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Original Article

Outcome of Post-Streptococcal Crescentic Glomerulonephritis in Children

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ABSTRACT

Background: Crescentic glomerulonephritis (CGN) is a relatively rare but severe condition in childhood. It is characterised by the presence of extensive crescents in renal biopsy, and clinically by a progressive decline in renal function.

Objective: In this study we aim to look at the outcome of pediatric patients admitted or referred to us diagnosed as post streptococcal rapidly progressively glomerulonephritis

Methods: Ten pediatric patients with crescentic glomerulonephritis following APSGN admitted or referred from other hospitals to our unit (in King Abdulaziz University Hospital, Jeddah, KSA) between January 2003 to May 2009, all patients were evaluated clinically and were assessed by laboratory tests including urine analysis, U&E, s. albumin, ASOT, anti-DNAse-B test, complement (C3 and C4), ANA, ANCAs anti-DNA antibodies; anti-(GBM) antibodies. Histopathologic assessment by light. IF and electron microscopy was done and immunosuppressive therapy was given to all patients

Results: Ten patients with poststreptococcal crescentic glomerulonephritis, 6 males and 4 females. The mean age at the time of presentation was 8.4 years with range of 4 to 11 years. All were having gross hematuria, progressive rise of serum creatinine. Mean creatinine was 563 mmo1/1 with range of (396-870), low complement C3, 8 patients were having hypertension (80%), 5 patients (50%) were having nephrotic range of proteinuria and remaining were having moderate range. Renal biopsy revealed > 50% crescents in all biopsies with mean of 62.5% and ranging between 50-88%. Two patients had fibrocellular crescents (20%) and 8 had cellular crescents (80%). The mean follow up duration in months was 26 months, ranging between 18-36 months, after immunosuppressant Eight patients regained their normal kidney functions (80%) with mean creatinine 46 mmoVl (ranging between 39 — 66 mmo1/1), p value < 0.001. Two patients (20%) had residual renal 'impairment; these 2 patients had fibro cellular crescents in renal biopsy. Eight patients regained their normal blood pressure at last follow up (80%), p value < 0.001.

Conclusion: The overall outcome of our 10 patients with poststreptococcal crescentic glomerulonephritis was excellent, 8 patients out of 10 i.e. (80%) regained their normal kidney functions. Due to the limited number of our patients, a large multi-centre study is needed to prove this result

INTRODUCTION

Group A beta-hemolytic Streptococcus (GAS) is the most common infectious agent responsible for acute glomerulonephritis in children, but other infectious agents and other Streptococci can be involved, such as Streptococcus pneumoniae [1] and Lancefield group G and C Streptococci (S. zooepidermicus)[1]. Over 470,000 cases of acute poststreptococcal glomerulonephritis (APSGN) occur annually, leading to approximately 5000 deaths; 97% of these cases occur in less well-developed countries [3].

Crescentic glomerulonephritis is the histopathologic correlate of the clinically defined condition of rapidly progressive

glomerulonephritis (RPGN). It is relatively rare in childhood and is characterized by the presence of extensive crescents demonstrable on renal biopsy and by sudden and progressive decline in renal function over days or weekst[4]. In most pediatric studies of crescentic glomerulonephritis (CGN) or RPGN, post-infectious or acute post-streptococcal glomerulonephritis (APSGN) constitute a small proportion of cases.

In one of the largest pediatric series of CON, the South West Pediatric Nephrology Study Group reported 50 children with CON, of whom only six were due to APSGNt[5]. In another series of CGN by Jardim[ы] only two of 30 children had APSGN as the primary diagnosis. In these two series vasculitides due to Henoch-Schonlein purpura or systemic lupus erythematosus were collectively the most common cause of CON. In contrast, our experience, like recent data of Wong et a1.[71] has been very different, with APSGN being the leading cause of crescentic or rapidly progressive glomerulonephritis, In this retrospective study from New Zealand, the authors examined the characteristics and treatment of acute PSGN in 27 pediatric patients. The authors pointed out that PSGN is the most frequent cause of severe acute GN among children in New Zealand, with children of either Pacific Island or Maori ethnicity making up 85% of PSGN patients. The authors found also that the need for acute dialysis was most common among the 11 children in the study with crescentic GN. They also determined that urinary sediment abnormalities persisted in the patients with crescentic GN even after a mean follow-up period of 3.2 years and that the benefits of immunosuppressive therapy were unclear in these patients.

AIM OF THE WORK

In this study we aim to look at the outcome of pediatric patients admitted or referred to us diagnosed as post streptococcal rapidly progressively glomerulonephritis.

PATIENTS AND METHODS

In this retrospective study we have included all pediatric patients with crescentic glomerulonephritis following acute post-streptococcal glomerulonephritis admitted or referred from other hospitals to our institute (King Abdulaziz University Hospital, Jeddah, KSA) between January 2003 and May 2009. The patients selection criteria were: 1- Those with clinical and laboratory evidence of rapidly progressive glomerulonephritis that was proven to be crescentic glomerulonephritis by renal biopsy 2- Have an evidence of post-streptococcal infection.

The diagnostic criteria for APSGN were: 1- Elevated streptococcal titers, 2- Transiently depressed C3 complement; 3- Absence of past history of chronic renal disease. The diagnosis of APSGN was made if the patients' clinical and laboratory findings and subsequent progression of the symptoms were consistent with the disease.

Crescentic glomerulonephritis was defined as the presence of large epithelial crescents filling the Bowman's spaces in 50% or more glomeruli on biopsy.

A11 patients were subjected to:

1- Clinical evaluation includes the following: At presentation we studied age,

gender, history of preceding upper respiratory tract or skin infection, presence of gross hematuria, generalized edema, hypertension for age and sex oligoanuria, need for dialysis and outcome regarding residual renal impairment and proteinuria or hypertension during follow up.

2- **Biochemical evaluation** by measurement of serum creatinine, U&E, serum albumin levels, urine routine and microscopic examination for proteins, RBCs count and casts, urine protein to creatinine ratio.

3- **Serologic tests:** anti-streptolysin O titer (ASO titer), anti-DNAse-B test, serum complement (C3 and C4), antinuclear antibody (ANA), anti-neutrophilic cytoplasmic antibodies (ANCAs), anti-double-stranded DNA antibodies; anti-glomerular basement membrane (anti-GBM) antibodies.

4- **Renal Biopsy:**

Indications for renal biopsy were: 1- Anuric renal failure; 2- Rapid rise of creatinine more than fourfold higher than upper limit or normal within 1-2 weeks of presentation; 3- Mixed nephritic nephrotic syndrome; 4- Delay in recovery of renal function within 2-3 weeks after the onset of acute nephritis, 5- Persistent gross hematuria for more than 2 weeks.

Nephrotic range proteinuria was defined as either +3 or more protein on dipstick testing or a urine protein to creatinine ratio greater than 200 mg/mmol.

All patients had a renal biopsy evaluated by expert pathologists who were blind to clinical outcome. The tissue biopsies were studied by light, immunofluorescence and electron microscopy. For light microscopy Paraffin-embedded renal sections were stained with trichrome, silver, periodic acid—Schiff and haematoxylin/eosin. The IF studies were performed by a classic direct IF technique using antibodies against IgA, IgG, IgM, C3 and C l q.

The following features were evaluated: Total number of glomeruli, number of glomeruli with crescents, type of crescents. The types of crescents were classified as: cellular, fibrocellular or fibrous according to the modified definitions of World Health Organization's classification of renal disease of Churg et al. [8].

We used the following:

5- **Immuonosuppression regimen:** Intravenous pulse therapy of methyprednisolone 600 mg/m^2 once daily for 3 days then another 3 doses over 6 days. If the renal biopsy showed cellular crescents, then we used cyclophosphamide 2.5 mg/kg/day for 60 days and oral prednisolone 30 mg/m^2/day for 30 days and then 30 mg/m^2 every other day for 30 days then weaning.

Follow-up plan for all patients was done, by monthly clinical evaluation regarding, gross hematuria, anuria or oliguria, hypertension, lower limb oedema and laboratory evaluation regarding: urine analysis and urine dipstick for proteins or RBCs, CBC for total and differential leucocytic counts, serum creatinine, serum albumen and, C3 and C4 every 3 months.

Statistical Methods:

Data were analyzed using Statistical Package for the Social Science version 14 (SPSS) for windows. Values were

expressed as percentage or mean + standard deviation (X + SD) and ranges. Data were examined by univariate and multivariate analysis. A two-tailed Student's t-test was used for the unpaired data. Differences among proportions were evaluated by chi-square test. A p value less than 0.05 was considered significant. Renal survival was evaluated by Kaplan—Meier survival analysis.

RESULTS

When we started to collect our data we found a total of 13 cases of RPGN due to different etiologies. Three out of them were excluded from our study. One of them showed both the clinical and laboratory criteria of poststreptococcal RPGN but renal biopsy never been done because of family refusal so, not proven to be crescentic GN.

The two other cases had no evidence of post streptococcal etiology; one of them was 15 months old girl. Her renal biopsy revealed MPGN-1 (membranoproliferative glomerulonephritis type-1) with 70°/o fibrous crescents. This patient died in the PICU after doing CVVHD. The other patient was a 2 yr old boy who presented with generalized body edema, severe hypertension, nephrotic range proteinuria, rapid rise of his serum creatinine and his renal biopsy again revealed MPtiN-1 with 100% cellular crescents. This patient received various immunosuppressive regimens including, methyleprednisolone, I.V cyclophosphamide and finally rituximab (anti-CD20 anti-body) with deterioration of his kidney function that needed regular dialysis support. Currently he is on CAPD.

Tables (1 and 2) show demographics, biochemical and serologic features of the patients at presentation.

Descriptive analysis:

We studied 10 patients. All of them were diagnosed as having post streptococcal crescentic glomerulonephritis based on clinical presentation, laboratory evidence of preceding streptococcal infection and biopsy results. Six of them were males (60%) and 4 were females (40°/o), so M/F ratio was 1:0.66. The mean age at the time of presentation was 8.4 years with a range of 4 to 11 years.

All were having gross hematuria, progressive rise of serum creatinine. Eight patients were having hypertension (80%) 5 of them were males (63%) and 3 were females (37%) the remaining two normotensive patients (20%) were one male and one female. The mean duration of symptoms before performing biopsy was 21 days with range 15-28 days. The mean of highest creatinine was 563 umol/1 with range of (396-870). Five out of 10 (50%) were having nephrotic range of proteinuria and remaining were having moderate range. Interestingly 4 out of the 5 patients with nephrotic range were males (80%). The mean serum albumin for the 10 patients was 20 g/1 at presentation. In those with nephrotic range proteinuria the mean albumin was 14.6 g/1 at presentation. Two of the patients with nephrotic range proteinuria had fibrocellular crescents in renal biopsy and the other 3 had cellular crescents.

All the patients had an evidence of preceding streptococcal infection, ASO titer mean was 743 with range of (450-1500). All 10 patients had low C3 (100%). No

patient had reduced C4 complement. Eight patients (80%) were having history of URTI, one had history of preceding skin infection (10%), and one had no evidence of clinical infection before their presentation (10%). Anti-DNAse-B was positive for 9 patients and unfortunately result was not found for the 10^{t}.. patient. None of the 10 patients were having positive antinuclear antibodies ANA, anti neutrophil cytoplasmic antibodies pANCA or cANCA or anti glomerular basement membrane (anti GBM) test. Hepatitis B serology was negative for all patients.

Table (3) shows renal biopsy results. All our 10 patients went to renal biopsy which revealed > 50% crescents in all biopsies with mean of 62.5% and ranging between 50-88%. Two patients had fibrocellular crescents (20%) and 8 had cellular crescents (80%). No patient had fibrous crescents. In the 10 cases, the glomeruli showed diffuse proliferation of mesangial and endothelial cells with neutrophils infiltrate and obliteration of the capillary Lumina. The tubules in most of the cases show ATN — like changes with regenerative changes and casts inside the Lumina. The interistium showed edema, mild fibrosis and focal lympho-plasma cells infiltrate. The blood vessels are unremarkable. IF showed diffuse coarse granular reaction along capillary loops and mesangium for IgG and C3 or C3 alone. EM showed numerous sub-epithelial humps like deposits.

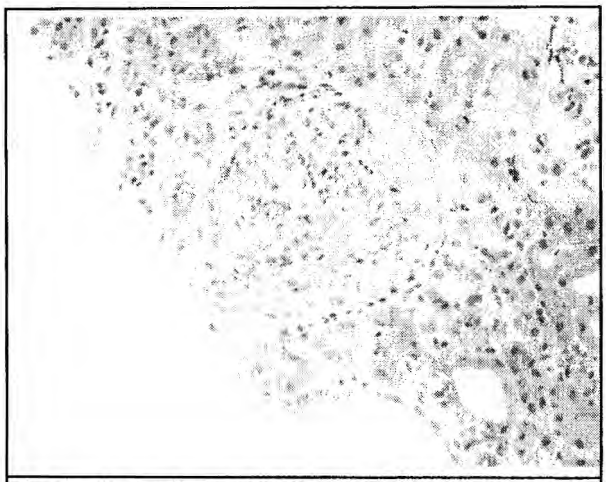

Image 1: A glomerulus showing a cellular crescent compressing the adjacent capillary tufts. (H&E, 40x).

Image 2: A glomerulus containing a fibrocellular crescent and adjacent mono-nuclear infiltrate in the interstitium (H&E, 40X).

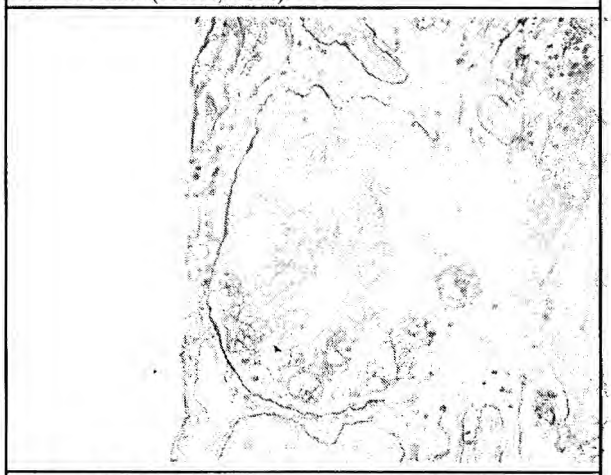

Image 3: The fibrocellular crescent is highlighted by silver stain (JMS, 40X).

Table (4) and Table (5) show the outcomes at last follow up.

All of the 10 patients had 6 doses of IV methyleprednisolone 600 mg/m^2 followed by 2 month course of oral cyclophosphamide 2.5 mg/kg/d and 1 month of daily prednisolone followed by one month of alternative dose then weaning, 6 patients needed acute dialysis support (60%) due to oligoanuria and hypervolemia. The mean follow up duration in months was 26 months ranging between 18-36 months. Eight patients regained their normal kidney functions (80%) with mean creatinine 46 umol/l ranging between (39-66) i.e., significant improvements, p-value < 0.001 ** Two patient out of 10 (20%) had residual renal impairment the serum creatinine of one of them (patient #6) was 122 umol/1 after 32 months follow up and his calculated GFR was 41 ml/min. He is followed in our renal failure clinic as stage 3 CKD. This patient is still also having residual hypertension needing double antihypertensives to be controlled and residual subnephrotic range proteinuria (+ 1 urine dipstick) on anti-proteinuric agent (Enalapril). This was the only patient with proteinuria out of 5 patients having nephrotic range proteinuria at 1 s' presentation (20%, p value < 0.001 +.) Of note, this patient had fibrocel1ular crescents in renal biopsy and was referred to us 3 weeks after symptoms. This is one of 2 patients (patient #5 and #6) still having hypertension (20%) that needed medical treatment. Interestingly, the 2 patients had fibrocellular crescents in renal biopsy. The 2$^{°d}$ patient with residual kidney dysfunction (patient #4) had last s. creatinine of 80 umol/1 and his calculated GFR was 65 ml/min i.e. stage 2 CKD and being followed up also in our renal failure clinic. By the end of the study the serum albumin returned to normal in 8 cases with mean of 35 g/1 and range of (33-39), p value < 0.001. The remaining 2 patients had near normal readings, their s. albumin was 29 g/1. Eight patients regained their normal blood pressure (80%, p value < 0.00^{1} **).

Table 1: Demographics, biochemical and serologic features of the patients at 1st presentation.

No.	Age in yr	Gen-der	Time to biopsy from admission (days)	BP at presentation > 95th centile	Peak (high) serum creatinine in umol/l	Peak (low) s. albumin in g/l	nephrotic proteinu-ria	ASOT	Anti-DNAse B	C3	ANA, Anti DNA, pANCA, cANCA, Anti GBM, Hepatitis B serology
1	10	M	20	HTN	570	17	Y	450	+	low	N
2	9	M	15	HTN	746	25	N	1500	+	low	N
3	11	F	22	HTN	488	26	N	1020	+	low	N
4	4	F	28	HTN	546	23	N	765	+	low	N
5	11	M	15	HTN	870	15	Y	690	+	low	N
6	5	M	28	HTN	455	15	Y	450	+	low	N
7	10	M	23	N	520	13	Y	450	+	low	N
8	7	F	19	HTN	500	13	Y	800	Not done	low	N
9	9	M	22	HTN	545	26	N	660	+	low	N
10	8	F	25	N	396	27	N	650	+	low	N
Total 10											

BP = blood pressure,
ASOT = anti streptolysin O titer.
ANCA = anti neutrophil cytoplasmic antibody,
HTN = hypertension,
C3 = complement C3,
Anti GBM = anti-glomerular basement membrane antibody.
s. albumin = serum albumin,
ANA = anti nuclear antibody,

Table 2: Descriptive analysis of demographic, biochemical and serologic parameters at 1st presentation.

Variable	Value
Age (year)	8.4 ± 2.4 (4-11)
Gender Male Female	 6 (60%) 4 (40%)
Time to biopsy from admission (days)	21.7 ± 4.6 (15-28)
BP (high) at presentation	8 (80%)
Peak (high) serum creatinine	563.6 ± 141.2 (396-870)
Peak (low) serum albumin	20 ± 5.9 (13-27)
Presenting with nephrotic proteinuria	5 (50%)
ASOT	743.5 ± 321.3 (450-1500)
C3 low at presentation	10 (100%)

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Table 3: Renal biopsy results.

No.	Glomeruli	% of crescents	Type of crescents	Tubules	Interstitium	IF	EM
1-	11 glomeruli by H&E. 6 with cellular crescents. Mesangial hypercellularity, scattered neutrophils.	55%	Cellular	Focal vacuolization of epithelial cells	Focal infiltration by chronic inflammatory cells	IgG (2+), C3 (2+) and C1q (1+) Others negative.	Sub epithelial deposits. Increase mesangial cells and matrix. Effaced foot process.
2-	12 glomeruli 9 with Cellular crescent with mesangial cells proliferation and necrosis	75%	Cellular	ATN-Like changes with regeneration	Edema, no inflammation and no fibrosis	IgG and C3 (3+) along capillary loops.	Sub-epithelial humps.
3-	14 glomeruli Diffuse proliferation 7 cellular crescents	50%	Cellular	Regenerative changes	Focal mild chronic inflammation & mild fibrosis.	Granular IgG (2+) and C3 (3+) capillary loops.	Numerous Hump-like large deposits in the sub-epithelial area.
4-	15 glomeruli Diffuse proliferate Necrosis and cellular crescents in 11 glomeruli.	75%	Cellular	ATN-like regenerative changes	Edema & focal chronic inflammation	IgG (3+) and C3 (3+) granular	Numerous sub-epithelial humps and rare sub-endothelial deposits.
5-	11 glomeruli 6 fibrocellular crescents. Segmental neutrophils in capillary loops	55%	Fibro- cellular	ATN-Like changes	Moderate fibrosis and inflammation	Positive granular for C3 (3+) IgG (4+) IgM+ mainly mesangium	Shows fibrocellular crescents. Mesangial and intra-membranous deposits.
6-	16 glomeruli. Diffuse proliferation mainly mesangial and endothelial with segmental neutrophils. 14 fibrocellular crescent	88%	Fibro- cellular	Normal	Edema and mild fibrosis with infiltration by neutrophils	IgG (4+) and C3 (3+) granular along capillary loops and mesangium	glomeruli Hyper cellular with numerous hump-like sub-epithelial deposits.
7-	10 glomeruli. Diffuse proliferation & cellular crescents in 5 glomeruli	50%	Cellular	ATN-Like changes with regenerative changes	Edema and mononuclear infiltrate.	Coarse granular IgG (3+) and C3 (3+) along capillary loops.	Numerous hump-like deposits.
8-	12 glomeruli 6 with cellular crescent with mesangial cells proliferation.	50%	Cellular	Normal	Edema, no inflammation and no fibrosis	Granular IgG (2+) and C3 (3+) capillary loops.	Numerous Hump-like large deposits in the sub-epithelial area
9-	16 glomeruli 12 with cellular crescent mesangial cells proliferation & Segmental neutrophils in capillary loops	66%	Cellular	ATN-like changes with regenerative changes	Edema & focal chronic inflammation	IgG (2+) and C3 (3+) along capillary loops. IgM+	Hyper cellular glomeruli with numerous hump-like sub-epithelial deposits.
10-	12 glomeruli 7 with cellular crescent and mesangial cells proliferation.	60%	Cellular	Focal vacuolization of epithelial cells	Edema, no inflammation and no fibrosis	IgG+2-C3+3 +C4	Numerous sub-epithelial humps and rare sub-endothelial deposits.

Table 4: Demographics and laboratory features of the patients at last follow up.

Patient No.	Last BP	Last s. creatinine	Last s. albumin	Last urine protein	Acute dialysis	Follow up duration in months	Others
1	N	55	39	trace	Y	24	
2	N	39	38	nil	Y	26	
3	N	55	35	trace	N	33	
4	N	80	29	trace	Y	28	Stage two CKD – regular follow up in CKD clinic
5	HTN	66	36	trace	Y	36	On anti-hypertensive (ACEi)
6	HTN	122	29	+	N	32	On anti-hypertensive (amlodipine) & anti-proteinuric (ACEi) stage three CKD – regular follow up in CKD clinic
7	N	65	34	trace	N	18	
8	N	58	33	trace	Y	24	
9	N	56	37	nil	Y	16	
10	N	61	33	nil	N	22	
Total 10							

Table 5: Changes of the measured parameters of the patients at last follow-up.

	At 1st presentation	At last follow up	p value
S. creatinine	563.6 ± 141.2	54.7 ± 18.2	< 0.001**
S. albumin	20 ± 5.9	34.3 ± 3.4	< 0.001**
B.P. (high)	8 (80%)	2 (20%)	< 0.001++
Proteinuria	5 (50%)	1 (10%)	< 0.001++

** paired t-test was used, ++ Mc'Nemar χ^2 test was used

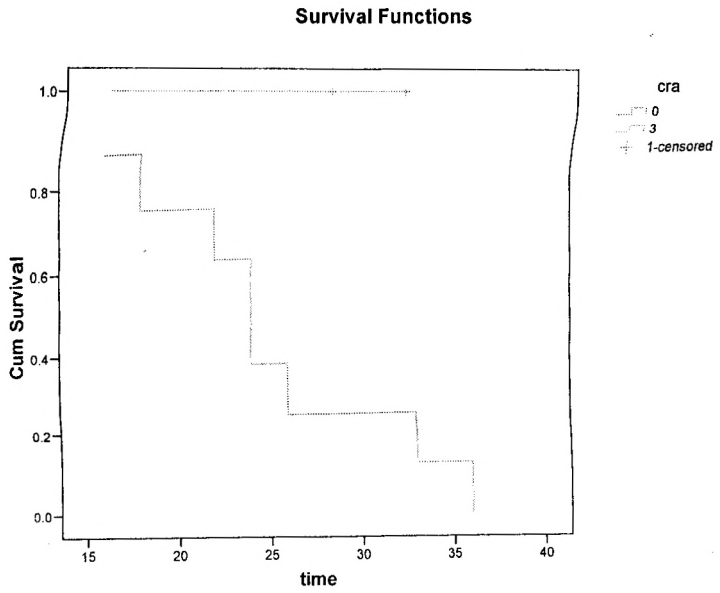

Fig. 1: Kaplan–Meier survival analysis showing mean renal survival time (months) during the follow-up period.

DISCUSSION

Most patients of APSGN, particularly children, have an excellent outcome[9]. This is true even in patients who present with acute renal failure and may have crescents on the initial renal biopsy. A review of three case series of 229 children with PSGN found that approximately 20 percent had an abnormal urinalysis (proteinuria and/or hematuria), but almost all (92 to 99 percent) had normal or only modestly reduced renal function 5 to 18 years after presentation[9]. However, the long-term prognosis of PSGN is not always benign[10]. Some patients, particularly adults[11], develop hypertension, recurrent proteinuria, and renal insufficiency as long as 10 to 40 years after the initial illness[12].

In this retrospective study we describe the outcome of 10 patients crescentic post-streptococcal glomerulonephritis admitted or referred from other hospitals to our institute (KAUH) between January 2003 and May 2009. We found a total of 13 cases of crescentic glomerulonephritis (CsGN) due to different etiologies. Ten of them (70%) showed both the clinical and laboratory criteria of poststreptococcal (CsGN). El-Husseini et al. (2003) noticed that the prevalence of CON among 128 Egyptian patients is somewhat different from that reported in Western literature: post-infectious GN is higher than that reported in other series this might be attributed to the endemicity of some infections such as streptococcal infection in our locality and possibly due to racial factors[13]. In a recent Indian study by Gulati et al. immune complex glomerulonephritis was the commonest etiology of crescentic glomerulonephritis in children, (86.4%), and the majority of these children had post-infectious glomerulonephritis[14]. The etiology in our study is in concordance with the findings in both studies and other studies[6,15] wherein immune-complex

glomerulonephritis accounted for the majority of the case. In contrast, Miller et al. observed that most children in their series had well-defined systemic or primary glomerular disease, and only two of the 56 patients with a crescentic lesion had disease that had a definite post-streptococcal etiology[16]. Similarly, post-streptococcal ON (PSGN) accounted for 12% of CsGN in another multicentre collaborative seriest[5]. Thus, post-streptococcal glomerulonephritis continues to be the commonest etiology in developing countries like ours.

A notable feature in the study of Gulati et al. was a delayed diagnosis and delayed referral, as observed by the mean duration of symptoms prior to referral of 2.47 months. Hence, the majority of his patients had severe disease at presentation and 15/22 (68%) were dialysis dependent at presentation. Late referral may be related to the fact that his institute is a tertiary care hospital[14]. In contrast to our study where is early referral and early diagnosis as the mean duration of symptoms before performing biopsy was 21 days with range 15-28 days. However, acute dialysis support was needed in 6 patients (60%).

All our 10 patients had low C3 (100%); Crescentic PSAGN may have an increased association with normocomplementemia in some studies, Five of the 10 crescentic PSAGN patients from Memphis[17] and four of 11 from New Zealand[7] had normal or near-normal serum C3 levels; however, none of the four reported by Lewy et al. [18] had normal or near-normal serum C3 levels. The reason for this possible association of normocomplementemia with crescent formation in PSAGN is not clear.

All of the 10 patients had 6 doses of IV methyleprednisolone 600 mg/m^2 followed by 2 month course of oral cyclophosphamide 2.5 mg/kg/d and 1 month of daily prednisolone followed by one month of alternative dose then weaning. However, the use of immunosuppression in treating poststreptococcal (CsGN) is an area of debate. Vijayakumar concluded that early recognition, prompt and aggressive therapy and adequate follow-up are mandatory. Prognosis is usually good unless associated with severe renal failure and crescentic glomerulonephritis where the outcome is relatively poor unless treatment is early and adequate. Immunosuppressive therapy is not needed in simple acute proliferative glomerulonephritis but is essential in modifying the outcome of crescentic glomerulonephritis[19]. Morales et al., reported that it is indicated to initiate immunosuppressive therapy either with prednisone or with other agents. The decision of the agent and the duration of the therapy should be individualized[20]. Raff et al_ report a patient with rapidly progressive glomerulonephritis and nephrotic-range proteinuria following acute pharyngitis, in whom serologic and kidney biopsy findings led to a diagnosis of PSGN. The patient was treated with corticosteroids and anti-hypertensive medications resulting in improvement in renal function and decrease in proteinuria[21]. These results suggest that aggressive treatment of crescentic PSGN with nephrotic syndrome can result in a favorable outcome. In the other side, Roy et al. in a study of 10 patients, reported no difference in outcome between patients receiving quintuple therapy (prednisone,

azathioprine, cyclophosphamide, dipyridamole, and anticoagulation) and those receiving supportive care"). More recently, Wong et al. reported the clinical course of 27 patients biopsied for difficult clinical course, 11 of whom had > 50% crescents on biopsy, and found no benefit of immunosuppression[4].

It is important to note that post-streptococcal crescentic glomerulonephritis may carry a better prognosis than crescent formation of other etiology. In our study, 8 patients regained their normal kidney functions (80%) with mean creatinine 46 mmol/1 ranging between (39-66 p value < 0.00 1 "). Eight patients (80%) became normotensïve at last follow up visits (p value < 0.001**). Two patients out of 10 (20%) had residual renal impairment; the serum creatinine of one of them (patient #6)_ was122 mmol/1 after 32 months follow up and his calculated GFR was 41 ml/min. This patient was still also having residual hypertension needing double antihypertensives to be controlled and residual subnephrotic range proteinuria (+1 urine dipstick) on antiproteinuric agent (Enalapril). 'Of note, this patient had fibrocellular crescents in the renal biopsy and was referred to us 3 weeks after symptoms. This is one of 2 patients (patient #5 and #6) still having hypertension (20%) that needed medical treatment. Interestingly the 2 patients had fibro cellular crescents in renal biopsy. The 2nd patient with residual mild kidney dysfunction (patient #4) had last s. creatinine of 80 mmol/1 and his calculated GFR was 65 ml/min. i.e. stage 2 CKD. Interestingly, the percentage of glomeruli with cellular crescents was very high (75%). The Southwest Pediatric Nephrology Study Group found that of 50 children with crescent formation, five with PSAGN had normal GFR, compared to progression to ESRD for 23 of 42 patients with crescent formation of other etiology[5]. However, this concept was challenged by experience from northern India that suggested that the prognosis for post-streptococcal crescentic glomerulonephritis is equally as poor as that for other types of crescentic giomerulonephritis[15].

El-Husseini et al. (2005)[22] have shown a positive correlation between the percentage of glomeruli affected by crescent formation and the progression to end stage renal failure they confirmed that the more extensive the crescent formation, the less there is a chance of recovery of renal function, and the poor prognosis of patients with post infectious CON when there is persistent nephrotic range proteinuria or hypertension[6]. El-Husseini et al. (2003)[13] demonstrated that the percentage of fibrous crescent had a significant impact on kidney function at last follow-up. This is in accordance to that reported by Atkins et al. They reported that the presence of acute cellular crescent is more indicative of a likely positive response to immunosuppressive treatment and anticoagulants than diseases in which crescents are undergoing fibrosis[23]. In the study of Gulati et al. they reported, the high incidence of advanced renal failure was also histopathologically correlated by the high frequency of chronicity changes seen on kidney biopsy, as evidenced by the presence of fibrocellular crescents in the majority of the patients [(14/22, 64%)] and the presence of

glomerular sclerosis in a significant number of children [(10/22, 45%)) at presentation[141]. These findings were almost similar to those in the study by the Southwest Pediatric Nephrology Study Group, where it was observed that only 37% of the crescents were cellular, while the majority (63%) were fibrous/fibrocellular crescentst[5].

In conclusion, the overall outcome of our 10 patients with poststreptococcal crescentic glomerulonephritis was excellent; 8 patients out of 10 i.e. (80%) regained their normal kidney functions and 8 patients (80%) became normotensive at last follow up visits. Due to the limited number of our patients, a large multi-centre study is recommended to prove these results and to assess the benefits of immunosuppression.

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