

Relation of serum C3 level and ASO titre with clinical profile and immediate outcome of Children with Acute Glomerulonephritis

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Abstract

Background

Acute glomerulonephritis (AGN) is a common pediatric renal disease in developing countries. Reduced serum complement C3 levels and elevated antistreptolysin O (ASO) titres are frequently observed in post-streptococcal AGN and may aid in diagnosis and assessment of disease severity.

Methods

This cross-sectional study was conducted in the Department of Pediatrics, Mymensingh Medical College Hospital, from April 2019 to March 2020. A total of 36 children diagnosed with AGN and fulfilling the inclusion criteria were enrolled. Clinical features, serum C3 levels, and ASO titres were evaluated, and their relationship with short-term outcomes was analyzed.

Results

Most patients (63.9%) were aged 6–12 years, predominantly male, and from rural areas. A preceding streptococcal infection was present in 83.1% of cases. Common clinical features included periorbital puffiness, oliguria, hematuria, and edema. Elevated ASO titres were found in 77.8% of patients, while low serum C3 levels were observed in 52.8%. Complete recovery occurred in 66.7% of cases, whereas 30.6% developed complications and 2.8% died. Elevated ASO titre was significantly associated with oliguria and hematuria, while low C3 levels were significantly associated with ascites. However, neither ASO titre nor C3 levels showed a significant association with short-term outcomes.

Conclusion

Serum C3 levels and ASO titres are useful supportive diagnostic markers and may reflect disease severity in children with AGN. However, their role in predicting short-term outcomes appears limited. Larger multicenter studies are recommended for further validation.

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Introduction

Acute glomerulonephritis (AGN), predominantly post-streptococcal glomerulonephritis (PSGN), remains a major cause of pediatric renal morbidity and mortality in developing countries. In a

pediatric cohort from Kashmir, PSGN accounted for 83.3% of AGN cases, with most patients under 10 years and a male predominance.¹ Clinically, AGN presents with hematuria, oliguria, edema, and

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Hypertension, sometimes progressing to acute renal failure, hypertensive encephalopathy, or congestive heart failure.² Laboratory evaluation plays a key role: serum complement C3 is reduced in over 90% of PSGN cases during the acute phase but usually normalizes within 6–8 weeks.^{3,4} Elevated antistreptolysin O (ASO) titre serves as a marker of recent streptococcal infection, although sensitivity varies with infection type.³ However, the relationship of these markers with clinical presentation and short-term outcomes in children, particularly in resource-limited settings, remains inadequately explored. So, this study was done to see the relationship of serum C3 level and ASO titre with clinical profile and immediate outcome of children with acute glomerulonephritis.

Materials and Methods

This cross-sectional observational study was conducted in the Department of Pediatrics, Mymensingh Medical College Hospital, Mymensingh, over a 12-month period from April 2019 to March 2020. The study population comprised children admitted with a diagnosis of acute glomerulonephritis (AGN). A purposive sampling method was employed, and a total of 36 patients were included.

Children aged between 2 and 12 years presenting with clinical features of AGN were eligible for inclusion. Patients with recurrent episodes of similar illness or with concomitant renal diseases were excluded. During the study period, 44 cases of AGN were admitted; of these, 36 met the inclusion criteria, while 8 were excluded.

Data Collection and Clinical Management:

After enrollment, a detailed clinical evaluation was performed, and relevant laboratory investigations—including serum C3 level and antistreptolysin O (ASO) titre—were obtained. Management consisted of bed rest, fluid and salt restriction, and administration of furosemide in all patients with edema and hypertension. Nifedipine was used as a second-line antihypertensive agent

when required. Patients were monitored daily through clinical examinations, including assessment of consciousness level, respiratory rate, heart rate, blood pressure, urine color, and urine output. Laboratory monitoring included urine routine and microscopic examination (R/M/E), serum creatinine, and blood urea, performed as per protocol. Clinical features and outcomes were recorded and analyzed in relation to serum C3 level and ASO titre.

Ethical Considerations and Statistical Analysis:

Written informed consent was obtained from the parents or guardians of all participants. Confidentiality was strictly maintained, and all interviews were conducted in Bangla to ensure comprehension. Ethical approval for the study was obtained from the Institutional Review Board (IRB) of Mymensingh Medical College Hospital (MMCH).

Data were entered into SPSS version 22.0 for analysis. Qualitative variables were summarized using frequencies and percentages, while quantitative variables were expressed as mean $\pm$ standard deviation. Appropriate bivariate and multivariate analyses were performed as required, and a p-value of <0.05 was considered statistically significant.

Results:

This cross-sectional study was conducted in the Department of Pediatrics, Mymensingh Medical College Hospital, from April 2019 to March 2020 to assess the relationship of serum C3 level and ASO titre with the clinical profile and immediate outcomes of children with acute glomerulonephritis (AGN). A total of 44 cases of AGN were evaluated during the study period. Of these, 36 patients were included in the analysis, while 4 were excluded due to a previous history of similar illness and the presence of concomitant other renal disease.

Table I: Distribution of study population by demographic characteristics (n=36)

Table I showed most of the patients age was in between 6-12 years, were male predominant and most of

Demographic characteristics	Frequency (n)	Percentages %
Age in years		
2-6 years	13	36.1
6-12	23	63.9
Sex		
Male	22	61.1
Female	14	38.9
Residence		
Rural	24	66.7
Urban	12	33.3

them came from rural area.

Table II: Distribution of study population by history of infections (n=36)

Previous history of streptococcal infection	Frequency n	Percentage%
Sore throat	08	22.2
Skin infection	22	61.1
Both sore throat and skin infection	01	2.8
No history of infection	05	13.9

Table II showed distribution of study population by previous history of infections. 83.1% children had history of streptococcal infections. Only 13.9% children had no history of streptococcal infection.

Table III: Clinical Features (Symptoms and Signs)

Feature	Frequency(n)	Percentage%
Puffiness of face	32	88.9%
Oliguria	31	86.1%
Hematuria	30	83.3%
Pedal edema	25	69.4%
Fever	21	58.3%
Hypertension	36	100%
Ascites	12	33.3%
Tachycardia	21	58.3%

Table III showed puffiness of face, oliguria, gross hematuria were more frequently found symptoms of AGN and hypertension, ascites, tachycardia were more frequently signs of AGN in children.

Table IV: Laboratory Findings

Parameter	Frequency(n)	Percentage%
Proteinuria	36	100%
Microscopic hematuria	35	97.2%
RBC casts	19	52.8%
High ESR	28	77.8%
Raised ASO titre	28	77.8%
Low serum C3	19	52.8%
Raised blood urea	9	25.0%

Table IV demonstrates that all patients presented with proteinuria, and the majority (97.2%) had microscopic hematuria on urine examination. RBC casts were detected in 52.8% of cases, elevated ESR was observed in 77.8% of patients. Raised ASO titre and low serum C3 level were found in 77.8% and 52.8% of patients, respectively. Raised blood urea was noted in 25.0% of cases.

Table V: Complications and Outcomes

Category	Frequency(n)	Percentage%
Congestive cardiac failure	5	13.9%
Hypertensive encephalopathy	4	11.1%
Acute renal failure	2	5.6%
Recovery without complications	24	66.7%
Recovery with complications	11	30.6%
Death	1	2.8%

Table V shows most common complication was congestive cardiac failure (13.9%), followed by hypertensive encephalopathy (11.1%) and acute renal failure (5.6%). Among 36 patients, 66.7% recovered completely, 30.6% developed complications and only 2.8% patient died during the course of treatment.

Table VI: Significant Associations

Variable	Association	p-value
ASO titre	Oliguria	0.028
ASO titre	Hematuria	0.004
ASO titre	Fever	0.003
ASO titre	Post-streptococcal AGN	<0.001
Low C3	Ascites	<0.05

Table VI shows Raised ASO titre showed significant associations with oliguria ($p=0.028$), gross hematuria ($p=0.004$), fever ($p=0.003$), and post-streptococcal AGN ($p<0.001$). Low serum C3 level was significantly associated with ascites ($p<0.05$). These findings suggest that ASO titre correlates with streptococcal etiology and key clinical manifestations, while low C3 may indicate disease severity.

Discussion:

This cross-sectional study was conducted at the Department of Pediatrics, Mymensingh Medical College Hospital, from April 2019 to March 2020, including 36 children aged 2–12 years diagnosed with acute glomerulonephritis (AGN). Clinical evaluation and laboratory tests, including serum ASO titre and C3 levels, were performed to assess their associations with clinical features and short-term outcomes. The peak incidence was noted between 6–12 years (63.9%), consistent with previous studies.⁵ Kumar et al. also reported a predominance during school age, likely due to greater exposure to hemolytic streptococcus.⁴ Earlier reports indicated that AGN rarely occurs below 2 years, attributed to immaturity of the immune complex system and lower incidence of pharyngitis in this age.^{6,7}

Of the 36 children, 22 were male and 14 were female, showing a male predominance (61.1%). Similar findings have been reported in previous studies, where boys were more frequently affected by AGN.⁸⁻¹⁰ This predominance may be related to greater environmental exposure and higher susceptibility to infections among males. In this study, 66.7% of the children were from rural areas, while 33.3% were from urban areas. Comparable results were reported by Khyber et al.¹¹

Acute glomerulonephritis in children is attributable to streptococcal infection in about 80–98% of cases. A history of preceding streptococcal infection is considered an established risk factor, illustrating the causal link with AGN. In the present study, 61.1% of children had a history of skin infections, 22.2% had a history of sore throat, while 16.7% reported no history of either. These

findings are consistent with earlier studies. Hannan et al. reported a history of skin infection in 50% of cases and sore throat in 11.1%⁵, whereas Bhuiyan reported skin infection in 42.1% and sore throat in 42% .¹²

The most frequently observed symptoms of AGN in this study were scanty urine (86.1%), puffy face (88.9%), and gross hematuria (83.3%). Other symptoms included fever (58.3%), headache (25.0%), respiratory distress (8.3%), and convulsion (5.6%). On physical examination, common findings were edema (88.9%) and hypertension (86.1%). Less frequent findings included pallor (19.4%), tachycardia (36.1%), ascites (27.8%), hepatomegaly (8.3%), and anuria (2.8%). Similar clinical features have been reported in several previous studies.^{5,13}

In clinical practice, the diagnosis of AGN is usually straightforward when patients present with the cardinal manifestations of hematuria, edema, and hypertension. Collectively, these features are referred to as the nephritic clinical presentation. Papangnou and Known (2008) reported hematuria as a universal finding, even if only microscopic .¹⁴In the present study, hypertension was observed in 88.3% of patients, comparable to the findings of other studies .^{4,5,12}The high prevalence of hypertension may be attributed to delays in seeking early treatment, resulting in advanced sequelae of the disease.

Routine urine microscopy in AGN commonly shows hematuria and urinary casts. In this study, RBCs were detected in 97.2% of cases, pus cells in 44.4%, and RBC casts in 52.8%, making them the most frequent cast type. Similar findings have been reported in previous studies, where microscopic hematuria was observed in over 90% of patients and RBC casts in 70–80% of cases, supporting the diagnostic value of urinary microscopy in AGN .¹⁵⁻¹⁷

In the present study, patients presented with varying grades of proteinuria. Among them, 63.9% had protein content (+), 30.6% had (++), and 5.6% had (+++). The proportion of subjects with proteinuria in this study is comparable to previous

findings .¹⁸ However, Rashid et al. reported proteinuria in more than 95% of cases.¹⁹

Raised ASO titre (>200 IU) was observed in 77.8% of cases in this study. Similar findings have been reported in previous studies, although the specificity and sensitivity of ASO titre remain relatively low.¹⁹

Regarding complications, hypertensive encephalopathy was the most common (11.1%), followed by heart failure (8.3%) and acute renal failure (2.8%). One patient (2.8%) presented with both heart failure and hypertensive encephalopathy. In contrast, Khyber et al. reported that 30.65% of patients were uncomplicated, while 9.6% had urinary tract infection (UTI), 8.06% had heart failure, and 1.61% had hypertensive encephalopathy.¹¹The higher incidence of complications in the present study may be explained by the fact that less severe cases often do not present to hospitals; patients usually seek hospital care only when their condition worsens and is no longer manageable with treatment from local practitioners.

The prognosis of AGN is generally better in children than in adults. Previous studies have reported complete recovery rates ranging from 60% to 100%,¹⁹ while case fatality rates vary from 0% to 13%.¹¹ Mortality in the acute stage is usually attributed to circulatory congestion, cardiac failure, acute renal failure, and hypertensive complications. In the present study, 97.2% of patients achieved complete recovery at discharge, while case fatality occurred in 2.8% of cases due to heart failure. This fatality rate is comparable to findings from other studies.¹⁹

In this study, raised ASO titre was not significantly associated with clinical symptoms, signs, or overall outcomes of AGN. However, oliguria and gross hematuria showed a significant association with elevated ASO titre. Post-streptococcal glomerulonephritis (PSGN) was also significantly associated with raised ASO titre ($p < 0.05$). In our study, ASO titre was elevated in 87.1% of subjects in the PSGN group compared to 20.0% in the NSGN group at clinical onset. A previous study reported higher frequencies, with ASO titre

elevated in 96% of PSGN cases and 51.7% of NSGN cases at onset.²⁰ This suggests that sole reliance on elevated ASO titre as a diagnostic marker in acute nephritic illness may be misleading.

Serum C3 level was found to be low in 54.8% of patients with a history of post-streptococcal infection, consistent with findings from several other studies.²¹ In contrast, among patients without such a history, 38% had low C3 levels. A similar observation was reported by Schroff, Ravichandran, and Acharya.²⁰

Conclusion:

From this study, it can be concluded that 77.8% of children had a raised ASO titre, while 52.8% had low serum C3 levels. Oliguria and hematuria were found to be significantly associated with raised ASO titre. Low C3 levels were significantly associated with the presence of ascites. However, serum C3 levels and ASO titres were not significantly associated with the immediate outcome of AGN.

Limitations of the Study:

This study was conducted on a relatively small sample size, which may limit the generalizability of the findings. Being a single-center, hospital-based study, the results may not fully represent the broader community population. In addition, the cross-sectional design did not allow for long-term follow-up to assess delayed complications or recovery patterns. Some laboratory parameters and potential confounding factors could not be evaluated due to resource constraints.

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Conflict of Interest

The authors declare that there are no conflicts of interest regarding the publication of this article.

Author Contribution

Begum R-study design, supervision, manuscript writing; Ali MA- clinical evaluation, manuscript revision; Khatun S - ethical oversight, manuscript review; Rahman M-data analysis, literature review; Nuruzzaman M - patient management, data collection; Das K - clinical assessment, manuscript review; Bari MA - data collection, follow-up; Rabeya T - statistical analysis, manuscript preparation; Ahammad AN - data entry, literature search; Alam N - laboratory coordination, manuscript review. All authors read and approved the final manuscript.

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Data Availability

The data that support the findings of this study are available from the corresponding author upon reasonable request.

AI Disclosure

No artificial intelligence (AI) tools were used in the preparation of this manuscript.

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