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Acute glomerulonephritis

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Abstract. Acute glomerulonephritis (AGN) is an inflammatory renal disorder characterized by the swift onset of glomerular inflammation, leading to hematuria, proteinuria, edema, and hypertension. AGN can emerge from a variety of etiologies such as post-infectious reactions, autoimmune conditions, and exposure to certain medications or toxins. The diagnosis of AGN involves a comprehensive evaluation of clinical history and symptoms in conjunction with laboratory tests such as urinalysis and blood tests. Imaging studies along with kidney biopsy may be employed in some cases to confirm the diagnosis and determine the underlying cause. Management of AGN relies on identifying its etiology which may include antibiotics for infections or immunosuppressive agents for autoimmune causes while supportive care is provided to control symptoms and prevent complications. Early intervention holds great significance in optimizing outcomes and preventing progression towards chronic kidney disease. This article presents an overview covering the causes, clinical features, diagnostic approaches as well as treatment options available for AGN while highlighting the importance of early detection alongside appropriate management measures.

Keywords: Acute glomerulonephritis, Kidney inflammation, Hematuria, Proteinuria, Edema, Hypertension, Post-infectious glomerulonephritis, Autoimmune glomerulonephritis, Kidney function, Urinalysis, Kidney biopsy, Immunosuppressive therapy, Corticosteroids, Antibiotics, chronic kidney disease, Early diagnosis, Symptom management.

Epidemiology

The epidemiology of acute glomerulonephritis (AGN) varies depending on the etiology and geographical location. AGN can affect individuals of all ages, but certain types of AGN are more prevalent in specific populations and age groups:

1. Incidence:

- AGN is a rare occurrence, with its incidence varying extensively depending on the underlying cause and population being studied.
- Post-infectious glomerulonephritis, particularly post-streptococcal glomerulonephritis, occurs more frequently in children and young adults.

Geographical Variation:

- The incidence of post-infectious glomerulonephritis

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tends to be higher in regions with a high prevalence of streptococcal infections and lower in areas with good public health practices.

- Certain autoimmune causes of AGN such as lupus nephritis are more common among specific ethnic groups like African or Asian descent.

Age and Gender:

- Although AGN can occur at any age, it is more common among children and young adults.

- The gender distribution differs based on the particular cause of AGN; for instance, males have a higher risk for developing post-infectious glomerulonephritis while females have an increased likelihood for lupus nephritis.

Seasonality: Infections that trigger AGN such as streptococcal infections may display seasonal patterns resulting in variations in the incidence rate.

Trends: Improved access to medical care along with antibiotics has reduced the occurrence rate of post-infectious glomerulonephritis significantly within some regions. Changes occurring over time regarding infection rates or autoimmune conditions can influence the epidemiology related to AGN.

Overall, multiple factors including genetics, environmental exposures alongside healthcare accessibility contribute towards shaping up the complex epidemiology concerning Acute Glomerulonephritis (AGN).

Etiology

Acute glomerulonephritis (AGN) can stem from diverse factors, and its etiology can be broadly classified into infectious, autoimmune, and other causes:

1. Infectious Causes:

- **Post-infectious glomerulonephritis:** This is one of the most common causes of AGN, frequently occurring after a streptococcal throat or skin infection. Other bacterial, viral, or parasitic infections may also instigate glomerulonephritis.

Autoimmune Causes:

- **IgA nephropathy:** This is a condition where the immune system deposits IgA antibodies in the glomeruli causing inflammation.

- **Systemic lupus erythematosus (SLE):** This autoimmune disorder can lead to lupus nephritis - a form of glomerulonephritis.

- **Anti-glomerular basement membrane disease:** A rare

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condition where antibodies target the glomerular basement membrane resulting in inflammation.

- **Henoch-Schönlein purpura (HSP):** A type of vasculitis that could cause glomerulonephritis particularly in children.

Other Causes:

- **Medications and toxins:** Certain drugs (e.g., nonsteroidal anti-inflammatory drugs, some antibiotics) as well as toxins might bring about damage to and inflammation within the glomerulus.

- **Genetic conditions:** Some inherited kidney diseases such as Alport syndrome could present with AGN.

- **Other systemic diseases:** Conditions like diabetes and hypertension could contribute towards injury to and inflammation within the glomerulus.

The specific cause of AGN varies depending on several factors including but not limited to medical history and age; hence identifying underlying causes remains crucial for effective treatment and management.

Pathophysiology

The pathophysiological mechanisms underlying acute glomerulonephritis (AGN) entail inflammation of the minute filtration units, known as glomeruli, in the kidneys. The inflammatory response disrupts their normal function and impedes their ability to filter waste products and excessive fluid from the bloodstream. The process could vary depending on the root cause of AGN but generally involves dysregulation of immune system functions and injury to the glomerular structures.

Key aspects characterizing the pathophysiology of AGN comprise:

1. Immune-Mediated Injury:

- **Antibody-Mediated:** In specific types of AGN, such as post-infectious glomerulonephritis or lupus nephritis, immune complexes (antibodies bound to antigens) are deposited in the glomeruli, triggering an inflammatory response.

- **Cell-Mediated:** T cells and other immune cells may directly attack the glomeruli in some cases leading to inflammation and damage.

Inflammation:

- Deposition of immune complexes or antibodies in the glomeruli activates complement systems that participate in immunological responses leading to inflammation and injury to various structures including basement membranes.

- Inflammatory reactions can also stimulate cytokines

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release among other mediators which further compromise functionality.

Altered Glomerular Permeability:

- Damage inflicted by inflammation alters permeability increasing proteinuria and hematuria.
- Altered permeability also affects kidney regulation capacity regarding electrolyte balance.

Glomerular Damage:

- Depending on severity & duration of inflammation; significant damage sustained by affected patients could lead to scarring (glomerulosclerosis). Severe/prolonged damage impairs renal function ultimately resulting in chronic kidney disease.

Hypertension

- Fluid retention & altered kidney function often leads to hypertension contributing further towards progression & exacerbation of symptoms

Overall, a complex interplay between immune dysfunctionality underpins AGN's pathophysiology alongside concurrent processes involving inflammation & structural damages impacting negatively on patient outcomes if not identified early enough for appropriate treatment measures aimed at ameliorating associated complications while minimizing potential long term health consequences for patients suffering from this condition needful attention too

Clinical features

1. **Hematuria:** Hemoglobin in the urine, which may give rise to pink, red or brown discolouration.

2. **Proteinuria:** Protein present in the urine and detected through urinalysis. In severe instances, it can lead to frothy or foamy urine.

3. **Edema:** Swelling, commonly around the eyes, hands, feet and abdomen due to fluid retention.

4. **Hypertension:** High blood pressure resulting from impaired kidney function and fluid retention.

5. **Reduced urine output:** A decline in urinary production indicating potential kidney dysfunction.

6. **Fatigue:** Weakness and exhaustion throughout the body possibly caused by anemia or toxin accumulation within bodily fluids.

7. **Flank or abdominal pain:** Discomfort located at lower back or abdomen as a result of kidney inflammation.

8. **Headache:** Potentially occurring due to elevated blood pressure levels

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9. Nausea & vomiting: These symptoms are possible results from waste product buildup within bloodstream resulting from impaired kidney function

10. Respiratory issues: Shortness of breath potentially arising if fluid accumulates inside lungs

As AGN's symptoms overlap with other systemic conditions affecting kidneys, seeking medical evaluation is paramount for patients experiencing any such indications early on since timely diagnosis followed by prompt treatment is integral towards effectively managing AGN while simultaneously preventing complications down the line

Daignosis

Physical examination -

During the assessment of a patient suspected to have acute glomerulonephritis (AGN), a physical examination is essential in determining the overall health status and identifying indications of kidney dysfunction or other systemic anomalies. The physical examination for AGN encompasses:

1. Vital Signs:

- **Blood Pressure:** Hypertension is frequently observed in AGN due to fluid retention and renal malfunction.

- **Heart Rate:** An increased heart rate may be noted as a response to stress or as compensation for elevated blood pressure.

General Appearance:

- **Edema:** Swelling around the eyes, hands, feet, and legs caused by fluid retention is a common sign of AGN.

- **Signs of systemic illness:** Assessing for signs of fatigue, weakness, or malaise.

Cardiovascular Examination:

- **Heart Sounds:** Evaluating heart sounds for murmurs or other abnormalities.

- **Lung Sounds:** Examining breath sounds for indications of fluid accumulation (e.g., crackles) due to excess fluids.

Abdominal Examination:

- **Palpation:** Checking for tenderness or masses in the abdominal region.

- **Ascites:** Observing any signs of fluid buildup within the abdominal cavity.

Peripheral Examination - Edema: Inspecting extremities such as legs and feet for edema

Neurological Examination: Evaluate neurological changes that can occur as a result of kidney dysfunction

7. Urinary System Examination: Inquire about changes in

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urine appearance and output; observe patients' reactions during urination

The results obtained from conducting an extensive physical evaluation combined with medical history records and laboratory tests serve as guides when making further diagnostic investigations towards treatment decisions that are effective management strategies aimed at preventing complications resulting from early identification symptoms indicative AGN through thorough physical examinations being key factors

Lab daignosis -

The laboratory diagnosis of acute glomerulonephritis (AGN) involves a series of tests to evaluate kidney function, detect inflammation, and identify potential causes of glomerular damage. Key laboratory tests used in the diagnosis of AGN include:

1. Urinalysis:

- Hematuria: Presence of red blood cells in the urine, which may be microscopic or macroscopic.
- Proteinuria: Presence of protein in the urine, often detected as albuminuria.
- Casts: Presence of red blood cell casts or other types of casts in the urine, indicating glomerular or tubular damage.

2. Blood Tests:

- Serum Creatinine and Blood Urea Nitrogen (BUN): Elevated levels indicate impaired kidney function.
- Electrolytes: Assessing levels of sodium, potassium, and other electrolytes can indicate kidney dysfunction.
- Complete Blood Count (CBC): May reveal signs of anemia or infection.
- Inflammatory Markers: Elevated C-reactive protein (CRP) and erythrocyte sedimentation rate (ESR) may indicate inflammation.

3. Immunologic Tests:

- Complement Levels: Decreased levels of complement (C3 and C4) can indicate immune-mediated glomerulonephritis.
- Antistreptolysin O (ASO) Titers^{**}: Elevated ASO titers may suggest recent streptococcal infection, a common cause of post-infectious glomerulonephritis.
- Autoantibodies: Tests for antinuclear antibodies (ANA), anti-double-stranded DNA (anti-dsDNA), and anti-glomerular basement membrane (anti-GBM) antibodies can help identify autoimmune causes such as lupus nephritis or Goodpasture

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syndrome.

4. Other Tests:

- Blood Cultures: If an infection is suspected, blood cultures may be performed to identify pathogens.

- Serum IgA Levels^{**}: Elevated levels may suggest IgA nephropathy.

5. Kidney Biopsy:

- Although not a laboratory test, a kidney biopsy may be performed if the cause of AGN is unclear. It involves taking a small sample of kidney tissue for microscopic examination and can provide definitive information about the type and extent of glomerular damage.

These laboratory tests help clinicians assess the severity of AGN, determine the underlying cause, and guide treatment decisions. Early and accurate diagnosis through laboratory evaluation is crucial for effective management and prevention of complications.

Differential diagnosis:-

The differential diagnosis of acute glomerulonephritis (AGN) necessitates distinguishing it from other conditions that may exhibit comparable symptoms such as hematuria, proteinuria, edema, and hypertension. The following ailments should be taken into consideration in the differential diagnosis of AGN:

1. Chronic Kidney Disease:

- May present with similar symptoms; however, chronic kidney disease commonly progresses slowly over time and may not have an abrupt onset.

Urinary Tract Infection (UTI):

- Hematuria can be a sign of UTI, particularly if the infection affects the kidneys (pyelonephritis).

- UTIs might also cause proteinuria but usually not to the extent seen in AGN.

Nephrotic Syndrome:

- Identified by copious proteinuria, hypoalbuminemia, and edema.

- The ailment may result from various causes such as minimal change disease, focal segmental glomerulosclerosis or membranous nephropathy.

IgA Nephropathy:

- A type of glomerulonephritis that often presents with recurrent episodes of hematuria after respiratory infections.

- Can be differentiated from other forms of AGN through immunoglobulin A (IgA) staining on kidney biopsy.

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Lupus Nephritis:– Renal involvement associated with systemic lupus erythematosus which may exhibit similar symptoms to AGN.– Lupus nephritis can be distinguished by additional systemic symptoms and specific autoantibodies (e.g., ANA or anti-dsDNA).

Goodpasture Syndrome:

- Indicated by anti-glomerular basement membrane antibodies leading to pulmonary hemorrhage and glomerulonephritis.

- Diagnosed using specific autoantibodies while frequently presenting alongside respiratory issues.

Membranoproliferative Glomerulonephritis:

- Another form of glomerulonephritis that might exhibit hematuria and proteinuria.

- Distinguished from other types via biopsy results coupled with complement levels.

Henoch-Schönlein Purpura (HSP):

- Small-vessel vasculitis causing AGN primarily among children

- Accompanied by a characteristic rash while joint pain or abdominal pain could also develop

Alport Syndrome:

An inherited disorder characterized by hearing loss along with glomerulonephritis. Usually diagnosed based on genetic testing combined with family history

10. **Drug-induced Kidney Injury:** Certain medications capable of inducing glomerular injury resulting in symptoms akin to those exhibited during an episode of acute GN. History regarding recent medication use is crucial for accurate diagnosis.

An inclusive assessment including medical records review, physical examination, laboratory tests as well as imaging studies helps distinguish between different types /causes of AGNs. In some cases, kidney biopsy proves necessary for confirmation purposes thus guiding treatment decisions ...

Treatment:

- The management of acute glomerulonephritis (AGN) entails a combination of supportive care, treatment of the underlying cause, and vigilant monitoring for possible complications. The specific approach adopted depends on the type of AGN, its severity, and the patient's overall health status. Here are some key aspects to consider when treating AGN:

1. Supportive Care:

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- **Blood Pressure Management:** Regulating hypertension with antihypertensive medications such as angiotensin-converting enzyme (ACE) inhibitors or angiotensin II receptor blockers (ARBs). These drugs also aid in reducing proteinuria.

- **Diuretics:** Administered to manage edema and fluid retention.

- **Dietary Modifications:** Restricting sodium and sometimes protein intake is necessary to manage fluid retention and reduce kidney workload.

- **Pain Management:** Pain relief may be required if the patient experiences discomfort.

1. Treatment of Underlying Cause:

- **Post-Infectious Glomerulonephritis:** Treating underlying infections such as streptococcal with antibiotics.

- **Autoimmune Causes:** Immunosuppressive agents like corticosteroids, cyclophosphamide, or mycophenolate mofetil could be used in conditions like lupus nephritis or IgA nephropathy.

- **Goodpasture Syndrome:** Plasmapheresis (plasma exchange) can remove circulating anti-glomerular basement membrane antibodies that cause kidney damage along with immunosuppressive drugs.

2. **Plasmapheresis:** In severe cases of certain types of AGN such as Goodpasture syndrome, plasmapheresis might be recommended to eliminate circulating antibodies causing kidney damage.

3. **Monitoring And Follow-Up:** Regular monitoring is vital for assessing treatment efficacy and detecting complications through serum creatinine levels urine analysis blood pressure readings and fluid status checks Follow-up visits are essential for adjusting treatments where necessary while ensuring adherence to medication prescriptions alongside dietary recommendations

4. **Dialysis:** Temporary dialysis may become necessary when managing severely impaired kidney function by removing waste products from blood while balancing electrolytes alongside fluids.

Patient Education And Lifestyle Modifications: Educating patients about their condition is crucial along with adhering strictly to prescribed treatment plans; encouraging lifestyle changes like smoking cessation maintaining healthy weight regular exercise would help significantly improve outcomes.

Individualized treatment plans should factor in both underlying causes together with an individual's overall

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health condition Early intervention coupled up with ongoing monitoring play a pivotal role in preventing further progression towards more severe stages which could result in irreversible damages on kidneys

Prevention:-

Preventing acute glomerulonephritis (AGN) involves mitigating risk factors and causes associated with the condition. While certain cases of AGN cannot be prevented, particularly those linked to autoimmune disorders or genetic factors, there are several measures that can help decrease the likelihood of developing AGN:

1. Infection Prevention:

- **Prompt Treatment of Infections:** The swift and effective treatment of infections such as streptococcal infections (strep throat) using antibiotics can aid in preventing post-infectious glomerulonephritis.

- **Good Hygiene Practices:** Encouraging handwashing and other hygienic practices may prevent the spread of infections.

5. Manage Chronic Conditions:

- **Control Diabetes and Hypertension:** Proper management of these conditions may lower the risk of kidney damage, including AGN.

- **Regular Monitoring:** Patients with chronic conditions should receive regular monitoring to ensure their kidneys remain healthy.

6. Avoid Nephrotoxic Substances:

- **Medications:** Evading or minimizing usage of medications that have potential harm on kidneys, such as nonsteroidal anti-inflammatory drugs (NSAIDs) and certain antibiotics can reduce the possibility for AGN.

- **Environmental Toxins:** Limiting exposure to environmental toxins and heavy metals could safeguard kidney health.

- **7. Manage Autoimmune Disorders:** - Patients who suffer from autoimmune disorders like lupus must work closely alongside their healthcare provider in managing their condition and avoiding complications, including AGN.

- **8. Healthy Lifestyle Choices:** - **Healthy Diet:** Consuming a balanced diet with limited sodium and protein intake may maintain kidney health. - **Regular Exercise:** Maintaining an active lifestyle might control blood pressure while promoting overall health.

- **9. Avoid Smoking And Limit Alcohol:** These habits

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increase the risk for kidney damage along with other health issues; hence it's essential to avoid them

10. Patient Education: Educating patients about signs & symptoms related to AGN is crucial so that they seek medical attention immediately if any symptoms occur. Raising awareness regarding managing risk factors like infections & chronic disease plays an important role

11. Regular Health Checkups: Regular check-ups allow early detection & management which prevents progression into Kidney diseases leading towards associated complications

By following these preventive measures individuals will be able to lessen their chances for developing AGN while maintaining sound overall kidney health. Early detection coupled with proper management is key when it comes down to preventing any progression in Kidney diseases along with its associated risks

Conclusion:

Acute glomerulonephritis (AGN) is a multifaceted renal ailment that can arise from various underlying causes, including infections, autoimmune disorders, and genetic factors. Its manifestation can range from mild and self-limiting cases to severe forms that require immediate medical attention due to their life-threatening nature. Timely diagnosis and treatment are pivotal in managing symptoms, preventing complications, and preserving kidney function.

Treatment strategies for AGN concentrate on addressing the root cause of the condition while controlling blood pressure levels, regulating fluid and electrolyte balance, and providing supportive care to alleviate symptoms. In select instances where necessary, immunosuppressive medications as well as plasmapheresis may be employed.

Preventive measures such as managing chronic conditions effectively, avoiding nephrotoxic substances altogether or treating infections promptly are useful in reducing the risk of developing AGN. Education about this ailment along with regular health check-ups play an important role in early detection and management of this condition.

Overall then it is crucial for healthcare providers alongside patients & caregivers to adopt a comprehensive multidisciplinary approach towards effective management of AGN while also aiming at preventing long-term complications such as chronic kidney disease.

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