TRANSPUBLIKA
Precise. Resilience. Felicitous.

Pharmacology, Medical Reports, Orthopedic, and Illness Details
https://ojs.transpublika.com/index.php/COMORBID
Online ISSN 2809-9745

https://doi.org/10.55047/comorbid.v4i1.1588

Case Report

Case Report: Acute Post-Streptococcal Glomerulonephritis with Renal Complications and Hemodialysis

Christine Bonuria Siregar[1*], Ridha Mutiara Indra[2], Nugrah Tri Amiranti[3]

[1-3]Eka Hospital, Bekasi Disctrict, West Java, Indonesia
Email: [1)] bonuria.christine@gmail.com

Received : 10 December - 2024
Accepted : 10 January - 2025
Published online : 16 January - 2025

Abstract

Acute poststreptococcal glomerulonephritis (APSGN) is characterized by infections of the skin (impetigo) or throat (pharyngitis) caused by nephritogenic strains of group A beta-hemolytic Streptococcus. It is more commonly observed in school-aged children, with a mean presentation age between 6 and 8 years. Most studies report a higher prevalence among males, ranging from 54% to 87%. If left untreated, APSGN can lead to chronic kidney failure, hypertension, and recurrent proteinuria. Antibiotic therapy in patients with the primary infection is crucial to prevent the progression of complications. This report aims to describe a current case of APSGN, including its complications, management, and recommended follow-up strategies. This study used a case study approach. Data were obtained from patients' medical records, including demographic information, medical history, laboratory test results, and therapy administered. Analysis was performed descriptively to describe patient characteristics, disease course, and treatment outcomes, and compared with current literature to identify relevant patterns. This study was conducted in compliance with research ethics, such as ethics committee approval and maintaining confidentiality of patient data. The results showed that the patient was 6 years old with chief complaints of fever, vomiting, persistent cough for two weeks, anemia, periorbital edema, and anuria. Physical examination showed hypertension (138/108 mmHg), anemia, periorbital edema, and signs of malnutrition. Laboratory results confirmed a very high creatinine level (14.92 mg/dL), hyperkalemia (7.1 mmol/L), and elevated CRP level (36 mg/L). The patient was treated with antibiotics, potassium correction, and continuous hemodialysis (*pro-CRRT*). After two days, the condition improved, with normalization of potassium levels and increased diuresis. The patient was discharged with continued therapy and a control plan. In conclusion, APSGN is a frequent immunologic kidney disease in children following streptococcal infection, with the majority of patients recovering after appropriate therapy.

Keywords: Acute Kidney Failure, APSGN, Renal, Streptococcus

1. Introduction

Acute post-streptococcal glomerulonephritis (APSGN) is a condition characterized by inflammation of the kidneys, triggered by infections in the respiratory system and skin caused by a specific type of Streptococcus bacteria. Group A beta-hemolytic bacteria typically present with symptoms such as edema, hematuria, hypertension, and azotemia (Ranawaka et al., 2025). IgA nephropathy is recognized as the primary reason for glomerulonephritis on a global scale (Rodriguez-Iturbe et al., 2016; Schena & Nistor, 2018). There is a male predominance (2:1), and it most frequently affects children aged 3–10 years, although it is relatively rare before the age of three. APSGN typically manifests in patients within 1-2 weeks after contracting streptococcal throat infection or 3-6 weeks after developing streptococcal skin infection. The majority of APSGN cases are linked to streptococcal pharyngitis rather than skin

Copyright: © 2025 by the authors.
This is an open access article distributed under the terms and conditions of the CC BY 4.0.

infections (Stahl & Hoxha, 2016). While the majority of children with APSGN recover, some may develop complications such as renal impairment, congestive heart failure, pulmonary edema, and encephalopathy (Ong, 2022; Rawla et al., 2019).

Given that acute post-streptococcal glomerulonephritis is the most recognized form of acute post-infectious glomerulonephritis and its clinical presentation commonly manifests as acute nephritic syndrome, terms such as "acute post-streptococcal glomerulonephritis," "acute glomerulonephritis," and "acute nephritic syndrome" are often, albeit inaccurately, used interchangeably. For example, APSGN is a typical representation of acute glomerulonephritis caused by streptococcal infections; similarly, Staphylococcus aureus infections can also lead to glomerulonephritis. In wealthy communities, the occurrence of APSGN has decreased, with the majority of cases now affecting older people with various underlying health issues like alcoholism, HIV, substance abuse, and diabetes. Nevertheless, APSGN, particularly post-streptococcal glomerulonephritis, remains prevalent among children in impoverished communities with limited access to medical care (Khalighi et al., 2018; Rodriguez-Iturbe et al., 2016).

Management of APSGN focuses on addressing acute symptoms of renal insufficiency and hypertension (Faraj et al., 2024). Mild cases can be managed on an outpatient basis; however, patients presenting with acute nephritic syndrome, severe hypertension, or complications require hospitalization. Bed rest is difficult to enforce and has not been proven beneficial, but most children naturally adopt it during the acute phase. Fluid and sodium intake restrictions form the cornerstone of management for patients with APSGN (Roy & Laila, 2014).

Sometimes, glomerulonephritis can go unnoticed for a long time before causing kidney failure. Signs of kidney failure can include lack of hunger, queasiness, throwing up, exhaustion, trouble sleeping, parched and irritated skin, and decreased urine production. Glomerulonephritis can occur suddenly and severely, rapidly progressing to renal failure, although this is rare. This article aims to highlight how acute post-streptococcal glomerulonephritis can pose diagnostic, therapeutic, and prognostic challenges that are not commonly encountered in clinical practice. It underscores the need for high clinical suspicion to ensure timely recognition and intervention.

2. Literature Review

2.1. Post-Streptococcal Acute Glomerulonephritis

Post-streptococcal acute glomerulonephritis (PSAGN) is an immunological complication of infection caused by Group A beta-hemolytic streptococcus (GAS). This disease typically presents 1-3 weeks following a streptococcal throat infection and is characterized by hematuria, hypertension, edema, and acute renal dysfunction. Although often self-limiting, PSAGN can lead to serious complications in some cases. The clinical manifestations of PSAGN include nephritic syndrome with microscopic or macroscopic hematuria, non-nephrotic proteinuria, acute renal dysfunction, edema, and hypertension. Diagnosis is based on a history of prior streptococcal infection, characteristic clinical findings, and laboratory results such as elevated anti-streptolysin O (ASO) titers and decreased C3 complement component levels.

2.2. Renal Complications in PSAGN

Although many cases of PSAGN are mild and self-limiting, some individuals experience significant renal complications. These complications may include acute kidney failure, nephrotic syndrome, and persistent hypertension (Sanderson & Harshman, 2020; Vivante et

al., 2014). Risk factors for severe complications include extremes of age (either very young or elderly), male gender, and more severe streptococcal infections. Significant renal dysfunction may occur in some PSAGN cases, requiring medical interventions such as supportive therapy and, in certain cases, dialysis. Nevertheless, the long-term prognosis for most PSAGN patients remains favorable, with full recovery of renal function.

2.3. The Role of Hemodialysis in PSAGN Management

Hemodialysis may be required in PSAGN patients experiencing severe acute kidney failure that does not respond to conservative medical therapy. This procedure helps to remove waste products and excess fluid from the body and corrects electrolyte imbalances caused by decreased renal function (Langer et al., 2020; Rovin et al., 2021; Simma & Neuhaus, 2018). However, hemodialysis is typically temporary, and many patients can discontinue this therapy once renal function is restored (Balasubramanian & Marks, 2017; Bobkova et al., 2016). Case studies demonstrate that with appropriate supportive therapy, including hemodialysis when necessary, many PSAGN patients can experience full recovery of renal function. However, it is essential to closely monitor renal function and other clinical parameters during the recovery period to ensure optimal outcomes.

2.4. Prognosis and Recovery in PSAGN Patients

The prognosis for PSAGN patients is generally favorable, with the majority experiencing full recovery of renal function. However, factors such as older age, male gender, and severe renal complications may impact the final outcome. Therefore, long-term monitoring and medical follow-up are crucial to ensure optimal recovery and prevent long-term complications (Al Nofal & Lteif, 2015; Hunt & Somers, 2019). In some cases, despite receiving supportive therapy, patients may experience long-term complications such as hypertension or mild proteinuria. Therefore, regular monitoring and early intervention are essential to prevent the progression to chronic kidney disease in PSAGN patients.

2.5. Recent Research on PSAGN and Renal Complications

Recent studies have shown that although PSAGN is often self-limiting, some patients may experience significant renal complications, including acute kidney failure and nephrotic syndrome. Risk factors for severe complications include extremes of age, male gender, and more severe streptococcal infections (Trautmann et al., 2020). Early diagnosis and appropriate management are therefore critical to prevent serious complications (Van der Watt et al., 2016; VanDeVoorde III, 2015). Furthermore, research also indicates that appropriate supportive therapy, including the use of hemodialysis when needed, can help PSAGN patients achieve full recovery. However, it is crucial to closely monitor renal function and other clinical parameters during the recovery phase to ensure the best possible outcome. PSAGN is an immunological complication of streptococcal infection that can lead to serious renal complications in some cases. Appropriate management, including supportive therapy and the use of hemodialysis if necessary, can help patients recover fully. Long-term monitoring and medical follow-up are essential to ensure optimal recovery and prevent long-term complications.

3. Methods

3.1. Research Type

This research is a case study aimed at conducting an in-depth analysis of Acute Post-Streptococcal Glomerulonephritis (APSGN) with kidney complications and the need for hemodialysis. A case study approach was selected as it allows the researcher to explore in detail the clinical conditions, management, and outcomes of patients suffering from APSGN with kidney complications requiring hemodialysis. This approach is suitable for rare diseases that require deep analysis to understand the pathophysiological mechanisms and therapeutic responses. The case study approach enables the researcher to collect comprehensive qualitative and quantitative data from one or more individuals, providing deeper insights into specific medical conditions. This approach also allows the researcher to identify factors influencing disease progression and treatment response, which can serve as a basis for further research or the development of clinical guidelines.

3.2. Data Sources

The primary data source for this study is the medical records of patients diagnosed with APSGN who experience kidney complications and require hemodialysis. The data collected includes demographic information, medical history, laboratory results, imaging findings, and notes on therapies administered and the response to treatment. This information was obtained from the hospital where the patients were treated, with the appropriate consent from the research ethics committee. In addition to primary data, this research also reviews literature related to APSGN, kidney complications, and hemodialysis management through relevant scientific sources. The literature is sourced from medical journals, textbooks, and research databases accessed through platforms such as PubMed and Google Scholar. These sources provide context and a broader understanding of the condition under study and help compare case study findings with existing literature.

3.3. Data Collection Techniques

Data collection was performed through document analysis of the medical records of patients meeting the inclusion criteria. Demographic data, medical background, physical exam outcomes, lab results, imaging findings, and details on the treatment given and its effectiveness were all gathered. This process was conducted following protocols for patient data privacy and confidentiality. Additionally, literature searches were carried out through scientific databases to gather supplementary information on APSGN, kidney complications, and hemodialysis management. The collected literature was used to compare case study findings with existing knowledge and provide a broader context for the condition under investigation. The literature search was conducted using relevant keywords and was limited to publications published within the last five years to ensure the information obtained was up-to-date.

3.4. Data Analysis

Data analysis was performed descriptively to illustrate patient characteristics, clinical course, management, and treatment outcomes. The collected data were analyzed to identify emerging patterns, such as factors influencing disease progression, treatment responses, and complications that occurred. This analysis was performed using statistical software to ensure the accuracy and validity of the findings. In addition to descriptive analysis, comparative analysis was also conducted by comparing case study findings with existing literature on APSGN and hemodialysis management. This comparison aimed to assess the alignment of findings with existing knowledge and to identify aspects that may not have been extensively

discussed in the literature. The comparative analysis helps in understanding the clinical implications of the case study findings and may serve as a foundation for further research.

3.5. Research Ethics

This research was conducted in compliance with applicable research ethics guidelines, including obtaining approval from the hospital's research ethics committee. All patient data used in this study has been anonymized to protect patient identity confidentiality. Furthermore, this research adheres to ethical guidelines for scientific publication, ensuring that all information sources are properly acknowledged, and plagiarism is avoided. Compliance with research ethics and scientific publication guidelines is important to maintain the integrity of the research and respect the rights of the patients involved. By adhering to these ethical guidelines, this research is expected to make a meaningful contribution to the medical field without compromising the rights and privacy of the individuals involved.

4. Results and Discussion

4.1. Case Report

Table 1. Case Report Resume

Section	Details
Patient Information	6-year-old female
Chief Complaint	Fever, vomiting, persistent cough for the last two weeks, anemia, periorbital edema, anuria
Medical History	Previous treatment at a clinic for fever, appeared lethargic, anthropometric status indicating malnutrition
Condition Prevalence	APSGN is more common in children aged 4-14 years, rare in children under 2 years and adults over 20. Occurs twice as frequently in males.
Infection Source	Usually, the infection occurs in the skin or throat, although any area infected by streptococcal bacteria could be involved. The period of inactivity is more prolonged after skin infections (3-5 weeks) compared to upper respiratory tract infections (7-15 days).
Physical Examination	Anemia, periorbital edema, lung rales, epigastric tenderness
Vital Signs	BP: 138/108 mmHg, Heart rate: 110 bpm, Respiratory rate: 24 breaths/min, Temperature: 38°C
Blood Test Results	Hemoglobin: 12.2 g/dL, MCV: 72.1 fL, WBC: 16,700/mm³, Platelets: 159,000/mm³, Sodium: 147 mmol/L, Potassium: 7.1 mmol/L, CRP: 36 mg/L, Albumin: 2.7 g/dL, Urea: 489 mg/dL, Creatinine: 14.92 mg/dL
Treatment Initiated	Ceftriaxone 1g daily, Amlodipine 7.5mg, Spironolactone 12.5mg daily, Captopril 6.25mg, Potassium correction with 40% dextrose + 2 units insulin, pro-CRRT
Follow-up	Two days later, ASO titer was positive. After correction: Sodium: 143 mmol/L, Potassium: 3.8 mmol/L. Symptoms improved, patient discharged with follow-up in one week. Diuresis >1 cc/hour, no edema, slightly elevated BP, continued oral therapy.

A 6-year-old girl arrived at the emergency room with a main issue of having had a fever, throwing up, and a cough that wouldn't go away for the past two weeks. She also had low red

blood cell count, swelling around the eyes, and no urine output. The patient had previously been treated at a clinic for fever. The child appeared lethargic with anthropometric status indicating malnutrition. Acute post-streptococcal glomerulonephritis (APSGN) is more commonly observed in children aged 4 to 14 years, whereas it is rare in children under 2 years of age and adults over 20 years old. It occurs twice as frequently in males compared to females. The first place where an infection begins is usually the skin or throat, although any part of the body infected with streptococcus can be involved. There is a longer period of time between getting infected and developing nephritis after a skin infection (3-5 weeks) compared to an infection in the upper respiratory tract (7-15 days). In this period of waiting, children who show no symptoms may experience microscopic hematuria.

The vital signs were: blood pressure 138/108 mmHg, heart rate 110 bpm, respiratory rate 24 breaths/min, and temperature 38°C. Physical examination revealed anemia, periorbital edema, lung rales, and tenderness in the epigastric region. Blood test results showed hemoglobin 12.2 g/dL, MCV 72.1 fL, white blood cells 16,700/mm^3, platelets 159,000/mm^3, sodium 147 mmol/L, potassium 7.1 mmol/L, C-reactive protein 36 mg/L, albumin 2.7, urea 489 mg/dL, and creatinine 14.92 mg/dL. After two days of treatment, the ASO titer was positive.

The patient was managed with ceftriaxone 1 gram daily (50 mg/kg), amlodipine 7.5 mg, spironolactone 12.5 mg once daily, captopril 6.25 mg, potassium correction with 40% dextrose 40 mL plus 2 units of insulin, and pro-CRRT. After correction, sodium was 143 mmol/L, and potassium was 3.8 mmol/L. The symptoms gradually improved, and the patient was discharged with instructions for follow-up in one week. On follow-up, diuresis >1 cc/hour was observed, there was no edema, blood pressure remained slightly elevated, and oral therapy continued.

4.2. Discussion

The kidney is made up of nephrons, which are the building blocks responsible for its structure and function. These nephrons are composed of renal cells, including glomeruli enclosed by Bowman's capsule, and renal tubules. An average human kidney houses around 1 million nephrons. The endothelium with pores makes up the inner layer of the glomerulus, followed by a layer made up of different extracellular proteins that create a network known as the glomerular basement membrane. The outermost layer is made up of visceral epithelial cells, podocytes, and mesangial cells. This complex structure provides the groundwork for ongoing filtration of plasma at the level of the glomerulus. The term "glomerulonephritis" encompasses a group of kidney diseases characterized by immune-mediated damage to the basement membrane, mesangium, or endothelial cells of capillaries, leading to hematuria, proteinuria, and azotemia. Acute glomerulonephritis may result from primary kidney causes or secondary diseases that lead to renal manifestations.

Post-streptococcal acute glomerulonephritis (PSAGN) is an immune-mediated disease associated with upper respiratory and skin infections caused by Group A beta-hemolytic Streptococcus. Group A beta-hemolytic bacteria typically present with edema, hematuria, hypertension, and azotemia. Male predominance (2:1) is observed, and the disease most frequently affects children aged 3 to 10 years, being relatively rare in those under three years old. The condition usually develops 1-2 weeks after streptococcal pharyngitis or 3-6 weeks after streptococcal pyoderma. Most cases of acute post-streptococcal glomerulonephritis occur following streptococcal pharyngitis rather than skin infection. While most children with post-streptococcal acute glomerulonephritis recover, some may experience complications, including kidney dysfunction, congestive heart failure, pulmonary edema, and encephalopathy.

In this case, the patient presented with fever, vomiting, cough, anemia, periorbital edema, and anuria for the last two weeks, with lethargy and anthropometric signs of malnutrition. Most children with PSAGN present with clinical swelling, hypertension, hematuria, and even azotemia. The majority of post-streptococcal acute glomerulonephritis cases are asymptomatic, and case recording is limited to symptomatic children. Macroscopic hematuria, edema, and hypertension are the most common clinical signs in PSAGN, observed in approximately 30-50%, 70%, and 50-90% of patients, respectively. Nephrotic-range proteinuria is rare, seen in approximately 2-5% of cases.

For reference, proteinuria levels according to Watt et al. (2016) are defined based on age: children 1-2 years >0.04 g protein/mmol creatinine, children 2-3 years >0.03 g protein/mmol creatinine, children 3-5 years >0.02 g protein/mmol creatinine, and children >5 years >0.015 g protein/mmol creatinine. Nephrotic-range proteinuria is defined as a urine protein/creatinine ratio >0.2 g/mmol or 3+ protein on urine dipstick. In this case, no proteinuria was detected, as the patient was anuric and required hemodialysis. The patient received ceftriaxone 1 gram daily (50 mg/kg), amlodipine 7.5 mg, spironolactone 12.5 mg once daily, captopril 6.25 mg, potassium correction with 40% dextrose 40 mL plus 2 units of insulin, and pro-CRRT. After correction, sodium was 143 mmol/L, and potassium was 3.8 mmol/L. Management of post-streptococcal acute glomerulonephritis is primarily supportive, as the condition may resolve spontaneously. Children who have high blood pressure, swelling throughout their body, or kidney problems need to be admitted to the hospital for observation of their blood pressure and kidney function. Treatment for post-streptococcal acute glomerulonephritis includes limiting fluids, taking medications to lower blood pressure, using diuretics, and possibly undergoing dialysis if needed. Receiving antibiotics during the initial infection can potentially stop the infection from spreading, thereby reducing the chances of developing post-streptococcal acute glomerulonephritis. In most cases, antibiotic prophylaxis is not necessary for PSAGN since the condition can resolve on its own and reoccurrence is uncommon. Thiazide diuretics are recommended as the primary treatment for PSAGN, but in cases of renal dysfunction, loop diuretics may be considered, especially for patients with eGFR <30 mL/min/1.73 m^2 and notable edema. Thiazide diuretics can lead to imbalances in electrolytes like low potassium, high blood sugar, and high calcium levels, so it is important to keep track of potassium and calcium levels when taking them. In PSAGN, high blood pressure can be treated with diuretics by themselves or with vasodilators like calcium channel blockers to deal with excess fluid caused by retaining sodium and water. Patients with swelling or high blood pressure should also limit their salt intake and restrict how much fluid they consume.

During the initial stage of PSAGN, potential issues to watch for are congestive heart failure, fluid buildup in the lungs, and encephalopathy caused by high blood pressure. A significant number of cases have experienced serious complications like hypertensive emergencies, heart failure, encephalopathy, and retinopathy in varying percentages. Around 30%-35% of children with post-streptococcal acute glomerulonephritis have been reported to experience hypertension-related neurological complications. Children who have severe high blood pressure might show unusual neurological signs like widespread seizures. The most frequent abnormality seen in the lab among individuals with post-streptococcal acute glomerulonephritis is anemia, which is caused by too much fluid in the blood vessels and/or reduced secretion of erythropoietin. This relationship is closely linked to the extent of azotemia.

Patients who have generalized swelling caused by sudden kidney failure or post-streptococcal acute glomerulonephritis might find it helpful to limit their sodium intake. It is advised to follow a diet that restricts sodium to a range of 1 to 2 milliequivalents per kilogram

per day in order to decrease swelling and encourage the excretion of sodium. Patients who are following sodium restrictions will also need to limit their fluid intake. However, those with severe swelling may be able to reduce their fluid intake to two-thirds of the normal amount or even less than half of their urine output once they have experienced a quick decrease in fluid retention. Patients who are following fluid restrictions need to be carefully watched for their fluid intake and output, as well as their electrolyte levels and vital signs.

Renal biopsy may be necessary for individuals with undetermined and rapidly worsening acute kidney issues in order to identify potential alternative causes of kidney problems that may demand specialized treatment. In severe cases necessitating renal biopsy, high doses of intravenous corticosteroids could be prescribed, although their effectiveness is largely supported by anecdotal accounts. Treatment of crescentic glomerulonephritis involving more than 75% crescents may include immunosuppressive therapy utilizing corticosteroids, with or without alkylating agents, to decrease inflammation outside of the capillaries. In cases where children experience severe kidney dysfunction leading to fluid overload and imbalances in electrolytes like hyperkalemia or acidosis, dialysis is advised. For patients with substantial fluid overload, characterized by excessive fluid accumulation exceeding 20% or 10% of body weight, that does not respond to diuretics, renal replacement therapy should be considered.

5. Conclusion

Poststreptococcal acute glomerulonephritis is the most common medical condition leading to acute nephritis globally, particularly affecting children between the ages of five and twelve. Its clinical manifestations can vary, ranging from asymptomatic hematuria or mild microscopic hematuria to more severe forms of acute nephritic syndrome. Early detection and prompt treatment are essential to prevent complications, making a collaborative approach from healthcare providers critical to addressing the underlying infection and managing the condition. Clinicians should maintain a high level of suspicion for poststreptococcal glomerulonephritis (GNAPS) in patients presenting with unexplained fever, particularly in regions where the condition is prevalent. Early diagnosis is crucial for initiating effective management, improving patient outcomes, and minimizing the risk of more severe complications. This case report was funded through private funding, with no conflicts of interest with industry.

This study highlights the importance of early detection, proper symptom management and monitoring of the patient's condition to prevent serious complications such as acute renal failure, severe hypertension and pulmonary edema. In addition, from a public health perspective, these results emphasize the need for public education on the prevention of streptococcal infection as a major precipitating factor, which can be done through improved personal hygiene awareness and better access to primary healthcare services. These implications are expected to improve the quality of patient care and reduce the health burden associated with this disease.

6. References

Al Nofal, A., & Lteif, A. (2015). Thiazide diuretics in the management of young children with central diabetes insipidus. *The Journal of Pediatrics*, *167*(3), 658–661. https://doi.org/10.1016/j.jpeds.2015.06.002

Balasubramanian, R., & Marks, S. D. (2017). Post-infectious glomerulonephritis. *Paediatrics and International Child Health*, *37*(4), 240–247. https://doi.org/10.1080/20469047.2017.1369642

Bobkova, I., Chebotareva, N., Kozlovskaya, L., & Shilov, E. (2016). Edema in renal diseases–current view on pathogenesis. *Nephrology@ Point of Care*, *2*(1), pocj-5000204. https://doi.org/10.5301/pocj.5000204

Faraj, S. S., Mohammad Amin, N. M., & Abdulkareem, M. M. (2024). Psychiatric Comorbidity in Patients Suffering from Chronic Medical Diseases. *Pharmacology, Medical Reports, Orthopedic, and Illness Details*, *3*(4). https://doi.org/10.55047/comorbid.v3i4.1511

Hunt, E. A. K., & Somers, M. J. G. (2019). Infection-related glomerulonephritis. *Pediatric Clinics*, *66*(1), 59–72. https://doi.org/10.1016/j.pcl.2018.08.005

Khalighi, M. A., Al-Rabadi, L., Chalasani, M., Smith, M., Kakani, S., Revelo, M. P., & Meehan, S. M. (2018). Staphylococcal infection–related glomerulonephritis with cryoglobulinemic features. *Kidney International Reports*, *3*(5), 1128–1134. https://doi.org/10.1016/j.ekir.2018.05.010

Langer, T., D'Oria, V., Spolidoro, G. C. I., Chidini, G., Scalia Catenacci, S., Marchesi, T., Guerrini, M., Cislaghi, A., Agostoni, C., & Pesenti, A. (2020). Fluid therapy in mechanically ventilated critically ill children: the sodium, chloride and water burden of fluid creep. *BMC Pediatrics*, *20*, 1–8. https://doi.org/10.1186/s12887-020-02322-3

Ong, L. T. (2022). Management and outcomes of acute post-streptococcal glomerulonephritis in children. *World Journal of Nephrology*, *11*(5), 139–145. https://doi.org/10.5527/wjn.v11.i5.139

Ranawaka, R., Dayasiri, K., Sandakelum, U., Nelson, D., & Gamage, M. (2025). Post-streptococcal acute glomerulonephritis in children: Association between proteinuria levels and renal outcomes. *World Journal of Clinical Pediatrics*, *14*(1). https://doi.org/10.5409/wjcp.v14.i1.100885

Rawla, P., Padala, S. A., & Ludhwani, D. (2019). Poststreptococcal glomerulonephritis. *StatPearls Publishing, Treasure Island (FL)*.

Rodriguez-Iturbe, B., Najafian, B., Silva, A., & Alpers, C. E. (2016). Acute postinfectious glomerulonephritis in children. *Pediatric Nephrology*, *7*, 959–969. https://doi.org/10.1007/978-3-662-43596-0_27

Rovin, B. H., Adler, S. G., Barratt, J., Bridoux, F., Burdge, K. A., Chan, T. M., Cook, H. T., Fervenza, F. C., Gibson, K. L., & Glassock, R. J. (2021). Kidney disease: Improving global outcomes (KDIGO) glomerular diseases work group. KDIGO 2021 clinical practice guideline for the management of glomerular diseases. *Kidney Int*, *100*(4S), S1–S276.

Roy, R. R., & Laila, K. (2014). Acute Post-Streptococcal Glomerulonephritis in Children A Review. *Bangladesh Journal of Child Health*, *38*(1), 32–39. https://doi.org/10.3329/bjch.v38i1.20025

Sanderson, K. R., & Harshman, L. A. (2020). Renal replacement therapies for infants and children in the ICU. *Current Opinion in Pediatrics*, *32*(3), 360–366. https://doi.org/10.1097/MOP.0000000000000894

Schena, F. P., & Nistor, I. (2018). Epidemiology of IgA nephropathy: a global perspective. *Seminars in Nephrology*, *38*(5), 435–442. https://doi.org/10.1016/j.semnephrol.2018.05.013

Simma, L., & Neuhaus, T. J. (2018). Common diagnosis at an unusual age-pulmonary oedema in a toddler. *Case Reports*, *2018*, bcr-2018. https://doi.org/10.1136/bcr-2018-225389

Stahl, R. A., & Hoxha, E. (2016). Glomerulonephritis. *Dtsch Med Wochenschr*, *141*(13), 960–

968. https://doi.org/10.1055/s-0042-107410

Trautmann, A., Vivarelli, M., Samuel, S., Gipson, D., Sinha, A., Schaefer, F., Hui, N. K., Boyer, O., Saleem, M. A., & Feltran, L. (2020). IPNA clinical practice recommendations for the diagnosis and management of children with steroid-resistant nephrotic syndrome. *Pediatric Nephrology*, *35*, 1529–1561. https://doi.org/10.1007/s00467-020-04519-1

Van der Watt, G., Omar, F., Brink, A., & McCulloch, M. (2016). Laboratory investigation of the child with suspected renal disease. *Pediatric Nephrology, 7th Edn. Heidelberg: Springer-Verlag*, 613–636. https://doi.org/10.1007/978-3-662-43596-0_19

VanDeVoorde III, R. G. (2015). Acute poststreptococcal glomerulonephritis: the most common acute glomerulonephritis. *Pediatrics in Review*, *36*(1), 3–13. https://doi.org/10.1542/pir.36-1-3

Vivante, A., Twig, G., Tirosh, A., Skorecki, K., & Calderon-Margalit, R. (2014). Childhood history of resolved glomerular disease and risk of hypertension during adulthood. *JAMA*, *311*(11), 1155–1157. https://doi.org/10.1001/jama.2013.284310