

EVALUATION OF CLINICAL, LABORATORY AND TREATMENT MODALITIES IN C3 GLOMERULOPATHY: SINGLE CENTER EXPERIENCE

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ABSTRACT

Background/aim: C3 glomerulopathy (C3GP) defines a rare group of glomerulonephritis (GN), which could lead to end stage renal disease (ESRD). Histopathologic features of the disease have yet to be defined and the prognostic factors and optimal treatment are not fully known. The purpose of this study was to determine the demographic, histological change, treatment modalities and outcomes among patients with C3GP.

Material and method: This retrospective observational study was conducted in the Department of Nephrology, Gazi University, Ankara, from 2013 to 2017. All patients with kidney biopsies fulfilling the criteria for C3GP were included in the study.

Results: Twenty-four patients with C3GP (50% male and of middle age - 43 years old) were enrolled in this study. 21% (5/24) patients developed ESRD. Renal biopsy findings such as crescent formation, glomerulosclerosis and tubular atrophy were similar in patients with ESRD, when compared to patients who did not develop ESRD. The treatment modalities of the patients were examined in two groups as MMF based and non-MMF based. The difference in the preservation of eGFR did not reach statistical significance between these two groups. The success rate of complete remission was similar between both groups. Serum creatinine levels >2.3 mg/dl at admission and need for renal replacement treatment (RRT) were associated with decreased renal survival.

Conclusion: MMF based or non-MMF based treatments have similar efficacy in C3GP. Serum creatinine level higher than 2.3 mg/dl at the time of diagnosis and need for RRT during admission are a strong predictor of ESRD with high sensitivity and specificity.

Keywords: C3 glomerulopathy; eculizumab; end stage renal disease; mycophenolate mofetil

INTRODUCTION

C3 glomerulopathy (C3GP) defines a rare group of glomerulonephritis (GN) characterized by complement C3 accumulation in renal glomeruli. The annual incidence of biopsy proven disease is 1 to 2 per million [1]. Expecting biopsy staining pattern in C3GP is that, absence or near absence of

immunoglobulin with C3 dominant staining [2]. Up to ten years ago, membranoproliferative glomerulonephritis (MPGN) had been histopathologically classified as type 1, type 2 and type 3 according to ultra structural appearance and location of electron-dense deposits [1, 2]. Over the past decade,

the MPGN classification has been changed with the understanding of the effect of complement pathway in disease pathology [3]. Nowadays, it is classified as immune complex mediated GN and complement mediated GN or C3GP and C3GP it is divided into two groups as dense deposit disease (DDD) and C3 glomerulonephritis (C3 GN) [4, 5].

Clinically, C3GP presents with hematuria, proteinuria and often renal failure [6, 7]. While both genders are affected equally, there are two peak ages. These age peaks were after puberty and early adulthood and after the age of 60 [7-9]. Ten year progression to end stage renal disease (ESRD) is approximately 40%-50% [1, 7]. After the pathophysiology of the disease has been established, treatment protocols have begun to be updated but there is still no effective treatment. Besides, a prognostic factor that could predict the course of the disease has not been identified. Medjeral-Thomas NR et. al. reported that at an age of more than 16 years, serum creatinine higher than 1.5 mg/dl and crescent formation in kidney biopsy are predictors of ESRD in C3GP [7]. However, there is limited data about independent predictors of ESRD in C3GP in the literature. The purpose of this study was to determine the demographic characteristics, histological features, treatment modalities and outcomes among patients with C3GP. We analyzed predictors of ESRD in patients with C3GP.

MATERIALS AND METHODS

2.1. Study population

This retrospective study was conducted in Gazi University, Department of Nephrology in Ankara, Turkey from 2008 to 2017. Patients, who were of age >18 years old with biopsy characteristics that fulfilled the diagnostic criteria for GN with dominant C3 set forth by the C3GP consensus report [5], were included in the study. Short follow-up time than six months and history of kidney transplantation determined as exclusion criteria. A total of 1273 biopsy records were screened. 61 of 1273 biopsy reported as MPGN and 30 of them met the inclusion criteria. At final decision, six of them had shorter than 6 months follow-up time and we analyzed the data of 24 patients. The patients who were treated with eculizumab were either patients with kidney transplantation or patients with cellular immunosuppressive resistant C3GP. There were 3 patients and they were not included in the analysis of 24 patients.

2.2. Data collection

Hospital electronic medical records system was used for baseline information such as sex, age and need for renal replacement treatment during the diagnosis. Total follow-up time and ESRD in follow-up were determined for all patients. Data regarding creatinine, albumin, blood urea nitrogen (BUN), estimated glomerular filtration rate (eGFR), calcium, phosphorus, lactate dehydrogenase (LDH), C3, C4, IgA, IgG, IgM, urine analysis and 24 hours urine protein levels were collected. We used the abbreviated Modification of Diet in Renal Disease (MDRD) equation to estimate the GFR [10, 11]. Patients' creatinine, BUN, GFR, albumin and 24 hours urine protein levels were recorded at the time of the diagnosis, at the 6 months, at the 12 months of follow-up.

Renal biopsy cores were obtained with ultrasonography accompanied standard procedure. Fresh biopsy cores were fixed in formalin and evaluated under light microscopy. Paraffin sections were prepared and stained with hematoxylin eosin, Kongo red and Jones silver methenamine stains. Small renal cortical tissue was separated for immunofluorescence study. Immunofluorescence studies on cryostat sections using polyclonal antisera against IgG, IgM, IgA, C3, C1q, C4d, kappa and lambda light chains have been used. Each renal biopsy was reviewed by the local pathologist according to the 2013 C3GP consensus guideline [5]. Electron microscopy was not used for all biopsy specimens, so that reason subgroup of C3GP (DDD or C3 GN) were not identified.

2.3. Study groups

There were two study groups: (1) patients on mycophenolate mofetil (MMF) based regimen (MMF + oral daily prednisolone); (2) non-MMF based regimen (high dose prednisolone ± cyclophosphamide). Patients, who were on conservative treatment with angiotensin converting enzyme inhibitors (ACEi) or angiotensin receptor blockers (ARB), were excluded because of the small number of patients. Treatment protocols of patients were decided by the Gazi University Nephrology Department until 2012. Afterwards, treatment protocols were decided according to the kidney disease improving global outcomes (KDIGO) 2012 GN guidelines [12]. While, oral daily prednisolone (1 mg/kg/d) + 1000 mg MMF twice a day treatment regimen was MMF base treatment, intravenous (IV) pulse prednisolone 500 mg/d (total dosage 3000 mg) + cyclophosphamide 500 mg with 15

days interval (total dosage 6000 mg) + maintenance oral prednisolone or IV pulse prednisolone + maintenance oral prednisolone treatment regimen was non-MMF based treatment. In MMF based treatment, MMF was given six months that achieved complete remission and MMF was given for 12-15 months in partial remission. Non-MMF based treatment was given for six months.

Ezulizumab treatment protocol is determined as induction with 900 mg IV one time per week for 4 weeks and maintenance with 1200 mg IV on week 5 and every other week. Eculizumab was used in case of resistant disease to cellular immunosuppressive treatment in non-transplant patients.

2.4. Study Outcomes

The primary outcome of our study is to determine remission rates, ESRD [less than 15 ml per minute per 1.73 m² (stage 5)] development and >50% reduction in baseline GFR for all patients. We also aimed to investigate the effect of demographics (gender, age), clinical findings (need for renal replacement treatment (RRT) during the diagnosis), laboratory markers (BUN, creatinine, albumin, LDH, hematuria and 24 hour urine protein) and kidney biopsy findings (glomerulosclerosis, crescent formation, tubular atrophy) on disease prognosis of patients. Complete remission accepted as under 500 mg/d urine protein during the follow-up with normal serum creatinine levels and partial remission, as accepted more than 50% reduction in urine protein with stable serum creatinine levels during the follow-up.

2.5. Statistical analysis

Asymmetrically distributed continuous variables in the text and tables were shown as median (minimum - maximum) and were compared with the Mann-Whitney U test. Categorical variables are expressed as percentage and were compared using the Fisher's exact test. Receiver operating curve (ROC) analysis were plotted to illustrate serum LDH and creatinine cutoff levels. Renal survival analysis was performed by means of Kaplan-meier curves and group comparisons for survival were performed using the log-rank test. P values less than 0.05 were considered to indicate statistical significance. Analyses were performed with SPSS 20 (SPSS, IBM, Armonk, NY) software for Windows.

RESULTS

Twenty-four patients with C3GP (50% male and of middle age - 43 years old) were enrolled in this study. 21% (5/24) patients developed ESRD. Renal biopsy findings such as crescent formation, glomerulosclerosis and tubular atrophy were similar in patients with ESRD when compared to patients who did not develop ESRD ($p=0.6$, $p=0.07$ and $p=0.7$, respectively). Needs for RRT on admission were significantly higher in patients with ESRD compared to patients who did not develop ESRD [4 (80%) vs. 2 (11%), $p=0.006$] (Table 1). While, serum BUN, creatinine, phosphorus and LDH levels were significantly higher in patients with ESRD (30 mg/dl vs. 17 mg/dl, 2.94 mg/dl vs. 1.02 mg/dl, 4.2 mg/dl vs. 3.5 mg/dl and 444 U/L vs. 187 U/L, $p=0.05$, $p=0.004$, $p=0.04$ and $p=0.003$, respectively), eGFR was significantly higher in patients, who did not develop ESRD (79 ml/min/1.73m² vs. 21 ml/min/1.73m², $p=0.004$). Median serum C3 levels of patients was below the normal range [69 mg/dl (6.6-158)]. On the other hand, median serum C4 level was within normal range [21 mg/dl (6-47)]. Median serum C3 levels in patients with or without ESRD were below the normal range, but there was not statistical difference between groups [65 mg/dl (42-85) vs. 71 mg/dl (6.6-158), $p=0.6$]. The laboratory parameters of patients are defined in table 2.

Table 1. Demographics and biopsy findings of patients according to ESRD development

ESRD				
	Total n=24	Yes n=5(21%)	No n=19(79%)	p value
Gender (Male) n(%)	12 (50%)	2(40%)	10(47%)	0.5
Age (years)	43 (18-62)	54 (28-62)	42 (18-60)	0.08
Histopathology				
Crescent (%)	22(0-46)	24(0-46)	21(0-38)	0.6
Glomerulosclerosis (%)	32(0-71) 18(75%)	39(27-71) 4(80%)	12.5(0- 61) 14(74%)	0.07 0.7
Tubular atrophy (n)				
RRT n(%)	6 (25%)	4(80%)	2 (11%)	0.006
Duration of Follow-up (month)	21(8-72)	12(10-46)	24(8-72)	0.02

ESRD: end stage renal disease; BUN: blood urea nitrogen; eGFR:

Table 2. Laboratory parameters of patients

ESRD				
	Total n=24	Yes n=5(21%)	No n=19(79%)	p value
BUN (mg/dl)	17(9-102)	30(13-102)	17(9-74)	0.05
Creatinine (mg/dl)	1.4(0.6-7.1)	2.94(2.1-7.1)	1.02(0.6-3.3)	0.004
eGFR (ml/min/1.73m) ²	48(7-134)	21(7-32)	79(20-134)	0.004
Calcium (mg/dl)	8.6(5-10.8)	8(5-8.1)	9.1(7.5-10.8)	0.003
Phosphorus (mEq/L)	3.6(2.4-11.3)	4.2(3.5-11.3)	3.5(2.4-6.2)	0.04
Albumin (g/dl)	3.6(1.6-4.4)	3.2(2.5-3.9)	3.9(1.6-4.4)	0.2
Total protein (g/dl)	6.5(3.5-7.6)	5.7(4.9-6.9)	6.5(3.5-7.6)	0.1
LDH (mg/dl)	240(131-587)	444(254-587)	187(131-299)	0.003
24-hour urine protein (g/d)	4.2(0.5-25.2)	5.4(2.7-9.4)	3.9(0.5-25.2)	0.3
Hematuria (n)	18(75%)	5(100%)	13(68%)	0.2
C3 (80-160 mg/dl)	69(6.6-158)	65(42-85)	71(6.6-158)	0.6
C4 (16-48 mg/dl)	21(6-47)	24(17-47)	21(6-37)	0.3
IgA (70-400 mg/dl)	183(54-403)	152(80-253)	183(54-403)	0.3
IgG (700-1600 mg/dl)	859(222-3000)	561(222-996)	959(385-3000)	0.1
IgM (40-230 mg/dl)	100(19-384)	130(24-227)	100(19-384)	0.6

estimated glomerular filtration rate; **LDH**: lactate dehydrogenase; **C3**: complement factor 3; **C4**: complement factor 4; **IgA**: immunoglobulin A; **IgG**: immunoglobulin G; **IgM**: immunoglobulin M

Three patients, who received conservative treatment, were excluded, total of 21 patients used immunosuppressive treatment. The treatment modalities of the patients were examined in two groups, as MMF based and non-MMF based. While, median glomerulosclerosis percentage was significantly higher in patients who used non-MMF based treatment [32% (0-71) vs. 14% (0-61), $p=0.04$], tubular atrophy and median crescent formation percentage were similar between non-MMF based and MMF

based treatment modality groups [9 (64%) vs. 7 (100%) and 26 (0-46) vs. 19 (0-30), $p=0.007$ and $p=0.09$, respectively]. During the follow-up, eGFR was not reduced in 72% (5/7) of patients, who used MMF based treatment. On the other hand, we observed that, in 43% (6/14) of patients', who used non-MMF based treatment, eGFR did not reduce. The difference in the preservation of eGFR did not reach statistical significance between two groups ($p=0.4$). While, providing complete remission in

Table 3. Comparison of MMF and non-MMF based treatments

Treatment Modality				
	Total n=21	Non-MMF n=14(67%)	MMF n=7(33%)	p value
Gender (male)	14(67%)	8(57%)	4(57%)	0.6
Age	44(18-62)	48(18-62)	42(19-59)	0.4
RRT (admission)	5(24%)	5(36%)	0	
BUN (mg/dl)	18(9-102)	23(9-102)	17(11-36)	0.6
Creatinine (mg/dl)	1.5(0.6-7.2)	1.58(0.6-7.2)	1.5(0.8-2.1)	0.8
eGFR (ml/min/1.73m) ²	47(7-134)	55(7-134)	47(35-126)	0.5
Albumin (g/dl)	3.36(1.6-4.4)	3.2(1.6-4.4)	3.9(2.9-4.15)	0.08
LDH (mg/dl)	243(131-587)	267(121-587)	184(146-258)	0.05
24-hour urine protein	4.2(0.5-25)	4.3(0.5-25)	4.2(1.7-13.3)	0.8
C3 (80-160 mg/dl)	69(6-147)	69(19-111)	64(6-147)	0.9
C4 (16-48 mg/dl)	21(6-47)	22(6-47)	21(9-37)	0.5
Glomerulosclerosis (%)	27(0-71)	32(0-71)	14(0-61)	0.04
Tubular atrophy (n)	16(76%)	9(64%)	7(100%)	0.07
Crescent (%)	22(0-46)	26(0-46)	19(0-30)	0.09
eGFR loss (n)				
No	11(52%)	6(43%)	5(72%)	0.4
<50%	3(14%)	2(14%)	1(14%)	0.8
>50%	7(34%)	6(43%)	1(14%)	0.4
Remission				
No	10(48%)	6(43%)	4(57%)	0.7
Partial	4(19%)	4(29%)	0	0.2
Complete	7(33%)	4(28%)	3(43%)	0.4
ESRD	4(19%)	4(100%)	0	<0.001

MMF: mycophenolate mofetil; **ESRD**: end stage renal disease; **BUN**: blood urea nitrogen; **eGFR**: estimated glomerular filtration rate; **LDH**: lactate dehydrogenase; **C3**: complement factor 3; **C4**: complement factor 4;

43% (3/7) of patients using MMF based treatment, complete remission was provided in 28% (4/14) of the patients who used non-MMF based treatment. The success rate of complete remission was similar between both groups ($p=0.4$) (Table 3).

Receiving operator curve (ROC) was used to determine best cutoff value of creatinine levels at admission associated with ESRD. 2.3 mg/dl was the best serum creatinine value associated with ESRD (sensitivity: 80%, specificity: 85%, negative

predictive value: 84% and positive predictive value: 80%, $UAC=0.920$ and $p=0.004$). Kaplan-meier survival analysis revealed that patients with serum creatinine levels <2.3 mg/dl at admission had increased renal survival, as compared to patients with serum creatinine above these levels (Log rank test <0.001). Besides, the need for RRT at admission was associated with decreased renal survival (Log rank test <0.001) (Figure 1).

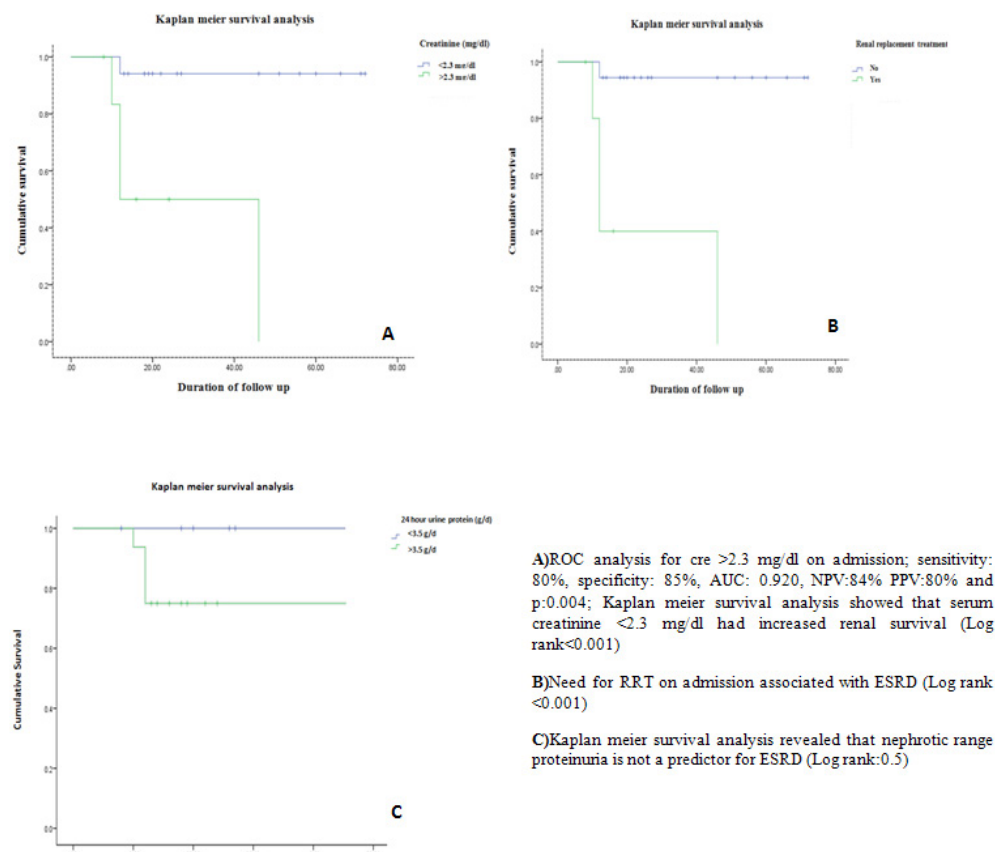


Figure 1. Kaplan meier survival analysis of renal survival: A)ROC analysis for cre >2.3 mg/dl on admission; sensitivity: 80%, specificity: 85%, AUC: 0.920, NPV:84% PPV:80% and $p:0.004$; Kaplan meier survival analysis showed that serum creatinine <2.3 mg/dl had increased renal survival (Log rank <0.001) B)Need for RRT on admission associated with ESRD (Log rank <0.001) C)Kaplan meier survival analysis revealed that nephrotic range proteinuria is not a predictor for ESRD (Log rank:0.5)

Table 4. Individual clinical course of C3GP patients treated with Eculizumab

Demographics of Patients							
	Age	Gender	K.transpl	Prior IST	Glomerulosclerosis(%)	Tubular atrophy	
Case 1	19	M	no	MMF-ste	8	Yes	
Case 2	25	F	yes	MMF-TAC-ste	56	yes	
Case 3	43	M	yes	MMF-TAC-ste	62	yes	
Laboratory Parameters of Patients							
	eGFR (First)	eGFR (Last)	sCre (First)	sCre (Last)	24 h UP (First)	24 h UP (Last)	Duration of follow up
Case 1	126	130	0.86	0.76	4039	2000	20
Case 2	42	30	1.67	2.16	4260	3820	22
Case 3	48	73	1.7	1.21	6000	4500	15

K.traspl: kidney transplantation; **IST:** immun suppressive treatment; **MMF:** mycophenolate mofetil; **STE:** steroid; **TAC:** tacrolimus; **eGFR:** estimated glomerular filtration rate ($\text{ml}/\text{min}/1.73\text{m}^2$) ; **sCre:** serum creatinine(mg/dl); **24 h UP:** 24 hour urine protein (mg/d)

Ecuzumab treatment was used in three patients. Two of three patients were kidney transplant recipient. Case 1 was a 19 year old male. C3GP was diagnosed with native kidney biopsy. Kidney biopsy showed 8% glomerulosclerosis with tubular atrophy. The disease was resistant to MMF and steroid treatments. Ecuzumab started to be used and partial remission of proteinuria was observed without decrease in eGFR at 20 months follow-up. Ecuzumab treatment did not achieve complete or partial remission in two kidney transplant recipients. There was less than 50% decrease in eGFR during the follow-up in one patient with kidney transplantation, whereas an increase in eGFR was observed in the other kidney transplant recipient. (Table 4).

DISCUSSION

C3GP is a rare disease that 40% of patients could progress to ESRD within 10 years [7]. Effective treatment of the disease is still controversial. In this study, demographic, laboratory and biopsy findings of patients with C3GP were identified and cellular immune suppressive treatment affectivity was compared. Patients, who developed ESRD during the follow-up, had poorer kidney function test on admission. However, patients had similar demographic and laboratory findings when separated into immunosuppressive treatment groups and there were significant differences between the two study groups regarding outcomes.

In this study, 21% (5/24) of patients developed ESRD after a median 21 months follow up. It is known that patients develop ESRD by 40%-50% in ten years follow-up in the literature [7, 13, 14]. Unlike the literature, low percentage of ESRD development may be associated with less than 10 years follow-up. Considering that, 48% of patients did not achieve complete or partial remission, it is inevitable that the number of patients who developed ESRD in ten years follow-up, will increase.

Despite the recent advances in understanding the pathophysiology of C3GP, there is limited data about effective treatment, risk stratification or prediction of disease progression [14-16]. This study suggests that MMF based and non-MMF based cellular immunosuppressant treatments have similar success in C3GP treatment. However, glomerulosclerosis percentage in kidney biop-

sy was significantly higher in patients who used non-MMF based treatment. This finding could explain why ESRD is more developed in patients who used non-MMF based treatments. On the other hand, complete remission rate and preserved eGFR rate were higher in patient who used MMF based treatment. Although, this difference did not reach statistical significance, the low number of patients might have affected this result. There are no randomized controlled trials that investigate the efficacy of cellular immunosuppressive therapies in the treatment of C3GP in the literature. The treatment efficacy has been investigated in limited observational and retrospective studies. Caliskan Y. et. al. showed that MMF based and non-MMF based cellular immunosuppressant treatments have similar clinical success to treat C3GP [17]. Similar to our study, they found that MMF based treatment had 40.7% complete remission rates. Rabasco C et. al reported that MMF based treatment is significantly more effective than non-MMF based treatments in C3 GN [18]. They found that MMF based treatment had 32% complete remission rates. However, the most important limitation of this study that they included only C3 GN patients to the study and DDD, which has poorer prognostic characteristics, is not included.

In this study, we demonstrated that serum creatinine level higher than 2.3 mg/dl at the time of diagnosis is a strong predictor of ESRD with 80% sensitivity and 85% specificity. Similarly, the need for RRT at the time of the diagnosis was determined to be predictor of ESRD. In the previous studies, age, nephrotic range proteinuria, and low eGFR were suggested as an independent predictor for kidney failure [7, 14, 17]. On the contrary, this study could not show nephrotic range proteinuria as a predictor of ESRD.

C3GP is characterized by over-activation of alternative complement pathway [4, 5, 19]. During the past decade an increased number of mutations in genes coding for regulation of the alternative complement pathway and also antibodies against complement regulatory proteins have been reported [1, 16, 20, 21]. After understanding the pathogenesis of the disease, targeted therapies have begun to be tried. Ecuzumab is an anti C5 antibody that inhibits C5 cleavage and prevents the generation of the terminal complement complex [22]. Although, ecuzumab is licensed to treat paroxysmal nocturnal hemoglobinuria and hemolytic uremic syndrome, ecuzumab was seen to mitigate C3 GP in animal models and case re-

ports [23-25]. This study showed that Eculizumab achieved partial remission with preserved eGFR in one patient who is not kidney recipient. Although, Eculizumab treatment did not achieve complete or partial remission in two kidney transplant recipients, there was less than 50% decrease in eGFR during the follow-up. Similar to our findings, the success of Eculizumab treatment in the literature is controversial. Welte T et. al. reported that creatinine level in one transplant recipient remained stable and in two transplant recipients was improved. Proteinuria remained stable in one patient and decreased in two patients [26].

This study has several limitations. Firstly, genetic and some serologic studies were not available. We could not test for C3 nephritic factor or complement factor H mutation. Therefore, we missed or overlooked patients with C3 nephritic factor or complement factor H mutation, which particularly affects the response to treatment. Secondly, DDD and C3 GN were not distinguished, because there were no electron microscopy findings. Thirdly, median follow-up of patients was short. Finally, the number of patients was low, due to the rare nature of the disease. Therefore, we could not evaluate the factors affecting ESRD development by multivariate analysis. Studies, which demonstrate the course of the disease, identify the risk factors and guide the treatment, could make significant contribution to the literature. Although, the number of patients was low, this study will shed light on not only the evaluation of patients, but also on the decision of treatment and possible predictors of ESRD.

In conclusion, C3GP is a rare disease that MMF based or non-MMF based treatments have similar efficacy. Serum creatinine levels higher than 2.3 mg/dl at the time of the diagnosis is a strong predictor of ESRD with high sensitivity and specificity. Remission success of Eculizumab treatment is promising, but controversial. The treatment decision must be done case by case.

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Резиме

ЕВАЛУАЦИЈА НА КЛИНИЧКИ, ЛАБОРАТОРИСКИ И МОДАЛИТЕТИ НА ТРЕТМАН ВО С3 ГЛОМЕРУЛОПАТИЈА: ИСКУСТВО НА ЕДЕН ЦЕНТАР

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Историјат/цел: Гломерулопатијата С3 (С3GP) дефинира ретка група на гломерулонефритис (GN), што може да доведе до крајна фаза на болест на бубрезите (ESRD). Хистопатолошките карактеристики на болеста допрва треба да се дефинираат, а прогностичките фактори и оптималниот третман не се целосно познати. Целта на оваа студија беше да се утврдат демографските, хистолошките промени, модалитетите на третман и резултатите кај пациентите со С3GP.

Материјал и метод: Оваа ретроспективна опсервациона студија беше спроведена на Одделот за нефрологија, Универзитет Гази, Анкара, од 2013 до 2017 година. Сите пациенти со биопсии на бубрезите што ги исполнуваат критериумите за С3GP беа вклучени во студијата.

Резултати: Дваесет и четири пациенти со С3GP (50 % машки и со средна возраст од 43 години) беа вклучени во оваа студија. 21 % (5/24) од пациентите развија ESRD. Наодите од бубрежната биопсија, како што се кресцентни формации, гломерулосклероза и тубуларна атрофија, беа слични кај пациентите со ESRD, при споредба со пациентите што не развиле ESRD. Модалитетите на третман на пациентите беа испитани во две групи како базирани на MMF и небазирани на MMF. Разликата во зачувувањето на eGFR не достигна статистичка важност меѓу овие две групи. Стапката на успех на целосна ремисија беше слична меѓу двете групи. Нивоата на серумскиот креатинин > 2,3 mg/dl при прием и потреба од третман на заместителна бубрежна терапија (RRT) беа поврзани со намалено бубрежно преживување.

Заклучок: Третманите базирани или небазирани на MMF имаат слична ефикасност кај С3GP. Нивото на серумскиот креатинин повисоко од 2,3 mg/dl за време на дијагностицирањето и потребата од RRT за време на приемот се силен предиктор на ESRD со висока чувствителност и специфичност.

Клучни зборови: С3 гломерулопатија; екулизумаб; крајна фаза на болест на бубрезите; микрофенолат мофетил