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Magnitude and associated factors of acute post streptococcal glomerulonepheritis among pediatric patients in aksum public hospitals, tigray, Ethiopia

Abstract

Objective: Acute post streptococcus glomerulonephritis is reported from all over the world with higher rates among children than in adults. The objective of this study was to assess the magnitude and associate factors of acute post streptococcal glomerulonephritis among pediatric patients in Aksum city public hospitals, Tigray, Ethiopia.

Methods: Institution based cross sectional study was conducted to retrieve data from 384 medical records of pediatric patients admitted to pediatric wards of Aksum city public hospitals between 2016 and 2018. The collected data were entered in to SPSS version 21 database for analysis. Finally, multivariate logistic regression was employed to identify determinants of adverse birth outcome at P value<0.05.

Results: Acute post streptococcal glomerulonephritis was diagnosed in 31.51% of pediatrics patients. Nutritional status [AOR=2.37, 95%CI (1.28–4.41)], previous history of sore throat and skin infection [AOR=7.23; 95%CI (1.12–46.50)], duration of sore throat infection [AOR=0.35; 95%CI (0.18–0.66)], and season of infection [AOR=9.93; 95%CI (4.78–20.62)] were factors significantly associated with the development of acute post streptococcal glomerulonephritis among children.

Conclusion: There is high burden of acute poststreptococcal glomerulonephritis among pediatric age group patients in Aksum public hospitals. Focus should be given to the early diagnosis and treatment of streptococcal pharyngitis.

Keywords: acute post streptococcal glomerulonephritis, pediatrics, public hospital, streptococcal Pharyngitis, determinants

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Introduction

Acute post-streptococcal glomerulonephritis (APSGN) is an immune-mediated disease associated with acute respiratory tract and skin infections by group A β-hemolytic Streptococcus (GAS) bacteria.[1] There are over 470,000 annual cases of acute post-streptococcal glomerulonephritis (APGN) worldwide; leading to approximately 5000 deaths with 97% of them were occurred in less developed countries.[2]

Acute post streptococcal glomerulonephritis (APSGN) commonly follows streptococcal pharyngitis during cold-weather months and streptococcal skin infections or pyoderma during warm-weather months. Although epidemics of nephritis have been described in association with throat (serotypes M1, M4, M25, and some strains of M12) and skin (serotype M49) infections, this disease is most commonly sporadic in nature.[1,3,4]

Acute Post streptococcal glomerulonephritis (APSGN) is reported from all over the world with higher rates reported in children. For example the incidence rate of APSGN among children (less than 15years) was 24.3 cases per 100,000 people whereas the estimated incidence was only 2 cases per 100,000 people older than 15years.[5] Acute post streptococcal glomerulonephritis occurs primarily in children and young adults, with males affected twice as often as females.[1] Prevalence of APSGN is low in industrialized nations because of easier and earlier access to competent medical treatment of streptococcal infections.[5]

Post streptococcal glomerulonephritis is most common in children aged 5-12years and uncommon before the age of 3years. The typical patient develops an acute nephritic syndrome 1-2weeks after an antecedent streptococcal pharyngitis or 3-6weeks after a streptococcal pyoderma.[6] In many cases the history of a specific infection may be absent, because symptoms may have been mild or have resolved without patients receiving specific treatment or seeking the care of a medical provider.[3]

Clinical manifestations of acute post streptococcal glomerulonephritis (APSGN) include edema, gross hematuria, hypertension, proteinuria and oliguria. Although mortality from APSGN is quite low, the disease contributes significantly to morbidities and hospitalizations.[7,8]

Declines in the incidence of acute post streptococcal glomerulonephritis have been reported in developed countries over the last 2-3 decades. However, acute post streptococcal glomerulonephritis (APSGN) remained a significant burden in developing countries.[7,9] This could be because of the high A beta-hemolytic streptococcus carrier rates that lead to streptococcal pharyngitis. For instance, the monthly carrier rate of group A beta-hemolytic streptococcus in Ethiopia averages at 17% varying between 7.5% and 39%.[10] Little is documented about the magnitude and factors associated with acute post streptococcal glomerulonephritis among pediatrics. Therefore, the aim of this study was to identify the predictors of acute post streptococcal glomerulonephritis in the Tigray regional State, Northern Ethiopia.

Methods and materials

Study setting

Institution based retrospective cross-sectional study was conducted in two public hospitals of Aksum town (Aksum university comprehensive specialized hospitals and St. Marry general hospital) central zone of Tigray, North Ethiopia. All medical records of pediatric patients who were admitted to the pediatric wards of the two public hospitals were included.

Eligibility

Registry records whose pediatric age groups were admitted to the pediatric wards of Aksum University comprehensive specialized hospitals and St. Marry general hospital were included in this study. Incomplete medical records were excluded from the study.

Sample size determination and sampling procedure

Sample size was determined by single population proportion for cross sectional study by taking the value of previous proportion of acute post streptococcal glomerulonephritis. Hence there is no similar study done, we took 50% proportion with 5% marginal error (d), 95% confidence interval. Where; N=required initial sample size Z α/2 = critical value for normal distribution at 95% confidence interval.

Based on these assumptions,

$$N = \frac{(z1-\alpha/2)2p(1-p)}{(d)2} N = \frac{(1.96)2*0.5*0.5}{(0.05)2} = 384$$

The final sample was 384.

There were a total of 3200 admitted pediatric patients in the two hospitals over a period of three years (2016-2018). Case load based proportion distribution was used to allocate the final sample size to the two hospitals. Systematic random sampling method was used to select the patient specific medical record. Data were collected using structured data collection tool.

Operational definitions

Acute post streptococcal glomerulonephritis (APSGN): pediatric patients admitted with history of anorexia, nausea, vomiting, malaise, flank pain and oliguria and/or on examination Hypervolemia, edema, hematuria and Hypertension and supported by physician's decision.

Hypertension: average systolic blood pressure (SBP) and/or diastolic BP that is ≥ 95th percentile for age, sex, and height on ≥3 occasions.[3]

Pediatric age: a child less than 18 years old.[3]

Hematuria: is the presence of at least 5 red blood cells (RBCs) per micro liter of urine in microscope, or a 1+ positive urinary dipstick reading.[3]

Proteinuria: is when ≥1+ to 3+ urinary dipstick reading, or 4-40 mg/m2/hr. 24-hr urine measurement.[3]

Data entry and analysis

After checking for completeness of the questionnaires, the coded data were entered into Epi-Info version 7.0. Final data set was exported to Statistical Package for Social Sciences (SPSS) version 22 software for inferential analysis. Descriptive statistics was used to characterize the sample and numerical data was presented as mean, proportion or percentages. Bivariate and multivariable logistic regressions were calculated to analyze the relationship between the dependent and independent variables.

Bivariate logistic regression was used to check variables associated with the acute post streptococcus glomerulonephritis at p value of less than 0.25 to be eligible for multivariable analysis model. These variables were analyzed in multivariate logistic regression model at p-values less than 0.05. The strength of association was reported in adjusted odds ratio (AOR) and 95% confidence interval.

Data quality assurance

The checklist was pre-tested in 5% of the calculated sample size in similar population (Adwa hospital) preceding the actual data collection period. Necessary corrections were made to the wording and structuring of questions. Employees of the respective study hospitals were deployed as data collectors to minimize bias. The collected data was checked daily for completeness with the principal investigator was monitoring the overall quality of data collection on daily basis.

Results

Socio-demographic characteristics and clinical presentation

Sample population description: A total of 384 medical records of children admitted to pediatric ward of Aksum public hospitals were included in this study. From those participants 143(37.2%) were<5years, 173(45.1%) 5-9 years, 44(11.5%) 10-14years and 24 (6.3%) 15-18years. The age range of the participant patients was between 2 and 16 years with mean age of 8.6 years. Male children were more than half 211(54.9%) of the study participants.

Clinical presentation: Most patients with APSGN presented to hospital with the complaints of generalized body swelling 91(75.20%) and facial swelling 28(23.14%). Previous histories of sore throat and skin infections were reported by 90(74.38%) and 25(20.66%) children with APSGN respectively. These infections occurred during the dry 69(57.02%) and rainy seasons 46(38.01). Six of the children with acute post streptococcal glomerulonephritis reported neither infection. Most of patients 86(71.07%) stayed in the hospitals for less than 2 weeks. Stages I and II were an admission presentation features for 70(57.85%) and 31(25.61%) of the children with acute post streptococcal glomerulonephritis. Only four children had hypertensive encephalopathy as a presenting feature. Diuretics and antibiotics were the commonest treatments given to 110 (90.1%) pediatric patients (Table 1).

Laboratory indications of acute post streptococcal glomerulonephritis

Complete blood count, dipstick and microscopic urinalysis were done for all patients (n=121) with acute post streptococcal glomerulonephritis (APSGN). Findings were mixed proteinuria and hematuria, only proteinuria, only hematuria, red blood cell casts (RBC casts) and mild anemia in 83(68.59%), 23(19.00%), 15(12.39%), 35(28.92%), 9(7.43%) of the patients respectively. Serum analysis was done to determine renal function and electrolyte levels for 117 and 103 patients respectively. Elevated age adjusted serum creatinine level and hyperkalemia were observed in 23(19.65%) and 19 (18.44%) of the patients respectively (Table 2).

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Table 1 Clinical characteristic of pediatric patients with acute post streptococcal glomerulonephritis in Aksum public hospitals, Tigray, Ethiopia

Variable	Category	Frequency (%)
Nutritional status of the patient	Well nourished	125 (29.9%)
	Under nourished	269 (70.1%)
Chief compliant of the patient	General body swelling	174 (45.3%)
	Facial swelling	48 (12.5%)
	Other than body swelling	162 (42.2%)
Previous history of infection	Sore throat	292 (76.0%)
	Skin infection	84 (21.9%)
	No history of infection	8 (2.1%)
Duration of the infection	<2 weeks	147 (38.3%)
	>2 weeks	229 (59.6%)
	Not applicable	8 (2.1%)
Season of infection	Dry	299 (77.9%)
	Rainy	77 (20.1%)
	No infection	8 (2.1%)
Blood pressure of the patient for age, sex and height at admission	Normal	266 (69.3%)
	Prehypertension	17 (4.4%)
	Stage I	70 (18.2%)
	Stage II	31 (8.1%)
Length of hospitalization	<2 weeks	345 (89.8%)
	>2 weeks	39 (10.2%)
Pharmacological treatment given	Antibiotic given	360 (93.8%)
	Antibiotic not given	24 (6.3%)

Table 2 Laboratory diagnostic results of pediatric patients with acute post streptococcal glomerulinephritis in Aksum town public hospitals, Tigray, Ethiopia

Variable	Category	Frequency (%)
Urine analysis*(121)	Hematuria	15 (12.39%)
	protienuria	23 (19.00%)
	Hematuria & proteinuria	83 (68.59%)
	RBC cast	35 (28.92%)
Renal function test **(117)	Creatinine normal	93 (79.48%)
	Creatinine elevated	23 (19.65%)
	Not done	4
Electrolyte analysis (103)	Normal	84 (81.55%)
	Hyperkalemia	19 (18.44%)
	Not done	18
Hemoglobin (121)	Normal	112 (92.56%)
	Mild anemia	9 (7.43%)

Numbers in bracket refer to the sample take for each investigation
*Urine dipstick and microscopy
**Renal function test as measured by serum creatinine level

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Magnitude of acute post streptococcal glomerulonephritis

A total of 384 records of children admitted in pediatric wards of Aksum public hospitals were included in this study. From those participants 121(31.51%) had acute post streptococcal glomerulonephritis (APSGN). Most affected 83 (68.59%) age group was between 5 and 9 years. The age range of the participant patients with APSGN was between 2 and 16 years with mean age of 8.6 years. Among the patients admitted to the pediatric wards, most were males 74 (61.11%). Eighty (66.11%) of the affected individuals were from rural areas and 41(33.88%) of them were from urban areas.

Factors associated with acute post streptococcal glomerulonephritis

In bivariate logistic regression model analysis age, area of residence, nutritional status, prior history of infection, duration of prior infection and season of infection was significantly associated with acute post-streptococcal glomerulonephritis (APSGN) at p- value less than 0.25. After controlling for possible confounders: nutritional status, prior history of infection, duration of prior infection, and season of infection were significantly associated with being diagnosed with acute post-streptococcal glomerulonephritis in multivariate logistic regression model at p- value of less than 0.05(Table 3).

Table 3 Factors associated with acute post streptococcal glomerulonephritis in Aksum town public hospitals, Tigray, Ethiopia (n=384)

Variable	Category	APSGN		COR 95% CI	AOR 95% CI
Age		Yes	No		
	<5	18	125	2.86 (1.04, 7.85)	0.99 (0.26,3.66)
	9-May	83	90	0.45 (0.18,1.13)	0.14 (.04,1.47)
	14-Oct	13	31	0.98 (0.33, 0.93)	0.10 (0.07,1.27)
	15-18	7	17	1	1
Residence	Urban	41	61	1	1
	Rural	80	202	1.697(1.06, 2.72)	1.04 (0.54,1.98)
Nutritional status	Well nourished	49	66	1	1
	Undernourished	72	197	2.03 (1.29, 3.21)	2.37 (1.28, 4.41) **
Prior history of infection	Sore throat	90	202	6.73 (1.33,34.01)	7.23 (1.12, 46.50) **
	Skin infection	25	59	7.08 (1.34, 37.51)	5.79 (0.85, 39.58)
	No infection	6	2	1	1
Duration of prior infection	<2weeks	55	92	5.02 (0.98, 25.74)	0.35 (0.18, 0.66) **
	>2 weeks	60	169	8.45 (1.66, 43.01)	
	No infection	6	2	1	1
Season of prior infection	Dry	69	230	10.0 (1.97, 50.67)	9.93(4.78, 20.62) **
	Rainy	46	31	2.02 (0.38, 10.67)	
	No infection	6	2	1	1
Length of hospital stay	<2 week	86	259	26.36 (9.10,76.28)	43.83 (1.87,149.29)
	>2 week	35	4	1	1

** Statistically significant at α=0.05

Patients who were under nourished were 2.37 times more likely to develop APSGN [AOR =2.37, 95% CI (1.28–4.41)] than their well-nourished peers. Similarly, patients with prior history of sore throat were 7.23 times more likely to develop APSGN than their peers with no history of throat infection [AOR=7.227; 95% CI (1.12–46.50)]. Children who had prior infection for less than 2 weeks were 65.5 % less likely to develop APSGN than those who had infection for more than 2 weeks [AOR=0.35;95% CI (0.18–0.66)].

Similarly, patients with history of infection during dry seasons had 9.93 times higher risk to develop APSGN than the patients who had no previous history of infections. [AOR=9.93; 95% CI (4.78–20.62)].

Discussion

The aim of this study was to assess the magnitude of acute post streptococcal glomerulonephritis in Aksum town. Acute post streptococcal glomerulonephritis (APSGN) was diagnosed in 31.51% of pediatric patients admitted to Aksum town public hospitals between 2016 to 2018. The highest burden of acute post streptococcal

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glomerulonephritis was observed among children aged between 5 and 9 years (68.6%). This result was similar to findings from studies conducted in Mekelle[5] and, Black lion public hospitals,[1] Ethiopia. The high burden of APSGN among children in this age group could be due to the higher risk of acquiring respiratory tract infections from peers in schools and fields.

Nutritional status, prior history of infection, duration of prior infection and season of prior infection were significantly associated with higher odds of developing acute post streptococcal glomerulonephritis.

Undernourished patients were 2.37 times more likely to develop acute post streptococcal glomerulonephritis. This finding agrees with a study conducted in Delta Region of Nigeria that showed undernourished patients to be more likely to develop acute post streptococcal glomerulonephritis than their well-nourished peers.[7] This might be due to the relatively higher vulnerability of undernourished patients to nephrogenic infectious agent.

Similarly, children with prior history of sore throat were 7.2 times more likely to develop acute post streptococcal glomerulonephritis than those without previous history of sore throat infections. This result was in line with studies conducted in Mekelle, Ethiopia,[5] and Nigeria.[7] Most children reported preceding sore throat or upper respiratory tract infection before they were presented with APSGN. This is also in line with the established scientific requirement for precedent infection with "nephrogenic" strains of group A ß-hemolytic streptococci prior to the development of APSGN.[11]

Pediatric patients who had sore throat or skin infection for less than 2 weeks were 65.5 % less likely to develop APSGN than those who had more than 2 weeks of infection [AOR = 0.345, 95% CI (0.182–0.657)]. This finding was similar with studies done in Bangabandhu sheikhs Mujib Medical University Dhaka, Bangladesh,[9] and Southern Iran.[8] This could be due the time requirement for stimulating the immune system and mounting immune mediated tissue attack. As such patients with longer duration of infection are likely to develop the disease than individuals in their earlier clinical stages of sore throat or skin infection.

The study also revealed that children with history of infection during dry seasons were at about ten times higher risk of developing APSGN than those who had the same illness during the rainy seasons [AOR = 9.93, 95%CI (4.778–20.623)]. The result was similar with the finding from a study conducted in Northern Territory Australia[12] and southern Iran.[13] This could be because dry seasons are implicated in favoring the harbor of throat and skin infections.

Conclusion

The study found that there was high magnitude of pediatric acute post streptococcus glomerulonephritis. Nutritional status, prior history throat/skin of infection, duration of infection and season of infection were significantly associated with acute post streptococcus glomerulonephritis.

Limitation

Hence the study was based on document retrieval; some registries had incomplete information on medical, socioeconomic, diagnostic modalities and other relevant variables that could have implications for policy and/or practice. Etiological diagnosis was not possible because of lack of additional investigations such as C3 level and Anti-DNase β titer in Ethiopia. This was especially evidenced in patient with clinical evidence of APSGN with no prior history of sore throat or skin infection.

Authors contributions

AA and HB: Conceived and designed the study. AA, AA, MG and HB: Analyzed the data. MG, AA, AA HB, AM and TB: Prepared the manuscript. All authors read and approved the final manuscript before submission for publication.

Availability of data and materials

Not applicable. All the data supporting the findings are contained within the manuscript.

Consent to publish

Not applicable.

Ethics approval and consent to participate

Ethical clearance was obtained from the Institutional Review committee (IRC) of Aksum University College of Health Science, with reference number.aku/chs/irc 256/11. A letter of support to the respective health facilities was obtained from the regional health bureau. The hospital permitted the retrieval of patient medical records. Data were analysed anonymously to keep confidentially.

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Conflicts of interest

The authors declare that they have no conflicts of interest.

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