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Staphylococcus Associated Glomerulonephritis with IgA Mesangial Deposition

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Case- The case is that of 52 year Caucasian male with motor vehicle accident, status post open reduction and internal fixation of the left hip. He sustained wound infection with osteomyelitis due to multidrug resistant pseudomonas infection. Extensive debridement of the wound was carried out but the hardware was left in place. He underwent treatment with polymyxin antibiotic for a month then the course was complicated by renal failure which resolved with polymyxin dose adjustment. However, the hard ware was removed after 2 months of treatment. At that time wound culture revealed MRSA infection.

He received 4 weeks of Vancomycin and 6 week course of polymyxin after the hardware was removal. He was readmitted to the hospital with increasing pain and persistent drainage from the wound. Imagings were consistent with erosion of the femoral head with joint space loss, and septic arthritis with evidence of osteomyelitis and the presence of sinus tract to the skin surface. Wash out of the wound with debridement was carried out and another course of Vancomycin was instituted.

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I. Case

The case is that of 52 year Caucasian male with motor vehicle accident, status post open reduction and internal fixation of the left hip. He sustained wound infection with osteomyelitis due to multidrug resistant pseudomonas infection. Extensive debridement of the wound was carried out but the hardware was left in place. He underwent treatment with polymyxin antibiotic for a month then the course was complicated by renal failure which resolved with polymyxin dose adjustment. However, the hard ware was removed after 2 months of treatment. At that time wound culture revealed MRSA infection.

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He developed worsening renal function with increasing creatinine from 1.2 to 6.7 mg/dl over 4 week period. His past medical history was positive for type II diabetes, hypertension, anemia, and hyperlipedemia. His medication consisted of insulin, lisinopril, iron, folic acid, omeprazole, and subcutaneous heparin. His review of system was positive for dark urine and leg swelling.

He was hypertensive on physical examination with BP 150/89 mmHg; afebrile and other wise examination of the cardiovascular, respiratory and abdomen were unremarkable. He had mild swelling of the left hip with surgical scar with chronic skin changes but no drainage. The examination also showed 3+ edema of the lower extremities.

His laboratory results showed WBC 11.4 with 73% PMN, Hg 7.8, and platelets of 332K. He had low albumin of 2.4 g/dl and phosphorus of 6.0 mg/dl. The serum creatinine had risen from 1.2 to 8.9 in 2 month's time. Urine protein was 2 gm/day and his UA showed protein >300 mg/dl, WBC 2-5, RBC packed, fine granular casts and RBC casts. His serology was negative for HIV, Hepatitis B and C, ANA, dsDNA, RF, ANCA.

His kidney biopsy revealed nodular mesangial sclerosis with necrotizing crescentic glomerulonephritis. The immunofluorescent (IF) staining of the kidney tissue showed 3+ IgA, 3+ C3. His complements C3, C4 were within normal limits and his urine immunofixation was negative.

Electron microscopy (EM) of renal specimen revealed deposition of immune-dense materials in the mesangium and in the subepithelia spaces. The final diagnosis was MRSA associated post-infectious glomerulonephritis.

Differential diagnoses: IgA nephropathy, post-infectious glomerulonephritis, pausi-immune ANCA associated nephritis, and MRSA post-infectious glomerulonephritis.

II. Discussion

There are 3 clinical settings for glomerulonephritis induced by Staphylococcus species; i- staphylococcal epidermidis bacteremia induced glomerulonephritis from ventricular-vascular shunts (1), ii- S aureus induced glomerulonephritis from endocarditis, and iii- Staphylococcal-associated glomerulonephritis (SAGN) which generally occurs by methicillin-resistant S aureus (MRSA) (2-9). MRSA induced glomerulonephritis resembles IgA nephropathy but a distinguished features of this form of nephritis is IgA-dominant or co-dominant mesangial staining with C3 deposition, Table-2. It is believed that Staphylococcal enterotoxins produced by MRSA act as superantigens, activating T-cells and inducing various cytokines which leads to this kind of glomerulonephritis. This antigen antibody reaction causes what is called "superantigen-related nephritis" (2). The antigen-antibody complexes deposit in the mesangium and sub-epithelium forming humps on electron microscopical examination. There are few reports on MRSA induced glomerulonephritis in the literature (7-9). Acute infectious glomerulonephritis is different when presented in adult patients.

The mean age of presentation is 49-58 years, and commonly associated with underlying co-

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morbidities in 40-50% of patients (10). These co-morbidities include alcoholism in 2-57%, diabetes in 8-29%, COPD in 7-33%, IV drug use in 3-27%, and malignancy in 5-10% (13) Table-1.

SAGN associated glomerulonephritis has protean manifestation including nephritic syndrome in 60%, nephrotic syndrome with gross proteinuria in 30-50%, the mean serum 24 hrs protein is 3.6 g/24 hrs which increases with increasing co-morbidities, and the mean serum creatinine in one series is 1.6-6.4 mg/dl, Table-1. The laboratory findings at the time of presentation are similar to those findings in other forms of glomerulonephritis (8). Hematuria in 98%, leuko-cytoria in 65%, mean protein excretion -3 g/day (21% had all features of nephrotic syndrome), and the mean serum creatinine at the time of biopsy – 5.1 mg/dl. Table-1

Kidney biopsy in these cases show Endocapillary proliferation in 70-100% of cases, crescents more than (20-30%) of the glomeruli in 14-36%, interstitial infiltration in 30-80%, and evidence of ATN in 20-40%.

Immunofluorescent staining showed granular staining and deposition of IgG and C3 or C3 alone in a peripheral capillary wall and mesangial distribution. IgA usually is absent or has less trace positivity on peripheral capillary walls (11). IF deposits are C3 in 93-100%, C1q in 18-35%, IgG in 55-65%, and IgM/IgA in 30-45% of cases, (11-18), Table-1.

The IF findings in this disease resemble those typically seen in patients with IgA nephropathy or Henoch-Schonlein purpura nephritis, however, the presence of hypocomplementemia, concurrent culture positive bacterial infection, and light microscopic pattern of diffuse Endocapillary hypercellularity with marked neutrophil infiltration in addition to mesangial and sub-endothelial deposits strongly favor acute post-infectious glomerulonephritis over IgA nephropathy, Table-2.

The EM study reveals mesangial deposits in 33-90%, sub-endothelial deposits in 44-75%, and sun-endothelial humps in 94-100% of cases (11).

The major diagnostic criteria should include at least 2 of the followings (11-13);

- Hypocomplementemia (primary low C3)
- Endocapillary proliferation and exudative glomerulonephritis on light microscopy.
- C3 dominant of co-dominant glomerular staining on IF microscopy. However, many of Staphylococcus-associated glomerulonephritis have IgA dominant or co-dominant disease together with C3 staining.
- Hump-shaped sub-epithelial deposits on EM.

The differential diagnoses of SAGN with hypocomplementemia in adults are;

- Infection associated glomerulonephritis
- Lupus nephritis
- Membrano-proliferative glomerulonephritis
- C3 glomerulonephritis
- Mixed cryoglobulinemia
- Athero-embolic disease which may presents with active urine sediment.

The presence of ANCA does not exclude the diagnosis of SAGN (11-13, 19-22).

III. Course of Disease and Prognosis

Successful eradication of the infection should result in resolution of GN. However, many patients with SAGN do not have complete resolution of the serum creatinine to baseline and will have persistent proteinuria. In one series (9) 50% of patients attained complete resolution of the disease. Older age and presence of co-morbid conditions like DM with high serum creatinine at presentation portend worse prognosis (8, 9).

In a study of 86 adults followed for 48 months in 41 patients without DM, 23/42(56%) attain complete remission, 11/41(27%) had persistent renal dysfunction, and 7/41(17%) progressed to ESRD requiring renal replacement therapy. The renal prognosis is worse in patients with DM among 11 patients with SAGN2/11 had persistent renal dysfunction and 9/11 progressed to ESRD (15, 23, 24).

In another report in elderly patients with SAGN (mean age 65 years) 34/109 were followed up for at least 3 months (11), 24% had complete recovery of renal function, 32% had persistent renal dysfunction, and 44% progressed to ESRD. Tubular atrophy and interstitial fibrosis are markers of chronic renal disease (11).

Table-1: Characteristics of staphylococcal associated glomerulonephritis

Characteristic	Percentage
Median age	49-50 years
Underlying disease	
• Alcoholism +/_ cirrhosis	2-57%
• Diabetes	8-29%
• COPD	7-33%
• IVDU	3-27%
• Malignancy	5-10%

Presentation	
• Nephritic syndrome	60%
• Nephrotic syndrome	30-50%
• Mean serum creatinine	1.5-6.4 mg/dl (increased with co-morbidities/crescentic GN)
• Mean 24 hr protein	3.6 g/24 hrs (increase with co-morbidities)
Kidney biopsy	
• Endocapillary proliferation	70-100%
• Crescents (>20-30%)	14-36%
• Interstitial infiltration	30-80%
• ATN	20-40%
IF staining:	
• C3 deposits	93-100%
• C1q	18-35%
• IgG deposits	55-65%
• IgM/IgA	30-45%
EM	
• Mesangial deposits	33-90%
• Sub-endothelial	44-75%
• Humps	94-100%
Sites of infection and microbiology	
• URI	24-44%
• SSTI	5-25%
• Lungs	16-18%
• Endocarditis	1-13%
• Dental	0-13%
• UTI	1-12%
Organisms	
• Streptococcus	14-47%
• Staphylococcus	12-24%
• Gram negative	1-22%
• No growth	24-59%

Table-2: differential from IgA nephropathy

Staphylococcal associated glomerulonephritis	IgA nephropathy
Older age at presentation with underlying DM	Younger age group with hematuria
Acute kidney injury at presentation	Can occurs when there is gross hematuria
Hypocomplementemia (mainly decrease C3)	Not typically seen
Diffuse exudative glomerulonephritis on LM	Mesangial proliferative disease
Stronger intensity of IF staining for C3 than IgA in glomerular deposits	Predominant global mesangial IgA staining
Sub-epithelial humps on EM	Mesangial deposits of IgA

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