AIM OF THE WORK

The aim of this work was to analyze the demographic, clinical and laboratory data of children with chronic kidney disease (stages II-IV) admitted to the Alexandria University Children's Hospital during ten years (2002-2011).

MATERIAL

This study was based on the data retrieved from the files of children with chronic kidney disease (stages II-IV) admitted to the Alexandria University Children's Hospital during ten years (2002-2011).

METHODS

Study design

Descriptive, record-based retrospective study.

Study setting

The study was carried out at the nephrology clinic in Alexandria University Children's Hospital (AUCH).

Target population

The target population of the study was children with chronic kidney disease (CKD) stages II-IV, admitted to the AUCH during the years 2002-2011.

Sampling design

Sampling:

All cases diagnosed as chronic kidney disease (stages II-IV) from 2002 till 2011 at the AUCH were included in the study. They reached 65 patients.

Data collection methods:

Data were collected from the files of all children diagnosed as having chronic kidney disease (stages II-IV) during ten years (2002-2011) at AUCH.

The following data were collected:

1- Personal characteristics:

- Child's name and sex.
- Residence.
- Date and age at diagnosis of CKD (at presentation).
- Family history of renal disease.

2- Initial clinical presentation:

- The initial clinical presentation (symptoms and signs).
- Anthropometric measurements.

3- Laboratory investigations:

- Initial urine analysis (hematuria, proteinuria, pyuria and significant bacteriuria).
- Initial blood chemistry (blood urea nitrogen and serum creatinine, calcium, phosphorus, alkaline phosphatase, sodium, potassium, cholesterol and triglycerides).
- Initial creatinine clearance (measured).
- Estimated glomerular filtration rate, using Schwartz formula:

$$\text{eGFR (mL/min/1.37 m}^2\text{)} = \frac{\text{k x height "cm"}}{\text{serum creatinine"mg/dL"}}$$

Where k is 0.33 for low-birth weight infants <1 yr old, 0.45 for term infants <1 yr old whose birth weight is appropriate for gestational age, 0.55 for children and adolescent girls, and 0.70 for adolescent boys. [6,10,22,51]

- Arterial blood gases.
- Hemoglobin level.

4- Radiological investigations:

- Sonography of the urinary tract, voiding cystourethrogram (VCUG) and other radiological investigations done.

5- Renal biopsy:

- The results of renal biopsy if done.

6- Etiological diagnosis and stage of CKD.

7- Treatment prescribed:

In the form of acute dialysis, non-dialytic therapy and surgery if performed.

8- Follow-up data including:

- Regularity of follow-up visits.
- Duration of follow-up.
- Course and fate (stationary, progressed, death)

Operational definitions:

- CKD: was defined by the presence of kidney damage (identified by the presence of abnormalities in blood, urine, imaging studies or kidney biopsy) for ≥ 3 months. [6] Stages of CKD were defined according to the Kidney Disease Outcomes Quality Initiative (K/DOQI), which classifies CKD into five stages based on the level of glomerular filtration rate.[6] Stage I is defined by a normal GFR (≥ 90 mL/min /1.73 m^2). Stages II - IV are characterized by a GFR of 60-89, 30-59, and 15-29 mL/min/1.73 m^2 respectively. Stage V is characterized by a GFR of <15 mL/min / 1.73 m^2 or being on dialysis (ESRD). GFR was estimated using the Schwartz formula. [6,10,22,51]

According to these criteria infants and children with CKD stages II-IV for at least a period of 3-months were included in the study. The patient was excluded from the study if: (i) his or her follow-up period was less than 3 months; (ii) The information in the file was insufficient.

- Hypertention : was considered if the systolic and /or diastolic blood pressure was ≥ 95th percentile for age and sex.[62]
- Anemia: was considered when the hemoglobin level was below the lower limit of the normal value for age.[63]
- Metabolic acidosis: was defined by arterial bicarbonate < 22 mmol/L and pH <7.35.[64]
- Pathological serum analyte: was considered when the serum level of the analyte was below or above the the normal range for age.[65]
- Underweight and short stature: were defined by values <-2SD below the mean for age and sex.[66]

Administrative design:

For the conduction of the present work the following administrative steps were done.

A. Ethical approval:

Approval of the Research Ethics Committee of the Faculty of Medicine was obtained before starting the study.

B. Communication:

The data of all patients were treated with confidentiality and respect of privacy.

C. Personnel:

The entire work was carried out by the researcher, under continuous guidance of the supervisors.

D. Financing:

The researcher financed the following items:

- Internet search
- Statistical analysis of the data
- Typing, printing and photocopying the thesis

Operational design:

A. Preparatory phase:

It started in January 2011 and ended in October 2011. During this phase, literature related to the study was reviewed.

B. Data collection phase:

During this phase, data were collected from files. Data collection period extended for fifteen months starting from November 2011 to January 2013.

C. Analysis of the data:

Analysis of the data started in January 2013 and ended by June 2013.

D. Writing the thesis:

Tabulation and analysis of the results and writing of the thesis were completed by November 2014.

Statistical analysis of the data [67]

Data were fed to the computer and analyzed using IBM SPSS software package version 20.0. [68] Qualitative data were described using number and percent. Quantitative data were described using range (minimum and maximum), mean, standard deviation and median. Comparison between different groups regarding categorical variables was tested using Chi-square test. When more than 20% of the cells have expected count less than 5, correction for chi-square was conducted using Fisher's Exact test or Monte Carlo correction. The distributions of quantitative variables were tested for normality using Kolmogorov-Smirnov test, Shapiro-Wilk test and D'Agstino test, also Histogram and QQ plot were used for vision test. If it reveals normal data distribution, parametric tests were applied. If the data were abnormally distributed, non-parametric tests were used. For normally distributed data, comparison between more than two populations was analyzed using F-test (ANOVA). For abnormally distributed data, Kruskal-Wallis test was used to compare between different groups. Significance test results are quoted as two-tailed probabilities. Significance of the obtained results was judged at the 5% level.

RESULTS

The present study included 65 children with CKD (stages II-IV) admitted to the AUCH from January 2002 to December 2011.

Demographic data of the 65 patients with CKD (stages II-IV) (Table 7)

In the present cohort, males were significantly more than females; with male: female ratio = 2.25:1. The mean age of the children at diagnosis of CKD was 5.67 ± 3.86 years. More than half of the cases were 5 years old or less, and this was statistically significant.

The great majority of the cases (97%) were from Beheira and Alexandria governorates. Also the great majority of the cases (91%) had no family history of renal or urologic diseases.

Table (7): Demographic data of the 65 studied cases of CKD (stages II-IV)

	No.	%	χ^2	P
Sex				
Male	45	69.2	9.615	0.002*
Female	20	30.8		
Age at diagnosis of CKD (years)				
0- 5	37	56.9	17.754	<0.001*
> 5- 10	18	27.7		
> 10	10	15.4		
Min. –Max.	3 M – 14 Y		-	-
Mean ± SD	5.67 ± 3.86			
Median	4			
Residence				
Alexandria	30	46.2	0.143	0.705
EL- Beheira	33	50.7		
Kafr -El- Sheikh	2	3.1		
Family history of renal disease				
-ve	59	90.8	26.985	<0.001*
+ve	6	9.2		

p: p value Chi square (2×1 contingency table)
*: Statistically significant at $p \leq 0.05$

Stages of CKD in the studied cases at presentation (Table 8, Figure 1)

The great majority (88%) of the cases at presentation were in stages III and IV. Cases in stages III and IV were significantly more than those in stage II, but the difference between the numbers of cases of the former two stages was statistically insignificant.

Table (8): Distribution of the studied cases according to stage of CKD at presentation

Stage of CKD	No.	%	χ^2	P
II	8	12.3		
III	30	46.2	13.138	<0.001*
IV	27	41.5		
II vs III			12.737	<0.001*
II vs IV			10.314	0.001*
III vs IV			0.158	0.691

p: p value Chi square (2×1 contingency table)
*: Statistically significant at p ≤ 0.05

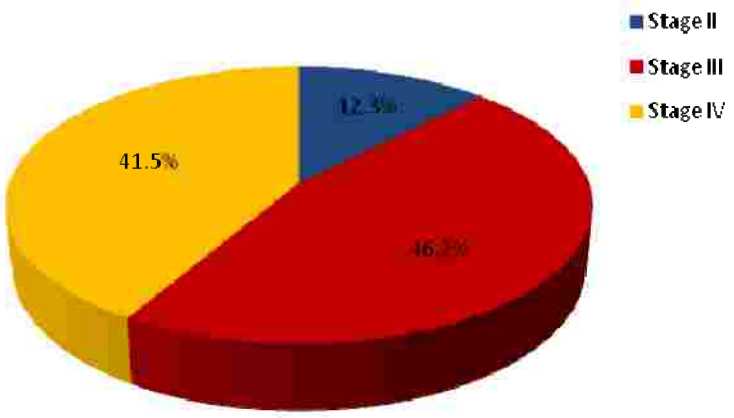

Figure (1): Stages of CKD in the studied cases at presentation

Age of the patients at presentation in the studied stages of CKD (Table 9, Figure 2)

The children in stage II were significantly older than those in stages III & IV, but the age difference between the latter 2 stages was statistically insignificant.

Table (9): Age of the patients in the different stages of CKD at presentation

Stage of CKD	Mean age ±SD (years)	^{KW}p
II	9.25 ± 3.65	
III	5.83 ± 3.93	0.007*
IV	4.43 ± 3.22	
II vs III		0.026*
II vs IV		0.003*
III vs IV		0.123

KW: Kruskal-Wallis test
*: Statistically significant at $p \leq 0.05$

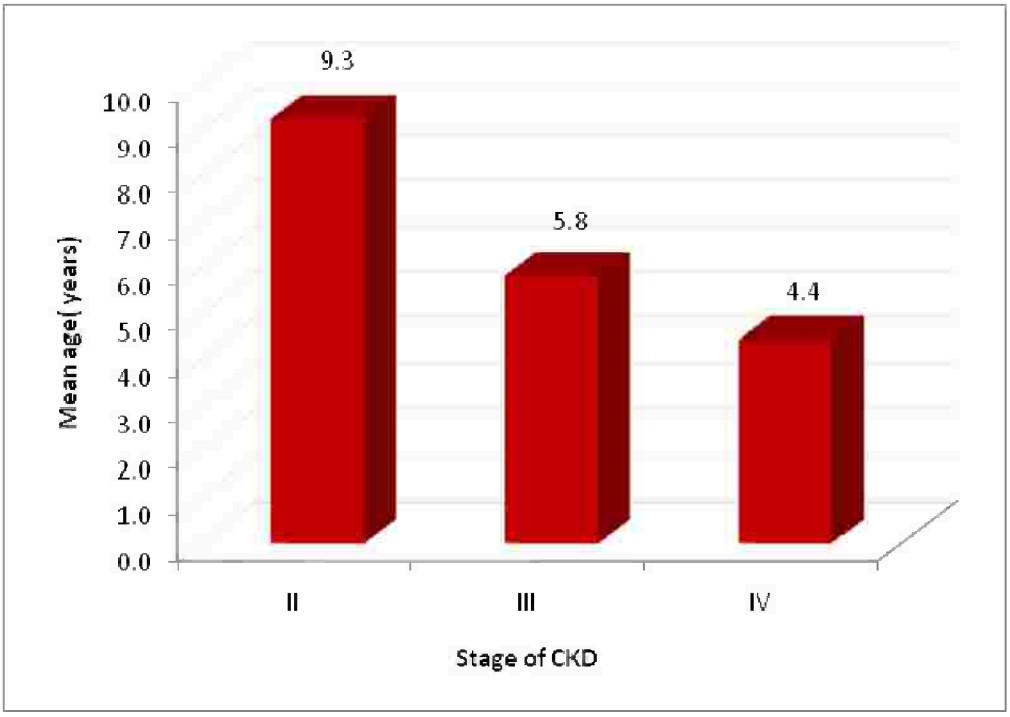

Figure (2): Age of the patients at presentation in the studied stages of CKD

Annual number of cases of CKD (stages II-IV) (Table 10, Figure 3)

The number of children with CKD (stages II-IV) in the second 5 years of the study (2007-2011) was more than double that in the first 5 years (2002-2006), (44 and 21cases, respectively).The yearly number of patients was fluctuating, with an average of 6.5 new cases per year. However, many cases were excluded because of short follow-up (less than 3 months after presentation) or significant deficiency of data in the files.

Table (10): Annual number of cases of CKD (stages II-IV)

Year	No.	%
2002	3	4.62
2003	2	3.08
2004	4	6.15
2005	4	6.15
2006	8	12.31
2007	10	15.38
2008	5	7.69
2009	11	16.92
2010	7	10.77
2011	11	16.92
Total	**65**	**100.0**

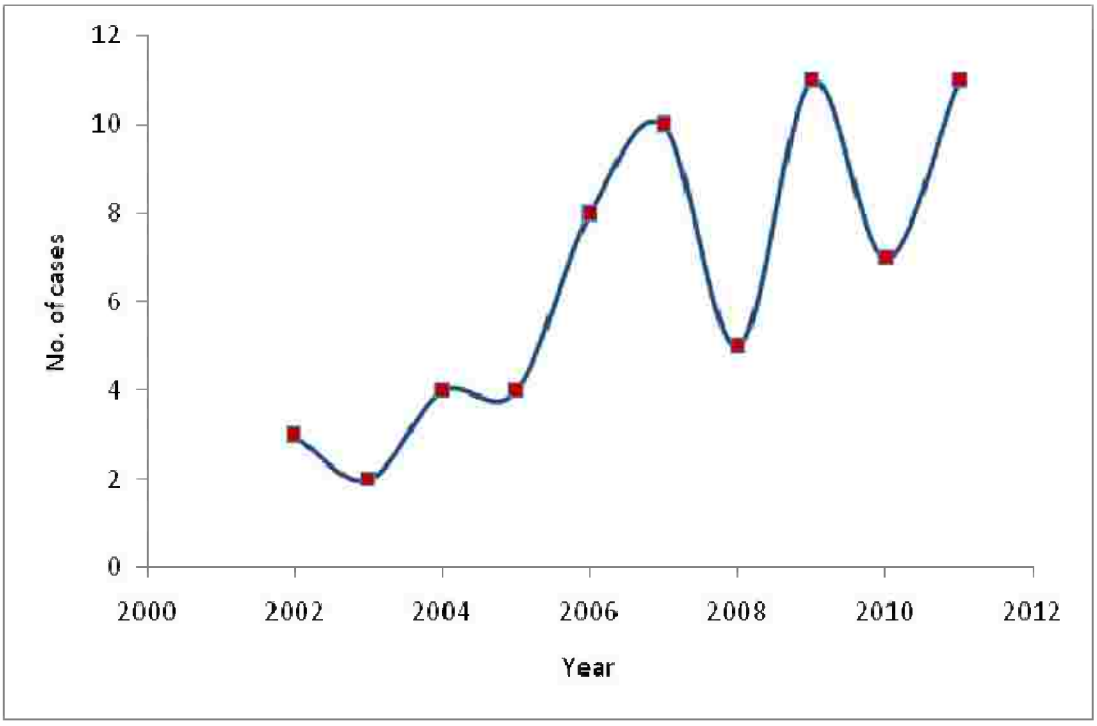

Figure (3): Annual number of cases of CKD (stages II-IV)

Etiologic diagnosis of the studied cases of CKD (Table 11, Figure 4)

Congenital anomalies of the kidney and urinary tract (CAKUT) was the most frequent cause of CKD in the present series (responsible for nearly half (47.7%) of the cases). Glomerulopathies, hereditary nephropathies and other renal/urologic diseases were the causes of CKD in similar percentages of patients (12.3-13.8%). The etiology in a minority of the cases was either multisystemic diseases or unknown (7.7% and 6.2% respectively).

Table (11): Etiologic diagnosis of the 65 studied cases of CKD

Etiologic Diagnosis	No.	%
Congenital Anomalies of the Kidney and UT	**31**	**47.7**
Uretheral valve	12	18.50
Neurogenic bladder	8	12.30
Vesicoureteral reflux (primary)	8	12.30
Bilateral hypoplastic kidneys	2	3.07
Prune-belly syndrome	1	1.53
Glomerulopathies	**9**	**13.8**
Mesangioproliferative GN	3	4.61
Focal segmental glomerulosclerosis	1	1.53
Rapidly progressive GN	1	1.53
Non-immune-complex proliferative GN	2	3.07
Unknown type of glomerulopathy	2	3.07
Hereditary Nephropathies	**8**	**12.3**
Polycystic kidney disease	7	10.77
IEM: organic acidemia	1	1.53
Other Renal/Urologic Diseases	**8**	**12.3**
Urolithiasis	4	6.15
Nephrocalcinosis	2	3.08
Lesch-Nyhan syndrome with urolithiasis	1	1.54
Interstitial nephritis	1	1.54
Multisystemic Diseases	**5**	**7.7**
Systemic lupus erythematosus	3	4.61
Hemolytic- uremic syndrome	2	3.07
Unknown	**4**	**6.2**

UT: Urinary tract
GN: Glomerulonephritis
IEM: Inborn error of metabolism

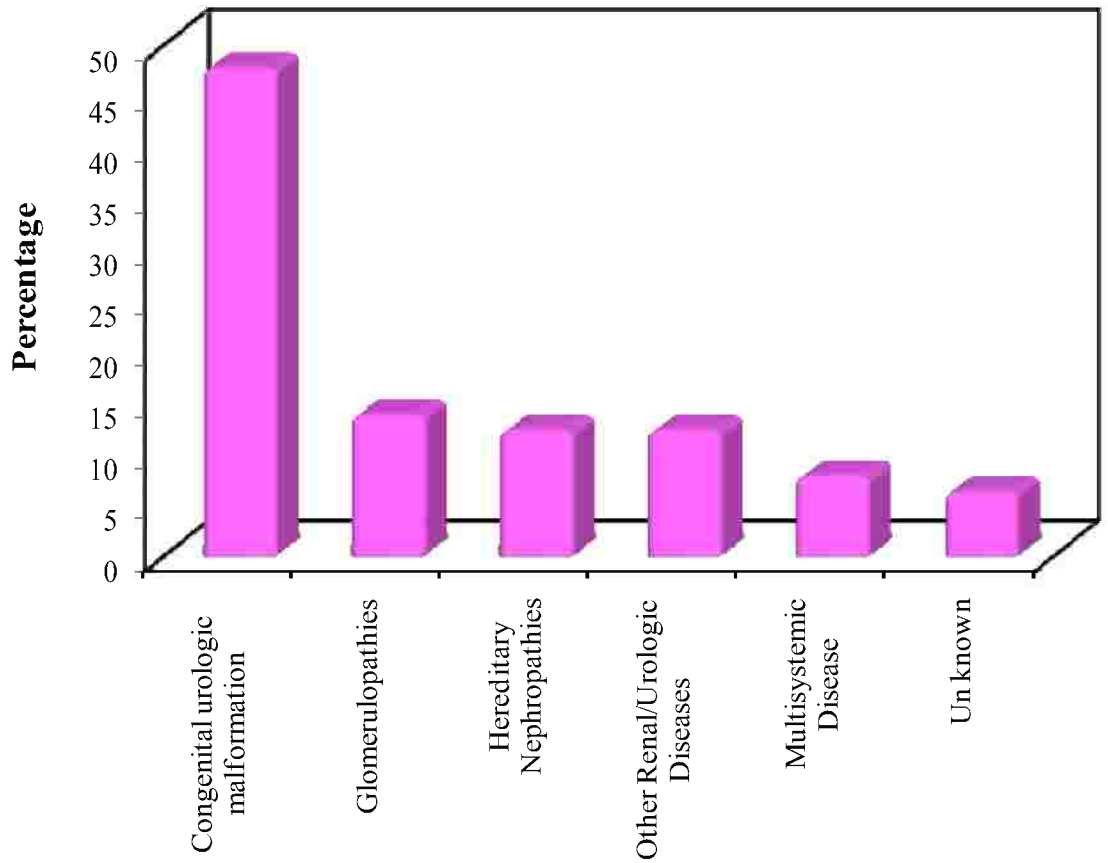

Figure (4): Etiologic diagnosis of the 65 cases of CKD

Relation of age group to etiology of CKD (Table 12)

There were no significant differences in age distribution (up to 5 years and above 5 years of age) within the different etiologic groups of CKD.

Table (12): Relation of age group to etiology of CKD

Etiologic Diagnosis	No.	≤ 5Y (n = 37)		> 5Y (n = 28)		χ^2	P
		No.	%	No.	%		
Congenital Anomalies of Kidney and UT	31	20	64.52	11	35.48	1.393	0.238
Glomerulopathies	9	4	44.4	5	55.6	0.663	0.415
Hereditary Nephropathies	8	5	62.5	3	37.5	0.116	$^{FE}p = 1.000$
Other Renal /Urologic Diseases	8	2	25.0	6	75.0	3.791	$^{FE}p = 0.067$
Multisystemic Diseases	5	4	80.0	1	20.0	1.176	$^{FE}p = 0.380$
Unknown	4	2	50.0	2	50.0	0.083	$^{FE}p = 1.000$

UT: Urinary tract
χ^2: value of Chi square
FE: Fisher Exact test

Relation of gender to etiology of CKD (Table 13)

Within the group of congenital anomalies of the kidney and urinary tract, males were 4 times more than females but the difference was statistically insignificant. Within the group of glomerulopathies females were significantly more than males (double). There was no sex predilection within the other etiologic groups of CKD.

Table (13): Relation of gender to etiology of CKD

Etiologic Diagnosis	No.	Males (n = 45)		Females (n = 20)		χ^2	P
		No.	%	No.	%		
Congenital Anomalies of Kidney and UT	31	25	80.65	6	19.35	3.625	0.057
Glomerulopathies	9	3	33.33	6	66.67	6.319	$^{FE}p = 0.020^{*}$
Hereditary Nephropathies	8	5	62.5	3	37.5	0.194	$^{FE}p = 0.693$
Other Renal /Urologic Diseases	8	6	75.0	2	25.0	0.143	$^{FE}p = 1.00$
Multisystemic Diseases	5	3	60.0	2	40.0	0.217	$^{FE}p = 0.639$
Unknown	4	3	75.0	1	25.0	0.067	$^{FE}p = 1.000$

UT: Urinary tract
χ^2: value of Chi square
FE: Fisher Exact test

The etiologic diagnosis in the different stages of CKD at presentation (Table 14)

Among stage II patients, glomrulopathy was significantly the most frequent etiology. The frequencies of various etiologies among patients in stages III and IV were not statistically different.

Table (14): The etiologic diagnosis in the different stages of CKD at presentation

Etiologic Diagnosis	No.	Stage of CKD					
		II (n=8)		III (n=30)		IV (n=27)	
		No.	%	No.	%	No.	%
Congenital Anomalies of the Kidney & UT	31	1	12.5	15	50	15	55.6
Glomerulopathies	9	3	37.5	2	6.7	4	14.8
Hereditary Nephropathies	8	0	0	6	20	2	7.4
Other Renal /Urologic Diseases	8	2	25	3	10	3	11.1
Multisystemic Diseases	5	1	12.5	4	13.5	0	0
Unknown	4	1	12.5	0	0	3	11.1
χ^2		9.244*		10.789		6.982	
P		0.032*		0.064		0.236	

UT: Urinary tract
χ^2: value of Chi square
*: Statistically significant at $p \leq 0.05$

Anthropometric characteristics of the 65 cases of CKD at presentation (Tables 15-17)

The mean weight and height (or length) standard deviation scores of the studied cases of CKD were within the normal range. More than 1/3 (36.9%) of the studied patients were short and nearly 1/5 (18.5%) of them were underweight. The frequencies of underweight and short stature were least among stage II patients. However, there were no statistically significant differences in the frequencies of underweight and short stature between the 3 stages of CKD studied.

Table (15): Standardized weight and height (SD scores) of the 65 cases of CKD

	Min. – Max.	Mean ± SD	Median
Weight SD score	-3.60 – 1.94	-0.92 ± 1.27	-0.87
Height SD score	-5.14 – 0.58	-1.70 ± 1.58	-1.67

Table (16): Frequency of underweight and short stature among the 65 cases of CKD

	No.	%	χ^2	P
Standerdized weight				
≥ -2SD	53	81.53	25.862	<0.001*
< -2SD (underweight)	12	18.46		
Standerdized height				
≥ -2SD	41	63.07	4.446	0.035*
< -2SD (short stature)	24	36.92		

p: p value Chi square (2×1 contingency table)
*: Statistically significant at $p \leq 0.05$

Table (17): Frequency of underweight and short stature in the different stages of CKD

	Stage of CKD						χ^2	P
	II (n=8)		III (n=30)		IV (n=27)			
	No.	%	No.	%	No.	%		
Underweight (<-2SD)	0	0.0	8	26.67	4	14.81	3.392	MCp=0.233
Short stature (<-2SD)	1	12.5	11	36.67	12	44.44	2.706	0.259

χ^2: Chi square test
MC: Monte Carlo test
*: Statistically significant at $p \leq 0.05$

Clinical and urine findings among the CKD patients at presentation (Table 18)

Apart from short stature (36.9%) and underweight (18.5%), the most frequent clinical manifestations were pallor (67.7%), fever (33.8%) (due to urinary tract or other infections), edema (27.7%), and hypertension (21.5%). Oliguria and polyuria were infrequently complained of (9.23% & 7.7%, respectively). Proteinuria (40%), pyuria (26.2%) and hematuria (15.4%) were the most frequent urinary findings. Among the 17 cases with pyuria the results of urine culture were found in only 8 files and were positive in 6 cases. Colony count was done only in 2 cases and was > 10^5/mL in both.

Pyuria was associated with neurogenic bladder (3 cases), uretheral valve (3 cases), reflux nephropathy (2 cases), urolithiasis (2 cases) and polycystic kidney disease (2 cases). The remaining 5 cases were associated with mesangioproliferation, systemic lupus erythematosus, Lesch-Nyhan syndrome with urolithiasis, prune-belly syndrome and nephrocalcinosis (one case for each).

Table (18): Clinical and urine findings among the 65 cases of CKD at presentation

Findings	No.	%
Pallor	44	67.69
Fever	22	33.84
Edema	18	27.69
Hypertension	14	21.5
Straining	8	12.3
Weak urinary stream	6	9.23
Oliguria	6	9.23
Polyuria	5	7.69
Vomiting	5	7.69
Dribbling	4	6.15
Convulsions	3	4.61
Tachypnea	3	4.61
Proteinuria	26	40
Pyuria	17	26.15
Hematuria	10	15.38

Clinical and urine findings in the different stages of CKD (Table 19)

The differences in the frequency of the various clinical and urine findings among the 3 stages of CKD studied were statistically insignificant. However, the frequency of pallor increased almost significantly from stage II to stage IV.

Table (19): Clinical and urine findings in the different stages of CKD

Findings	Stage II (n=8)		Stage III (n=30)		Stage IV (n=27)		χ^2	P
	No.	%	No.	%	No.	%		
Pallor	3	37.5	19	63.3	22	81.5	5.943	$^{\chi^2}p= 0.051$
Fever	1	12.5	10	33.3	11	40.7	2.205	$^{\chi^2}p= 0.332$
Edema	4	50.0	6	20.0	8	29.6	2.925	$^{\chi^2}p= 0.232$
Hypertension	2	25.0	8	26.7	4	14.8	1.246	$^{MC}p=0.536$
Straining	0	0.0	4	13.3	4	14.8	1.309	$^{MC}p=0.327$
Weak urinary stream	0	0.0	2	6.7	4	14.8	2.054	$^{MC}p=0.466$
Oliguria	0	0.0	4	13.3	2	7.4	1.523	$^{MC}p=0.597$
Polyuria	1	12.5	1	3.3	3	11.1	1.508	$^{MC}p=0.325$
Vomiting	0	0.0	3	10.0	2	7.4	0.895	$^{MC}p=1.000$
Dribbling	0	0.0	2	6.7	2	7.4	0.404	$^{MC}p=1.000$
Convulsions	0	0.0	2	6.7	1	3.7	0.725	$^{MC}p=0.482$
Tachypnea	0	0.0	0	0.0	3	11.1	4.427	$^{MC}p=0.170$
Proteinuria	4	50.0	10	33.3	12	44.4	1.111	$^{MC}p=0.564$
Pyuria	3	37.5	8	26.7	6	22.2	1.290	$^{MC}p=0.796$
Hematuria	1	12.5	6	20.0	3	11.1	0.921	$^{MC}p=0.789$

χ^2: value of Chi square
MC: Monte Carlo test
*: Statistically significant at $p \leq 0.05$

Results of kidney function tests of the studied cases of CKD at presentation (Tables 20&21)

The blood urea nitrogen and serum creatinine were elevated in all the cases. The measured creatinine clearance and the estimated glomerular filtration rate were low in all the cases. Creatinine clearance was measured in only less than half (44.6%) of the cases. The results of kidney function tests showed significant deterioration from stage II to stage IV.

Table (20): Results of kidney function tests of the studied cases of CKD at presentation

Kidney function tests	No.	Min. – Max.	Mean ± SD	Median
BUN (mg/dL)	**65**	22.0 – 107.0	43.77 ± 19.92	40.0
Serum creatinine (mg/dL)	**65**	0.80 - 3.90	1.70 ± 0.80	1.60
Creatinine clearance* (measured)	**29**	16.0 – 80.0	43.05 ± 19.04	39.0
eGFR*	**65**	15.58 - 88.60	39.15 ± 19.37	35.0

BUN:blood urea nitrogen
eGFR:estimated glomerular filtration rate
*mL/min/1.73m^2

Table (21): Results of kidney function tests (mean±SD) in the different stages of CKD at presentation

Kidney function tests	Stage			$^{KW}\chi^2$	P
	II(n=8)	III(n=30)	IV(n=27)		
BUN (mg/dL)	32.63 ± 16.68	39.83 ± 18.67	51.44 ± 19.89	10.681	0.005*
Serum creatinine(mg/dL)	0.99 ± 0.34	1.28 ± 0.35	2.39 ± 0.74	38.142	<0.001*
Creatinine clearance# (measured) (n=29)	71.86 ± 7.47	39.84 ± 5.43	23.45 ± 7.59	22.055	<0.001*
eGFR#	75.54 ± 10.15	45.45 ± 9.13	21.36 ± 4.55	53.022	<0.001*

#mL/min/1.73m^2
$^{KW}\chi^2$: Kruskal-Wallis test
*: Statistically significant at $p \leq 0.05$

Blood analytes of the 65 cases of CKD at presentation (Table 22)

The mean hemoglobin level, pH value, serum bicarbonate and serum calcium were low. The mean levels of serum phosphorus, alkaline phosphatase, sodium, potassium and cholesterol were within the normal range. The mean level of serum triglycerides was high. The parathyroid hormone level was not measured in any of the cases.

Table (22): Blood analytes of the 65 cases of CKD at presentation

Analytes	Min.-Max.	Mean ± SD	Median
Hemoglobin (g/L)	6.50 – 11.20	8.93 ± 1.33	9.25
Blood pH	7.04 – 7.45	7.33 ± 0.08	7.35
S. bicarbonate (mEq/L)	5.40 – 26.0	19.57 ± 5.28	22.10
S. calcium (mg/dL)	5.0 – 10.80	8.74 ± 1.01	8.80
S. phosphorus (mg/dL)	2.60 – 8.80	5.06 ± 1.45	4.90
S.alkaline phosphatase (unit/L)	73.0 – 563.0	268.15± 116.91	257.0
S. sodium (mEq/L)	131.0 – 144.0	137.22 ± 3.01	137.0
S. potassium (mEq/L)	2.30 – 6.80	4.43 ± 0.87	4.30
S. cholesterol (mg/dL)	97.0 – 485.0	177.39 ± 72.50	162.0
S. triglycerides (mg/dL)	45.0 – 499.0	168.90 ± 120.58	126.50

S.:Serum

Blood analytes in the different stages of CKD at presentation (Table 23)

The mean values of hemoglobin, and serum calcium were significantly lower in stage IV. Also, the mean values of pH and serum bicarbonate were lower in stage IV, but this was not statistically significant. The differences between the three stages of CKD studied in mean levels of the other analytes were not statistically significant.

Table (23): Blood analytes in the different stages of CKD at presentation (Mean ± SD)

Analytes	Stage II (n=8)	Stage III (n=30)	Stage IV (n=27)	Test of sig.	p
Hemoglobin (g/L)	9.77 ± 0.81	9.37 ± 1.30	8.35 ± 1.21	F = 4.387	0.018*
Blood pH	7.36 ± 0.03	7.34 ± 0.07	7.31 ± 0.08	F = 2.351	0.104
S. bicarbonate (mEq/L)	21.71 ± 2.14	19.85 ± 5.44	18.61 ± 5.64	F = 1.154	0.322
S. calcium (mg/dL)	8.80 ± 0.62	9.13 ± 0.82	8.33 ± 1.14	F = 3.926	0.026*
S. phosphorus (mg/dL)	4.76 ± 0.42	4.92 ± 1.36	5.30 ± 1.73	F = 0.532	0.591
S. alkaline phosphatase (unit/L)	213.86 ± 109.81	259.38 ± 123.0	297.06 ± 111.28	$^{KW}\chi^2$= 2.786	0.248
S. sodium (mEq/L)	136.83 ± 2.64	136.85 ± 3.23	137.74 ± 2.94	F = 0.470	0.628
S. potassium (mEq/L)	4.28 ± 1.08	4.38 ± 0.71	4.52 ± 0.99	F = 0.206	0.815
S. cholesterol (mg/dL)	283.33 ± 180.99	161.29 ± 45.77	174.0 ± 50.80	$^{KW}\chi^2$= 1.670	0.434
S. triglycerides (mg/dL)	269.0 ± 220.62	208.29 ± 145.64	125.64 ± 69.89	$^{KW}\chi^2$= 1.697	0.428

S.:Serum
F: F test (ANOVA)
χ^2: Chi square for Kruskal-Wallis test
*: Statistically significant at $p \leq 0.05$

Pathological blood analytes among the studied cases of CKD at presentation (Table 24)

Anemia was found in more than 2/3 of the cases (70.8%). Although the frequency of anemia increased from stage II to stage IV, yet the differences were not statistically significant. Metabolic acidosis was found in 1/3 of the cases (33.8%). Metabolic acidosis was significantly more frequent in stage IV than in stage III (51.9% and 26.7% respectively), and was absent in stage II.

One third of the cases had hypocalcemia. The frequency of hypocalcemia increased significantly from stage II to stage IV. Hyperphosphatemia and elevated serum alkaline phosphatase were found in nearly 1/5 (18.5%) of the cases and hyperkalemia in 10.8% of the cases, mostly in stage IV. Hypokalemia was encountered in only one case in stage II. None of the cases had hyponatremia or hypernatremia. Hypercholesterolemia and hypertriglyceridemia were found in 12.3% of the cases with no significant differences in frequency between the 3 stages of CKD studied.

Table (24): Pathological blood analytes among the studied cases of CKD at presentation

Pathological Findings	Total (n=65)		Stage II (n=8)		Stage III (n=30)		Stage IV (n=27)		χ^2	p
	No.	%	No.	%	No.	%	No.	%		
Anemia	46	70.8	3	37.5	22	73.3	21	77.8	5.017	0.081
Metabolic acidosis	22	33.8	0	0	8	26.7	14	51.9	8.693	0.013*
Hypocalcemia	22	33.8	1	12.5	7	23.3	14	51.9	8.677*	0.013*
Hyperphosphatemia	12	18.5	0	0.0	4	13.3	8	29.6	4.573	MCp = 0.123
Elevated serum alkaline phosphatase	12	18.5	2	25.0	4	13.3	6	22.2	1.005	MCp = 0.604
Hyponatremia	0	0	0	0.0	0	0.0	0	0.0	-	-
Hpernatremia	0	0	0	0.0	0	0.0	0	0.0	-	-
Hypokalemia	1	1.5	1	12.5	0	0.0	0	0.0	7.236	MCp = 0.127
Hyperkalemia	7	10.8	0	0.0	1	3.3	6	22.2	6.377	MCp = 0.069
Hypercholesterolemia	8	12.3	2	25.0	3	10.0	3	11.1	1.378	MCp = 0.505
Hypertriglyceridemia	8	12.3	1	12.5	4	13.3	3	11.1	0.065	1.000

χ^2: value of Chi square
MC: Monte Carlo test

Results of renal biopsy of some of the cases of CKD (Table 25)

Renal biopsy was done in 15 patients (23%). Nine of these patients (60%) had idiopathic glomerulopathies/glomerulonephritis , 3 (20%) had lupus glomerulonephritis, 2 (13.3%) had hemolytic-uremic syndrome, and one (6.7%) had chronic pyelonephritis.

Table (25): Results of renal biopsy of 15 cases of CKD

Results of biopsy (n = 15)	No.
Lupus nephritis 9 (stages II, III& IV)	3
Mesangioproliferative glomerulonephritis	3
Rapidly progressive glomerulonephritis	1
Focal segmental glomerulosclerosis	1
Non-immune-complex proliferative glomerulonephritis	2
Hemolytic-uremic syndrome	2
Unknown type of glomerulopathy	2
Chronic non-specific pyelonephritis	1

Imaging findings in the studied cases of CKD (Table 26)

Ultrasonography for the urinary tract was done in all cases. More than half (58.5%) of the cases had bilateral increased renal parenchymal echogenicity, and one third (33.8%) had bilateral hydronephrosis. Voiding cystourethrogram was performed in nearly 2/3 (61.5%) of the cases and showed abnormalities in the majority (70%) of these cases. The abnormalities included urethral valves, neurogenic bladder and bilateral primary vesicouretral reflux.

Renal scintigraphy was done in 21.5% of the cases and CT scan of the abdomen and pelvis in 6.2% of the cases. Echocardiography was performed for murmurs in 5 cases (7.7%), 4 of them had associated acyanotic congenital heart disease. None of the cases had bone X-rays.

Table (26): Imaging findings in the studied cases of CKD

Imaging Studies	No.	%
Ultrasound for Urinary Tract	**65**	**100**
Increased parenchymal echogenicity of both kidneys	38	58.46
Hydronephrosis (bilateral)	22	33.84
Small kidneys	12	18.46
Loss of corticomedullary differentiation	10	15.38
Nephrocalcinosis	2	3.07
No abnormality	0	0
Voiding Cystourethrogram	**40**	**61.54**
Posterior urethral valve *	12	30
Neurogenic bladder	8	20
Primary vesicoureteric reflux	8	20
No abnormality	12	30
Renal Scintigraphy	**14**	**21.54**
CT Scan Abdomen & Pelvis**	**4**	**6.15**

* With anterior urethral valve in one case

** Revealed polycystic kidney disease in 2 cases, nephrocalcinosis in one case and bilateral reflux nephropathy in one case.

Treatment given to the studied cases of CKD (Table 27)

Acute peritoneal dialysis was done to more than one third (36.9%) of the cases on presentation. Alfacalcidol and calcium carbonate were given to about 2/3 of the patients. Sodium bicarbonate was given to 1/3 of the patients. Less than 1/3 (30.8%) of the cases received erythropoietin. Other vitamins and iron were given to less than half of the cases. Antihypertensive drugs were needed in 1/5 of the cases. Steroids and cyclophosphamide were given to a minority of the cases (with glomerulopathies). Antibiotics were given to 1/3 of the cases (for urinary tract or other infections). Surgical intervention was done for 14 cases (21.5%): nephrectomy (3 cases), urethral valve fulgration (5 cases), vesicotomy (3 cases), augmentation ileocystoplasty (2 cases), and pyelolithotomy and perinephric abscess

drainage (one case). None of the cases received growth hormone. There was no mention of any dietary instructions or psychosocial support in the files.

Table (27): Treatment given to the studied cases of CKD

Treatment	No.	%
Acute dialysis at presentation	24	36.9
Calcium carbonate	44	67.69
Alfacalcidol	41	63.07
Other vitamins	31	47.69
Iron	28	43.07
Sodium bicarbonate	22	33.84
Erythropoietin	20	30.76
Antihypertensive drugs	13	20
Steroids	7	10.76
Cyclophosphamide	3	4.61
Antibiotics	22	33.8
Surgery	14	21.5

Treatment given in the different stages of CKD (Table 28)

Two thirds of the cases that required acute peritoneal dialysis on presentation were in stage IV (59.3% of the cases in this stage). Only a minority of the patients in stage II received calcium carbonate, alfacalcidol and erythropoietin. The majority of the patients in stages III and IV received calcium carbonate and alfacalcidol. Although calcium carbonate, alfacalcidol and sodium bicarbonate were used significantly more frequently among stage IV patients, yet a good percentage of the patients in this stage did not receive these drugs (18.5%, 22.2% and 48.1%, respectively). Only about 1/3 of the cases in stages III and IV received erythropoietin. The use of vitamins, iron, antihypertensive drugs, as well as surgery were not related to the stages of CKD. Steroids were used significantly more in stage II patients.

Table (28): Treatment given in the different stages of CKD

Treatment	Stage II (n=8)		Stage III (n=30)		Stage IV (n=27)		χ^2	P
	No.	%	No.	%	No.	%		
Acute dialysis at presentation	1	12.5	7	23.3	16	59.3	10.212	0.006*
Calcium carbonate	1	12.5	21	70.0	22	81.5	13.563	0.001*
Alfacalcidol	2	25.0	18	60.0	21	77.8	7.608	0.022*
Other vitamins	6	75.0	11	36.7	14	51.9	40.041	MC p=0.141
Iron	3	37.5	11	36.7	14	51.9	1.452	MC p=0.504
Sodium bicarbonate	0	0.0	8	26.7	14	51.9	8.693	0.013*
Erythropoietin	1	12.5	9	30.0	10	37.0	1.760	0.524
Antihypertensive drugs	2	25.0	8	26.7	3	11.1	2.292	0.318
Steroids	3	37.5	3	10.0	1	3.7	7.370	MC p=0.044*
Cyclophosphamide	1	12.5	0	0.0	2	7.4	3.059	MC p=0.103
Surgery	1	12.5	8	26.7	5	18.5	0.550	0.708

χ^2: Chi square test
MC: Monte Carlo test
*: Statistically significant at $p \leq 0.05$

Follow- up data and fate of the studied cases of CKD (Table 29)

The mean duration of follow- up was 3.2 ± 2.5 years. Follow-up was irregular in nearly half (47.7%) of the cases. More than half (55.4%) of the cases showed deterioration of kidney function during follow-up, and 13.8 % of them (9 cases) received maintenance dialysis. The kidney function in the remainder cases (44.6%) was stationary up to the last follow-up visit; but the actual fate of these cases was uncertain.

Table (29): Follow- up data and fate of the 65 cases of CKD

	No.	%	χ^2	P
Follow-up				
Regular	34	52.3	0.138	0.710
Irregular	31	47.7		
Follow-up duration (n = 65)				
Min. – Max.	4 M - 10 Y		-	-
Mean ± SD	3.19 ± 2.51Y			
Median	2Y			
Fate				
Progressed#	36	55.38	0.754	0.385
Stationary##	29	44.61		

p: p value Chi square (2×1 contingency table)
*: Statistically significant at $p \leq 0.05$
M: months
Y: years
showed further rise in serum creatinine and drop in eGFR during follow-up
until last follow-up visit

Relation between etiology and fate of CKD (Table 30)

The frequencies of progression of CKD in the various etiologic groups were not statistically different.

Table (30): Relation between etiology and fate of CKD

Etiologic Diagnosis (No.)	Fate			
	Progressed		Stationary	
	No.	%	No.	%
CAKUT (31)	17	54.8	14	48.2
Glomerulopathies (9)	7	77.8	2	22.2
Hereditary Nephropathies (8)	5	62.5	3	37.5
Other Renal/Urologic Diseases (8)	3	37.5	5	62.5
Multisystemic Diseases (5)	1	20	4	80
Unknown (4)	3	75	1	25
χ^2	6.186			
^{MC}p	0.328			

CAKUT: Congenital anomalies of the kidney and urinary tract
χ^2: value of Chi square
MC: Monte Carlo test
*: Statistically significant at $p \leq 0.05$

Relation between stage of CKD and fate (Table 31, Figure 5)

The frequency of progression of CKD was highest (58.3%) among patients in stage IV, followed by those in stage III (53.3%), then those in stage II (50%). However the differences were not statistically significant.

Table (31): Relation between stage of CKD and fate

Fate	Stage II (n=8)		Stage III (n=30)		Stage IV (n=27)		χ^2	^{MC}p
	No.	%	No.	%	No.	%		
Progressed (n=36)	4	**50**	16	**53.3**	16	**58.3**	0.309	0.831
Stationary (n=29)	4	50	14	46.7	11	40.7		

χ^2: value of Chi square
MC: Monte Carlo test
*: Statistically significant at $p \leq 0.05$

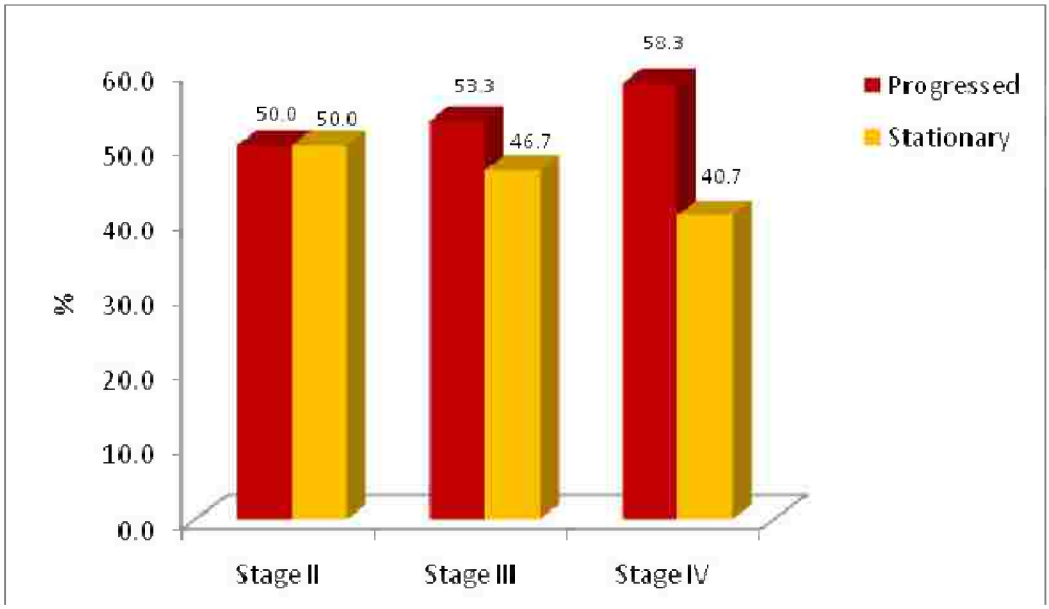

Figure (5): Relation between stage of CKD and fate