity and mortality from renal disease in many parts of the world, particularly in the tropical and subtropical regions. According to several local registries and sporadic publications, it seems to be responsible for 23.2–58.4% of patients on regular dialysis in the tropics compared with contemporary figures of around 16–18% in the USA and 9–15% in Europe. Its prevalence among dialysis patients in Egypt has been reported to be 16.6% in 1998 [6].

Medical audit of morbidity patterns is an invaluable tool in health planning in any given community.

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It is important in healthcare research and resource allocation particularly in economies where financial allocation to the healthcare sector falls short of the minimum requirement [7]. In this study, we have reported the spectrum of renal diseases among patients admitted acutely to one of the internal medicine units in Cairo University Hospital (unit 6). We analyzed the clinical and laboratory factors associated with overall morbidity and mortality in both groups in addition to the total hospital cost related to hospital stay, investigations, and interventions.

Patients and methods

This is a retrospective analysis of all medical admissions to one medical unit (department 6) at the Kasr Al-Ainy University Hospital through emergency department in 1 year from July 2010 to July 2011. Kasr Al-Ainy School of Medicine, Cairo University, is the largest tertiary referral hospital in Egypt, playing a major role in healthcare management.

We evaluated all patients admitted to department 6 through the emergency department every Thursday from 8 p.m. to 8 a.m. The total capacity of the medical unit was 24 beds, divided into 12 beds for male patients (50%) and 12 beds for female patients (50%). The total number of patients admitted to this unit through the emergency room during the study period was 571. For this type of study, formal consent is not required.

Patients with renal diseases were identified and classified as follows:

(1) Patients with acute kidney injury (secondary to medical and surgical/obstetric causes). Acute kidney injury (AKI) is defined as any of the following: increase in serum creatinine by at least 0.3 mg/dl within 48 h or increase in serum creatinine to at least 1.5 times baseline, which is known or presumed to have occurred within the previous 7 days, or urine volume less than 0.5 ml/kg/h for 6 h [8].
(2) Patients with chronic kidney disease (CKD) presented with acute problems. (CKD is defined as kidney damage or glomerular filtration rate below 60 ml/min/1.73 m^2 for 3 months or more irrespective of the cause [9].
(3) Patients with nephrotic/nephritic syndromes.
(4) Patients with obstructive uropathy (obstructive uropathy refers to the structural or functional changes in the urinary tract that impede normal urine flow [10].

The following data were retrieved for patients with renal diseases:

(1) Demographic data (name, age, sex, and special habits of medical importance).
(2) Comorbid conditions such as diabetes mellitus (DM), hypertension (HTN), cardiovascular diseases, liver diseases, lung diseases, neoplasm, and vascular diseases.
(3) Type of dialysis required, access-related problems, complications during dialysis.
(4) Duration of hospitalization and cause of death if any.
(5) Laboratory investigations performed on admission including (blood urea and serum creatinine, estimated glomerular filtration rates, serum electrolyte estimation, Ca^{2+}, PO_4^{+}, uric acid, albumin, blood gases, and complete blood picture).
(6) Fundus examination, ECG, plain chest radiography, abdominal ultrasound.
(7) Etiology of renal disease, previous nephrology care, and targets achieved, if any.
(8) Intervention required during hospital stay.

Results

The total number of patients admitted to department 6 during the study period was 571. They were classified into two main groups:

(1) Group 1 included patients with renal diseases and there were a total of 200 patients (35.02%).
(2) Group 2 included patients with nonrenal diseases and there were a total of 371 patients (64.98%).

The mean age of the patients included in the study was 50.72 ± 14.154 years (range 14–95 years). Most of the patients were males (51.66%). The average duration of hospital stay during the study period was 6.43 ± 3.57days (range 1–30 days). In our study, the most common comorbid condition was DM [196 patients (34.3%)]. Among patients with renal diseases, DM was present in 60 patients (30%), whereas among patients with nonrenal diseases, it was present in 136 patients (36.65%). The prevalence of hepatitis C virus (HCV) was 30.82% (176 cases).

The spectrum of renal diseases in group 1 was as follows:

(1) Patients with acute kidney injury [n = 66 (33%)].
(2) Patients with CKD who presented with acute problems [n = 103 (51.5%)].
(3) Patients with nephrotic/nephritic syndromes [n = 15 (7.5%)].
(4) Patients with obstructive uropathy [n = 16 (8%)].

Table 1 shows the mean and range of laboratory parameters of patients in group 1.

DM and HTN were the most common comorbid conditions in group 1 [43 cases (30.71%)], followed by HTN in 37 cases (26.43%) and DM in 17 cases (12.14%). The average duration of hospital stay in group 1 was 7.59 ± 3.894 days (range 1–30 days) [Table 2].

Among patients with nephrotic/nephritic syndromes, lupus nephritis, with its different classes, was the most frequent etiological diagnosis present in 12 patients (80%). Focal and segmental glomerulosclerosis was found in two patients (13.33%). One patient was diagnosed with postinfectious diffuse proliferative glomerulonephritis (6.66%).

Hospital intermittent hemodialysis modality was the most frequent dialysis modality used for patients in group 1 as it was used for 118 patients (84.29%), whereas intermittent peritoneal dialysis modality was used for four patients (2.86%) in group 1. Among patients with CKD who presented with acute problems, 99 patients (96.12%) were treated with intermittent hemodialysis and four patients received intermittent peritoneal dialysis.

Seventy-two of the study patients died during their hospital stay (12.61%). Forty patients were females (55.5%) and 32 were males (44.5%). Their average age was 55.42 ± 15.17 years (range 14–95 years).

In group 1, 15 patients (7.5%) died during their hospital stay; 11 patients were females and four were males. Their average age was 49.87 ± 11.42 years (range 28–65 years). Their average duration of hospital stay was 3.87 ± 3.36 days (range 1–14 days).

Multivariate logistic regression analysis was used to identify variables that were independent predictors of mortality. Total leucocyte count (TLC) level above 19.55/cm^2 (P < 0.0001), serum K^+ above 5.74 mEq/l (P = 0.0002), atrial fibrillation (P = 0.0026), and HTN (P < 0.0173) were statistically significant mortality predictors among the patients in group 1 (Table 3).

A diagnostic test (2 × 2 table) for statistically significant mortality predictors enables calculation of mortality predictor characteristics such as sensitivity, specificity as well as positive and negative predictive power from a 2 × 2 table.

The most sensitive mortality predictor among the patients in group 1 was serum K^+ above 5.74 mEq/l (66.67%), followed by TLC level above 19.55/cm^2 (60%), whereas the most specific mortality predictor among the patients in group 1 was atrial fibrillation (100%), followed by TLC level above 19.55/cm^2 (95.2%) (Table 3).

The total costs of services provided for patients admitted to department 6 during the study period were 275.624 L.E., with the average cost per patient being 482 L.E. The total costs of services provided for patients in group 1 were 118.919 L.E., ~43.15% of the total cost, with the average cost per patient being 849 L.E.

Discussion

Renal disease constituted 35.02% of the total admissions through the emergency room. Half of these

Table 1 Showed mean and range of laboratory parameters of patients in group 1

Laboratory Parameters	Mean ± SD	Range
Serum creatinine (mg/dl)	11.83 ± 5.89	0.6–28.3
Blood urea level (mg/dl)	216.5 ± 98.59	10–466
Serum sodium (mEq/l)	133.48 ± 6.125	110–147
Serum potassium (mEq/l)	4.92 ± 1.04	2.5–7.5
Hemoglobulin level (g/dl)	8.29 ± 1.83	4.5–13.6
Total leukocyte count (/cmm)	10.33 ± 6.32	2.3–30.5
Platelet count (/cmm)	259 ± 80.98	110–480
pH	7.23 ± 0.126	6.9–7.53
Serum Bicarbonate (mmol/l)	11.81 ± 5.60	2.6–25
Serum phosphorus (mg/dl)	5.61 ± 2.11	1.8–10
Serum uric acid (mg/dl)	7.46 ± 2.54	2.5–15
Serum albumin (g/dl)	3.21 ± 0.50	2–4
Serum calcium (mg/dl)	6.96 ± 1.06	4–9.4

Table 2 The pathological diagnosis for US guided renal biopsies in group 1

Pathological diagnosis	Number of cases	%
Lupus nephritis class II	1 case	6.66
Lupus nephritis class III	4 cases	26.67
Lupus nephritis class VI	7 cases	46.67
Focal segmental sclerosis	2 cases	13.33
Post infectious glomerulonephritis	1 case	6.66

Table 3 Predictors of mortality in group (1): Multivariate Analysis

Mortality Predictor	OR (95% CI)	*P* value
Age > 49.87 years	1.2785 (0.437–3.7401)	0.65
Male gender	0.4068 (0.1229–1.3466)	0.14
Female gender	2.4583 (0.7426–8.138)	0.14
Hypertension	3.7833 (1.4622–11.3615)	0.017*
Serum potassium >5.74 mEq/l	8.8696 (2.6776–28.4345)	0.0002*
Hemoglobin level <7.47 gm/dl	2.3419 (0.7888–6.953)	0.12
Total leukocyte count >19.55/cmm	29.7500 (7.9555–111.2512)	<0.0001*
Serum bicarbonate <9.5 mmol/l	2.3265 (0.7794–6.945)	0.13
Atrial fibrillation	98.7421 (4.9711–1940.5565)	0.002*

CI, confidence interval, OR, odds ratio *P-value is significant if ≤ 0.05.

patients (51.5%) had CKD and were admitted because of acute problems such as pulmonary congestion, hyperkalemia, severe anemia, and gastrointestinal bleeding. Kidney diseases are often detected too late, when the patient is already in end-stage renal disease and required renal replacement therapy. Late referral of patients with CKD was defined as a course in a renal unit starting within 16 weeks or less before the start of renal replacement therapy (RRT). Late referral of CKD cases to nephrology practice is a worldwide problem and is associated with increased morbidity and mortality [11]. Late referral leads to increased costs of healthcare because of urgent need for dialysis through a temporary catheter and its related complications. The total cost of the renal group represented 43.15% of the total cost of the group mainly because of the cost of renal replacement therapy.

Patients with acute kidney injury constituted 33% of the renal group. Liangos *et al*. [12] recently described the epidemiology and outcomes of ARF in a national survey of hospitalized patients in the USA. They found an incidence of 19.2 per 1000 hospitalizations. Furthermore, they found that AKI was more commonly coded for in older patients, male sex, black race, and in the setting of CKD, congestive heart failure, chronic lung disease, sepsis, and cardiac surgery [12]. Before the 1970s, most studies in the developed countries indicated that ~60% of AKI cases were related to surgery or trauma, 30% occurred in a medical setting, and about 10% were related to the complications of pregnancy [13]. Over the past three decades, there have been changes in the relative etiology of AKI in developed as well as in developing countries [14]. Although AKI resulting from trauma and surgery has decreased, AKI because of medical diseases has increased in developed countries [14].

Glomerulonephritis remains a major cause of morbidity and mortality from renal disease in many parts of the world, particularly in the tropical and subtropical regions. According to several local registries and sporadic publications, it seems to be responsible for 23.2–58.4% of patients on regular dialysis in the tropics compared with contemporary figures of around 16–18% in the USA and 9–15% in Europe.

Its prevalence among dialysis patients in Egypt has been reported to be 16.6% in 1998 [6].

Lupus nephritis was reported in 12 cases (80%); class IV was the most frequent class encountered (46.67%), followed by class III (26.67%) and class II (6.67%). Thus, lupus nephritis was the most frequent etiological diagnosis; this is probably, in part, because of increased awareness of the disease. Moreover, the adoption of the National Institute of Health (NIH) protocol for the treatment of lupus nephritis (which requires a renal biopsy to determine the WHO class of lupus nephritis as well as the activity and chronicity index before starting therapy) has enabled most centers to perform renal biopsies more readily than before in systemic lupus erythematosus cases.

The prevalence of HCV was 30.82% in this study. Egypt has the largest epidemic of HCV in the world. The recently released Egyptian Demographic Health Survey (EDHS) tested a representative sample of the entire country for the HCV antibody. The sample included both urban and rural populations and included all 27 governorates of Egypt. Over 11,000 individuals were tested. The overall prevalence (percentage of individuals) of positivity for the antibody to HCV was 14.7% [15].

DM and HTN were the most common comorbid conditions in group 1 [43 cases (30.71%)]. The data from the EDHS 2008 showed the crude prevalence rate of physician-diagnosed diabetes among the adult population of Egypt aged 15–59 years to be 4.07% [12]. Egypt is in the world's top 10 in terms of the highest number of patients with diabetes in 2003 (3.9 million) and the highest projected number of patients with diabetes in 2025 (7.8 million) [16].

Cardiovascular disease and infection are important mortality predictors among kidney disease patients [17]. Atrial fibrillation, HTN, hyperkalemia, and leukocytosis were strong mortality predictors among patients with renal diseases in this study. Early referral of CKD patients is advised to initiate therapeutic interventions designed to reduce cardiovascular risk such as blood pressure control, lipid control, and timely creation of vascular access. Late referral is associated with high mortality because of the need to use a central venous catheter, extensive cardiovascular disease, and advanced uremia.

Conclusion

Kidney disease was a major cause of acute illness among patients admitted through the emergency room. CKD and acute kidney injury were the predominant reasons for admission. Sepsis, hyperkalemia, atrial fibrillation, and HTN were significant predictors of mortality in patients with kidney disease. Late referral was associated with high mortality and contributed toward the high cost of care for these patients (Table 4).

Acknowledgements

Ethical approval: All procedures performed in studies involving human participants were in accordance

Table 4 2 × 2 table for statistically significant mortality predictors among the patients in group 1

Variables	Sensitivity (%)	Specificity (%)	PPV (%)	NPV (%)
Serum potassium >5.74 mEq/l	66.76	81.60	30.30	95.33
Total leukocyte count >19.55/cmm	60	95.2	60	95.2
Hypertension	53.33	76.80	21.62	93.20
Atrial fibrillation	26.67	100	100	91.91

NPV, negative predictive value; PPV, positive predictive value.

with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

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Conflicts of interest
There are no conflicts of interest.

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