

# West Nile Virus Encephalopathy Leading to Prolonged ICU Hospitalization

Brett Cornforth MS4 & Jeff Hunt M.D.

Sanford Medical Center Fargo, University of North Dakota School of Medicine and Health Sciences



## Background

- West Nile Virus (WNV) is the leading cause of mosquito-borne disease in the United States
- WNV is a positive-sense, single-stranded RNA flavivirus
- Approximately 80% of WNV cases are asymptomatic
- Approximately 20% of WNV cases have self-limited viral syndrome with abrupt onset of fever, headache, malaise and myalgias
- Approximately 1 out of 150 cases of WNV presents with neuroinvasive disease
- Neuroinvasive disease can present as meningitis, encephalitis, or with paralysis similar to poliovirus
- Approximately 10% mortality for patients with neuroinvasive disease.
- There is no vaccine prevention for WNV and treatment is entirely supportive
- Around 1/3 of patients recover completely, 1/3 have some recovery, and 1/3 have permanent deficits
- Neuroinvasive WNV is more common in older adults (mean age 66) and age is the highest predictor of poor outcome

## Initial Presentation

- 64-year-old male
- PMH: DMII, HTN, HLD, CKDIV, chronic back pain
- Presenting with fever of 103, 1 day history of fatigue, increasing daytime sleepiness, weakness, and dry heaves
- Pt had worsening of his chronic back pain for 2 weeks since returning from camping in rural ND
- Direct admission from urgent care for suspected pneumonia
- CXR did not show evidence of pneumonia, but patient had no other obvious infectious source
- Pt had increase in creatinine above his baseline, became progressively sleepy during the interview, and began having dips in his O2 saturations as he dozed off
- Pt was started on ceftriaxone for CAP with doxycycline rather than Azithromycin in order to cover for potential tick-borne illnesses due to his camping exposure

## Disease Progression

- Overnight rapid response called due to altered mental status and decreased responsiveness
- Seizure-like activity was noted during the rapid
- Non-contrast head CT was negative
- MRI Brain was negative
- Pt was transferred to the ICU
- Ceribell EEG was ordered, EEG was negative
- Due to encephalopathy and seizures pt was started on acyclovir for presumed herpes encephalitis
- Lumbar puncture was performed
  - Elevated glucose, protein, WBC – 84% neutrophils
- Vancomycin and meropenem were added to treat possible bacterial meningitis, acyclovir discontinued
- Meningitis/encephalitis and autoimmune panels returned negative
- Pt was intubated due to low GCS score and hypercapnia on BiPAP
- West Nile Virus RNA PCR returned positive
- West Nile Virus IgM returned positive
- Antibiotics stopped as WNV treatment is supportive
- Pt developed VAP which worsened his respiratory failure, required antibiotics and therapeutic bronchs
- Acute on chronic kidney injury led to need for dialysis
- Pt's mental status was complicated by encephalitis, sedation, and ICU delirium
- While in the ICU pt developed sacral decubitus ulcers requiring surgical debridement and diverting colostomy
- Pt developed flaccid paralysis in both lower extremities
- Pt had tracheostomy tube placed 13 days into his ICU stay as well as PEG tube placement
- Pt stayed in the ICU for a total of 58 days
- Pt was then discharged to Vibra
- Pt had new fever prior to discharge to Vibra, was started on cefepime empirically
- No significant mental status changes over last several weeks of ICU stay, opens eyes spontaneously, still unable to communicate

## Discussion Points

- WNV encephalitis can present with convulsions, seizures, tremors. Can easily be mistaken for Herpes encephalitis which is classically associated with temporal lobe hemorrhage and seizures.
- Like most neuroinvasive viral diseases WNV typically has leukocytic predominance on CSF; however, early in the disease state neutrophilic predominance can occur which can lead to the issue of having to cover for assumed bacterial meningitis
- Early inclusion of WNV in differential for encephalitis/meningitis can lead to earlier diagnosis and decreased use of empiric antibiotics
- Recovery from WNV can be long and slow, most of the recovery process occurs in the first 6-8 months, but 70% of patients with encephalitis reported symptoms 5.5 years after infection

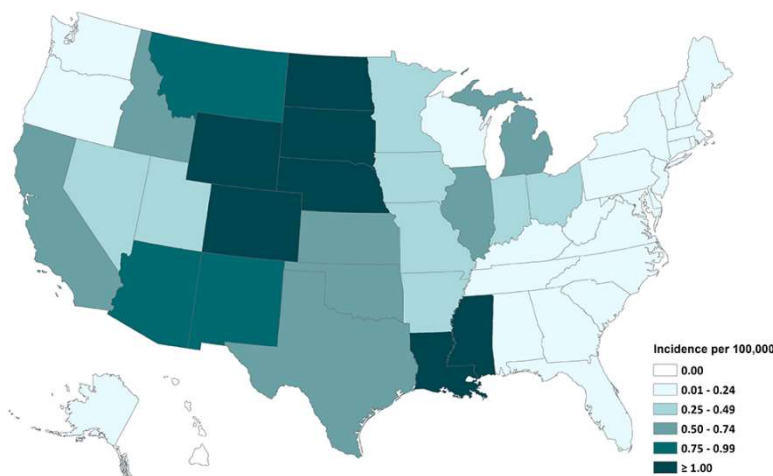
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Average annual incidence of West Nile virus neuroinvasive disease reported to CDC by state, 1999-2020



Source: ArboNET, Arboviral Diseases Branch, Centers for Disease Control and Prevention

	Viral meningitis	Tuberculous meningitis	Fungal meningitis	Bacterial meningitis
cell count	<2000 cells/mcL predominately lymphocytes	100-500 cells/mcL predominately monocytes	100-500 cells/mcL predominately lymphocytes	>1000-2000 cells/mcL predominately neutrophils
glucose	normal	<45 mg/dL	low to normal	<45 mg/dL
protein	<150 mg/dL	100-500 mg/dL	normal to high	>250 mg/dL

# The role of plasmapheresis in treating and preventing hypertriglyceridemia-induced pancreatitis

Annabel Jiran, University of North Dakota School of Medicine and Health Sciences

## Case Presentation

- 39 year old female presents to ED with a rash
- HPI: Rash resolved with Benadryl. Also has upper abdominal pain radiating to the back, similar to previous acute pancreatitis. Has had pancreatitis 4 times previously and treated with plasmapheresis twice
- Medical history: lipodystrophy, hyperlipidemia, chronic pancreatitis, recurrent hypertriglyceridemia-induced acute pancreatitis (HTG-AP), PCOS, mood disorder, GERD, morbid obesity, and prediabetes
- Medications: fenofibrate, atorvastatin (40 mg), metformin, spironolactone
- Surgical history: cholecystectomy for biliary dyskinesia and colectomy for colonic intussusception caused by a lipoma
- Social history: Rare alcohol use. Quit smoking 20 years ago
- Physical exam: central obesity (BMI 44), epigastric tenderness
- Labs
  - Lipase 41 (within normal limits)
  - Triglycerides 7318
  - Cholesterol 583
  - Lactic acid 4.8
  - Sodium 126
  - Bicarbonate 20.6, <13.5 on repeat
- Imaging: abdominal CT showed no acute changes
- Admitted for abdominal pain, severe hypertriglyceridemia, and hyponatremia



Guillin-Amarelle, C., Sánchez-Iglesias, S., Castro-Pais, A. et al. Type 1 familial partial lipodystrophy: understanding the Köbberling syndrome. *Endocrine* 54, 411–421 (2016). <https://doi.org/10.1007/s12020-016-1002-x>

## Hospital Course

- NPO to clear liquid diet
- Insulin drip with D5
- Sodium bicarbonate drip for lactic acidosis, resolved by day 5
- Nephrology consulted, recommended plasmapheresis with goal of triglycerides <500 and increasing atorvastatin to 80 mg
- GI consulted, recommended omeprazole for GERD
- Total of 5 rounds of plasmapheresis through a central line
- Triglycerides initially improved, but would rebound
- Abdominal pain improved and food tolerated. Insulin stopped on day 6.
- Hypertension developed on day 7. Spironolactone doubled
- Triglycerides stayed <1000 since day 8
- Discharged home after 11 days
- Recurrent HTG-AP requiring plasmapheresis 6 months later

## Discussion

- HTG-AP is known complication of hypertriglyceridemia and familial partial lipodystrophy
- Pancreatic lipoprotein lipase converts excess TG to free fatty acids which are toxic to pancreatic acinar cells
- Plasmapheresis is often used to treat severe HTG-AP, but there are no clear guidelines for its use
- Plasmapheresis drastically lowers TG levels, but its efficacy in improving prognosis is unclear
- American Society of Apheresis Recommendations (2019)
  - 1C for treatment of HTG-AP
  - 2C for prevention of HTG-AP
  - Category III for both treatment and prevention
  - Optimum role of apheresis is not established
  - Decision making should be individualized
- More research is needed to guide recommendations on plasmapheresis for prevention of acute pancreatitis and ASCVD, but initial research suggests there may be benefit
- Other emerging long-term treatments include ApoC-III inhibitors and ANGPTL3 inhibitors

## Conclusions

- There is conflicting evidence regarding reduction of complications and mortality benefits of plasmapheresis in treatment of HTG-AP
- Use of plasmapheresis should be patient specific
- In this case, plasmapheresis was appropriate treatment since the patient had severe hypertriglyceridemia refractory to medical treatment and developed lactic acidosis.
- This patient may potentially be a candidate for regular plasmapheresis for prevention of acute pancreatitis
- Newer medications are also potential treatment options that could reduce HTG-AP incidence and the need for plasmapheresis.
- Further research is required to establish guidelines for using plasmapheresis to treat and prevent HTG-AP

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# Third Degree Heart Block: A Case of Temporary Pacing in a Gravid Patient

Lauren Johnson, MS; Stephen Boateng, DO

Department of Medicine, University of North Dakota School of Medicine and Health Sciences

## Introduction

- The incidence of congenital complete heart block (CHB) is 1 in every 20,000 live births
- Only 30% of congenital CHB is diagnosed in adulthood
- Identification of CHB during pregnancy is rare with few reported cases
- Management of CHB in gravid patients requires a multidisciplinary approach involving cardiology, obstetrics and anesthesiology
- A conservative approach is preferred when treating CHB in gravid patients
- Placement of a temporary or permanent pacemaker may be required for hemodynamic support during gestation and delivery

## Case Presentation

- 28 year old primigravida woman at 35 weeks gestation found to be bradycardic with HR of 49 bpm at prenatal follow up
- Patient reported occasional palpitations with SOB on exertion and was referred to cardiology for further evaluation
- Electrocardiogram (ECG) identified 2:1 AV block with narrow QRS complex
- Echocardiogram identified no structural or wall motion abnormalities
- As patient remained asymptomatic a pacemaker was not indicated
- Zio patch was placed to monitor for advanced heart block in outpatient setting

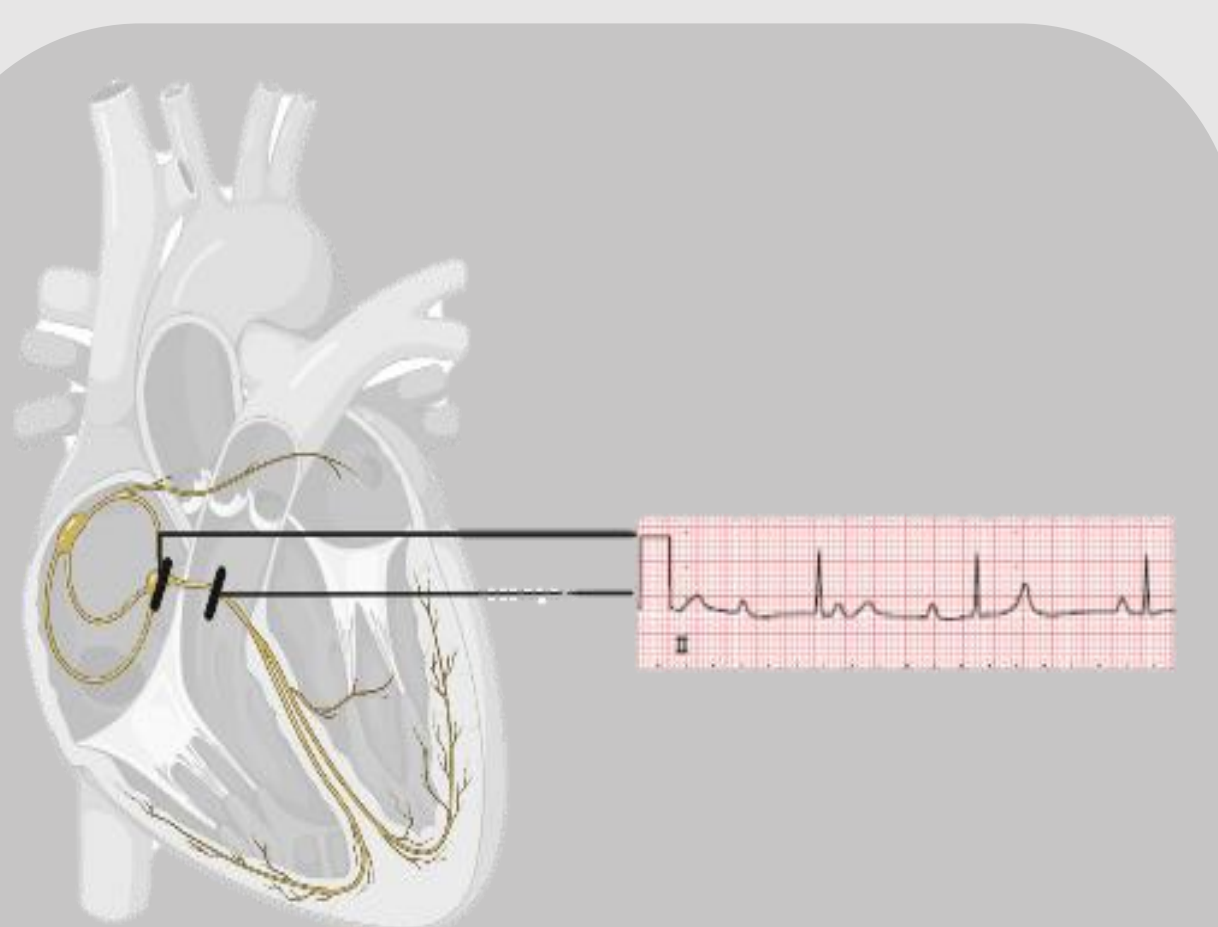
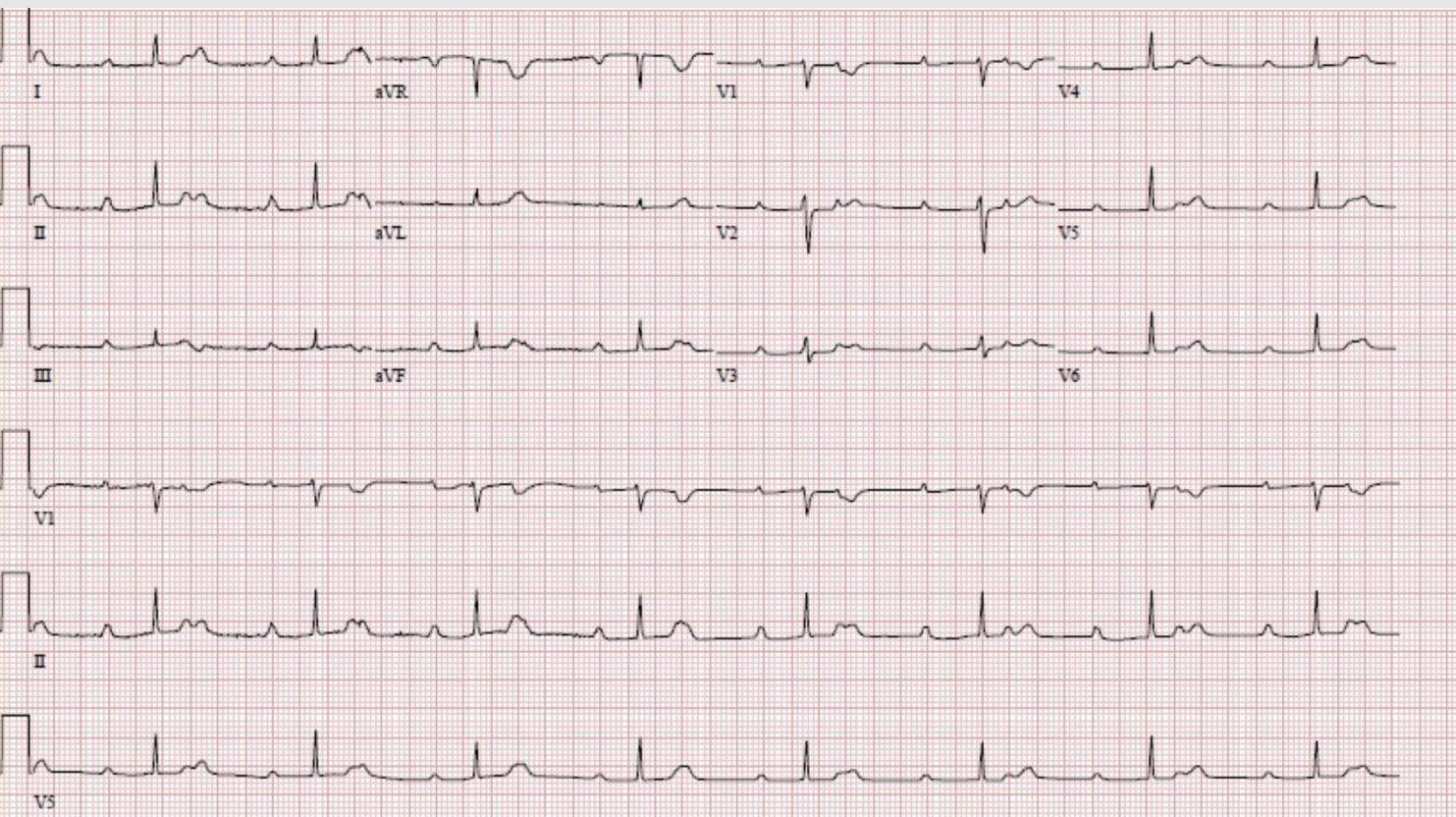
## Clinical Course

- Patient presented to the emergency department later that day for lightheadedness and dyspnea with exertion
- Vitals:** BP 123/59 mmHg, pulse 49 bpm, RR 16 breaths per minute
- Physical Exam:** Bradycardic with normal S1 and S2, no murmur or gallop, and 2+ pitting edema of the lower extremities bilaterally; Lungs clear to auscultation bilaterally
- Fetal Ultrasound:** single live fetus with fetal HR of 140 bpm, regular rhythm
- ECG:** third degree atrioventricular block with borderline prolonged QT interval of 513 ms
- Zio patch:** CHB with HR ranging from 39-65 and narrow QRS complexes
- Pertinent Investigations:** Hgb 11.1, Na 139, K 3.8, Mg 1.6, BUN 9, Cr 0.75, lactic acid 0.5, TSH 1.98, troponin 0.001, BNP 230
  - Evaluation for metabolic derangements, electrolyte disturbances, Lyme disease, COVID-19 and other causes of viral myocarditis were unremarkable
- Imaging:** CXR negative for cardiomegaly, pulmonary infiltrates, effusion or pneumothorax
- Symptoms did not progress and patient remained hemodynamically stable

## Treatment

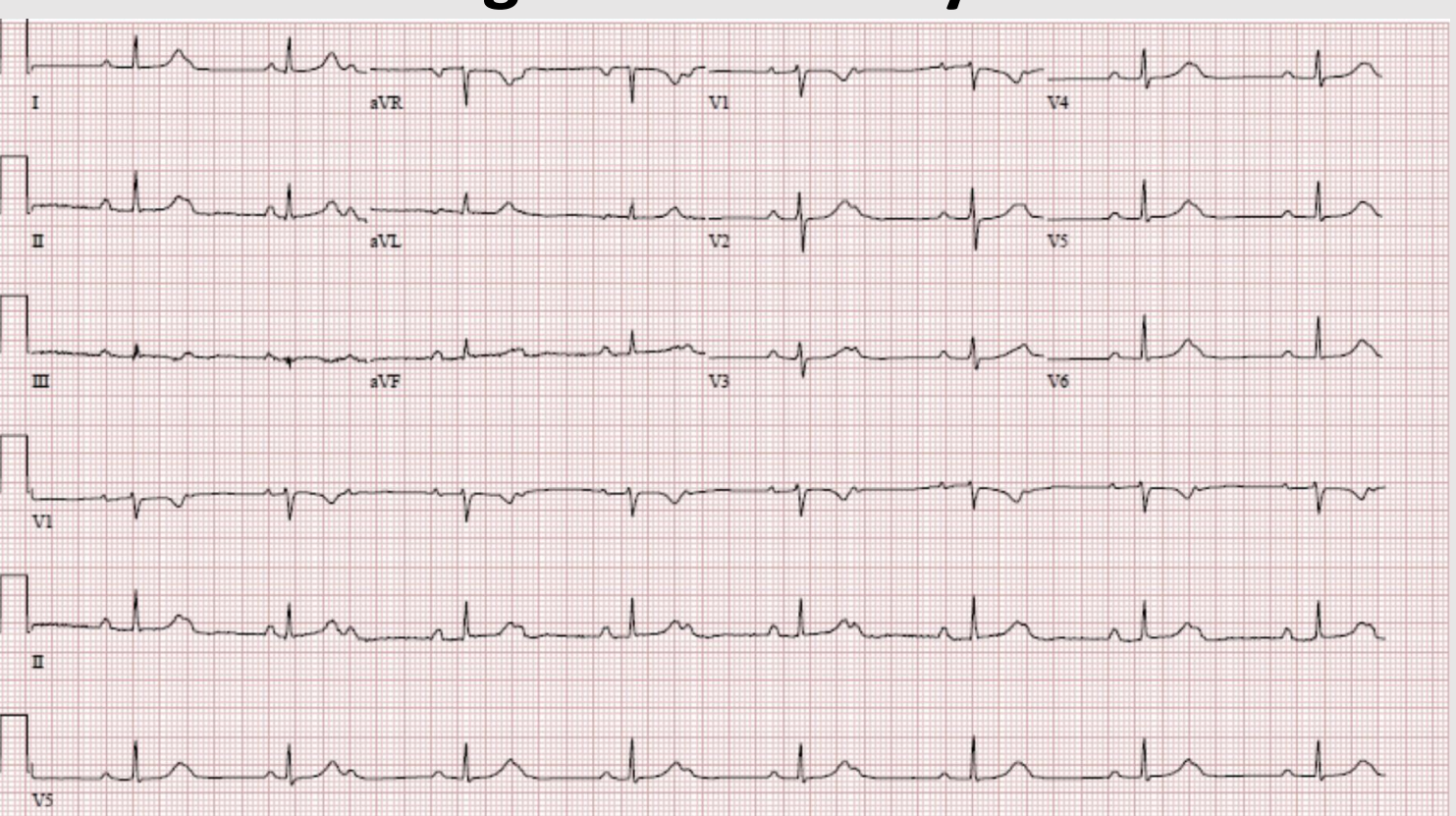
- Patient was monitored on telemetry in the ICU
- A temporary pacemaker was placed via the right internal jugular vein and paced at 80 bpm
- Low transverse cesarean section performed following pacemaker implantation at 36 weeks gestation
- Dyspnea, lightheadedness and lower extremity edema resolved
- Temporary pacing was placed in back up mode and patient spontaneously returned to 2:1 AV block
- Pacemaker was removed 3 days status post cesarean section and patient was placed on 24 hr telemetry for monitoring
- Patient remained asymptomatic with stable bradycardia and did not require permanent pacing
- Patient was discharged with baby 4 days status post cesarean section without complications

ECG at Initial Presentation: 2:1 AV block

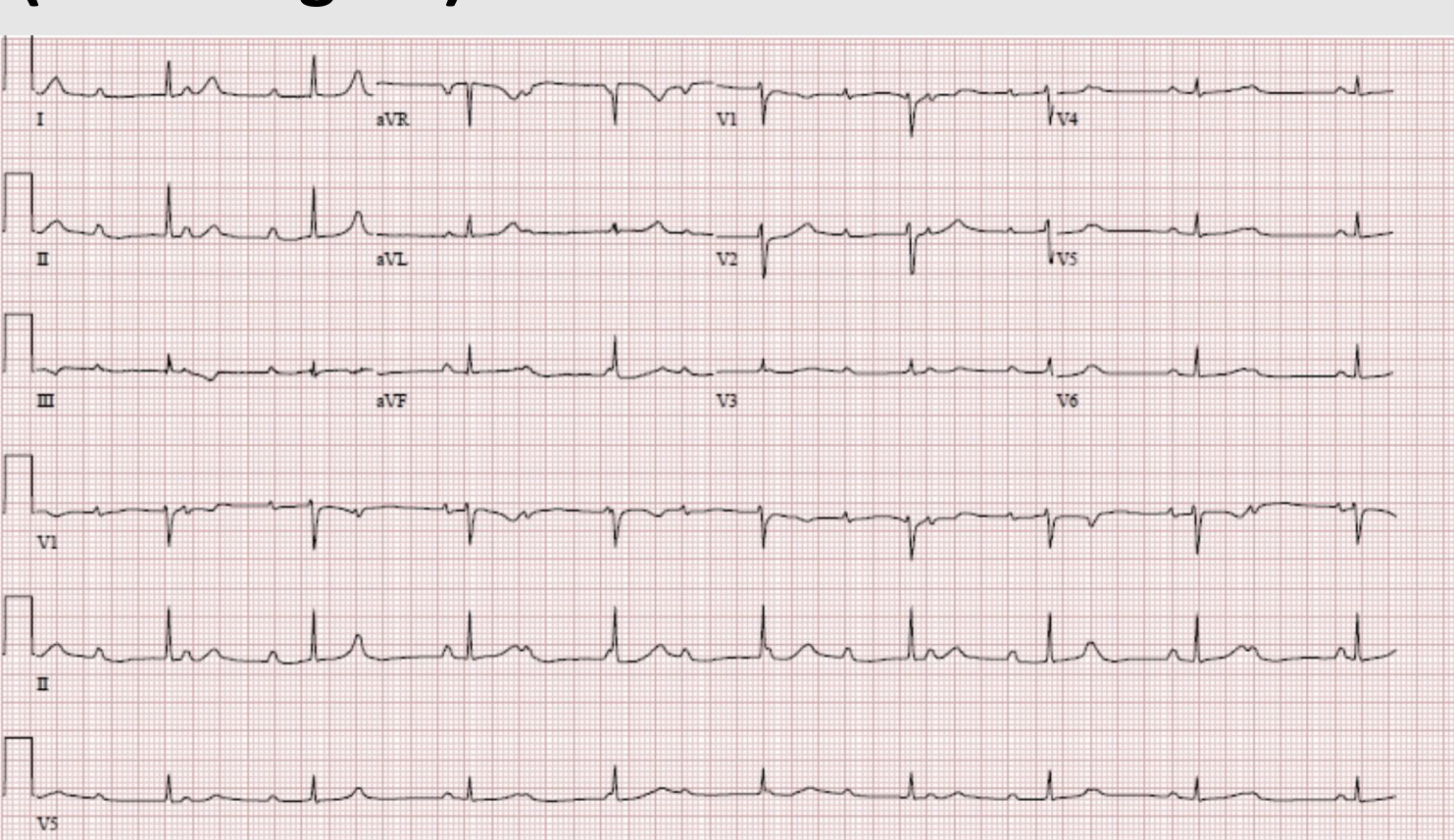


**Narrow Complex AV Block:** A narrow QRS complex portends a better prognosis in the setting of CHB. Conduction abnormalities are present at the level of the AV node or Bundle of His

ECG at Discharge: Sinus bradycardia



ECG on Admission: Complete AV block (third degree)



## Discussion

- Patients with congenital CHB typically require permanent pacing
- Physiologic changes during pregnancy can unmask cardiac conduction abnormalities
- There is no standard treatment for gravid patients with new onset CHB
- Complications during pregnancy are rare but include preterm delivery and intrauterine growth restriction. Complications during labor include symptomatic bradycardia, cardiac arrest and asystole as well as postpartum cardiac arrest and syncope
- Permanent pacemaker implantation is associated with increased risks to mother and baby including radiation exposure, perforation of the right ventricle, infection, bleeding, embolism or pacemaker malfunction
- In our patient, temporary pacing was chosen to support her HR through delivery
- Permanent pacing was avoided due to risk of increased radiation exposure to the fetus, preclusion of future MRIs to further evaluate possible causes of her heart block and because her CHB was likely transitory due to pregnancy and increased vagal tone

## Conclusion

- Management of CHB in gravid patients requires a multidisciplinary approach
- Thorough evaluation for underlying causes of acquired heart block should be conducted in patients with new symptom onset
- Temporary pacing should be considered in symptomatic gravid patients for hemodynamic support during delivery as patients may not require a permanent pacemaker postpartum

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# Double Orifice Mitral Valve: An Isolated Anomaly

**Lauren Johnson, MS; Stephen Boateng, DO**  
**University of North Dakota School of Medicine and Health Sciences**  
**Department of Medicine**



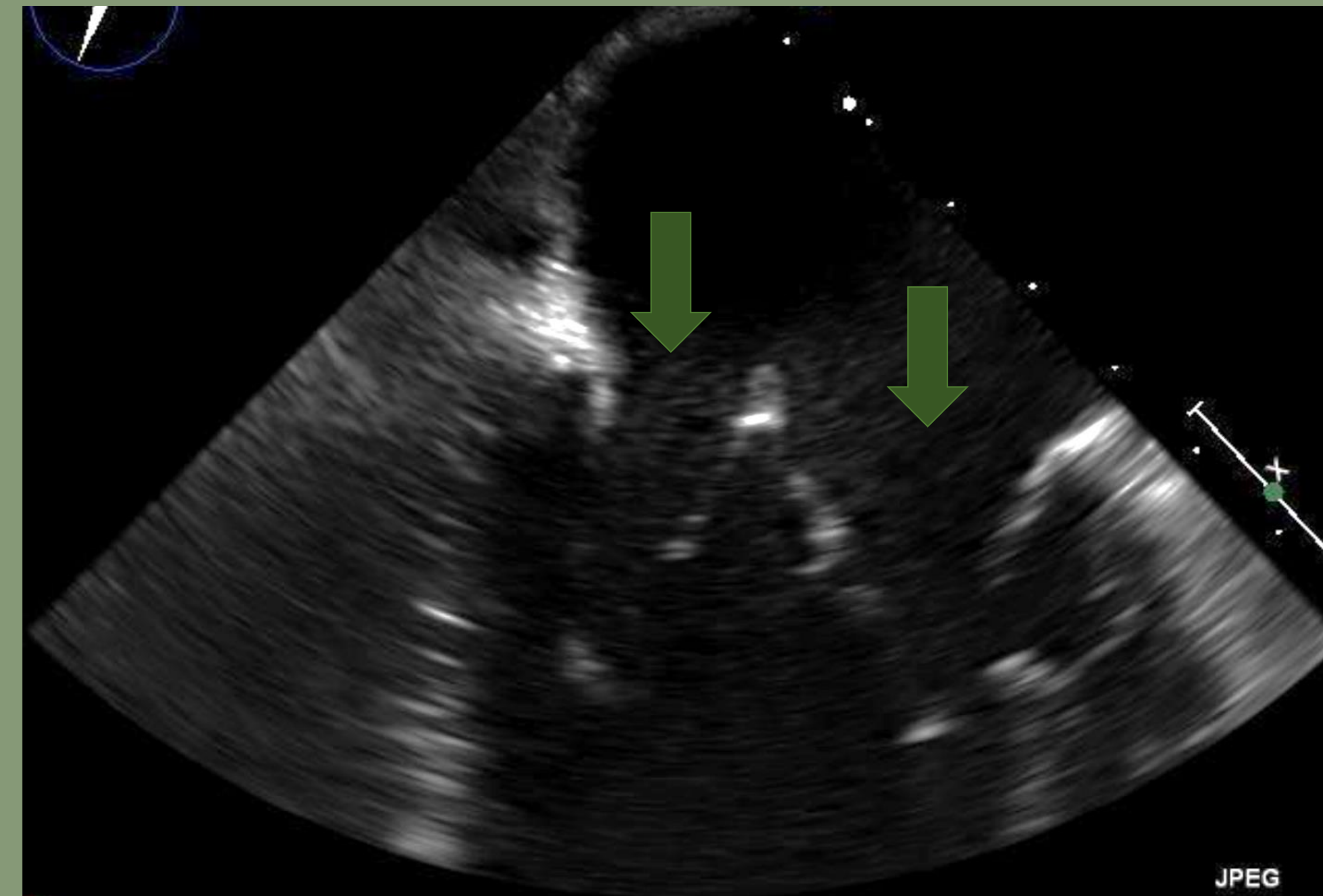
## Introduction

- DOMV is a rare congenital anomaly characterized by a fibrous tissue bridge dividing the mitral valve into 2 distinct orifices
- DOMV is identified in childhood with an incidence rate of 0.04% and is identified in adults with an incidence rate of 0.01%
- Only 15% of DOMV anomalies form a complete bridge with balanced orifices
- 48% of valves function normally but regurgitation or stenosis may be present with equal frequency
- DOMV is commonly associated with additional congenital defects and is rarely an isolated abnormality
- DOMV is identified with 2D TTE but can be detected using TEE

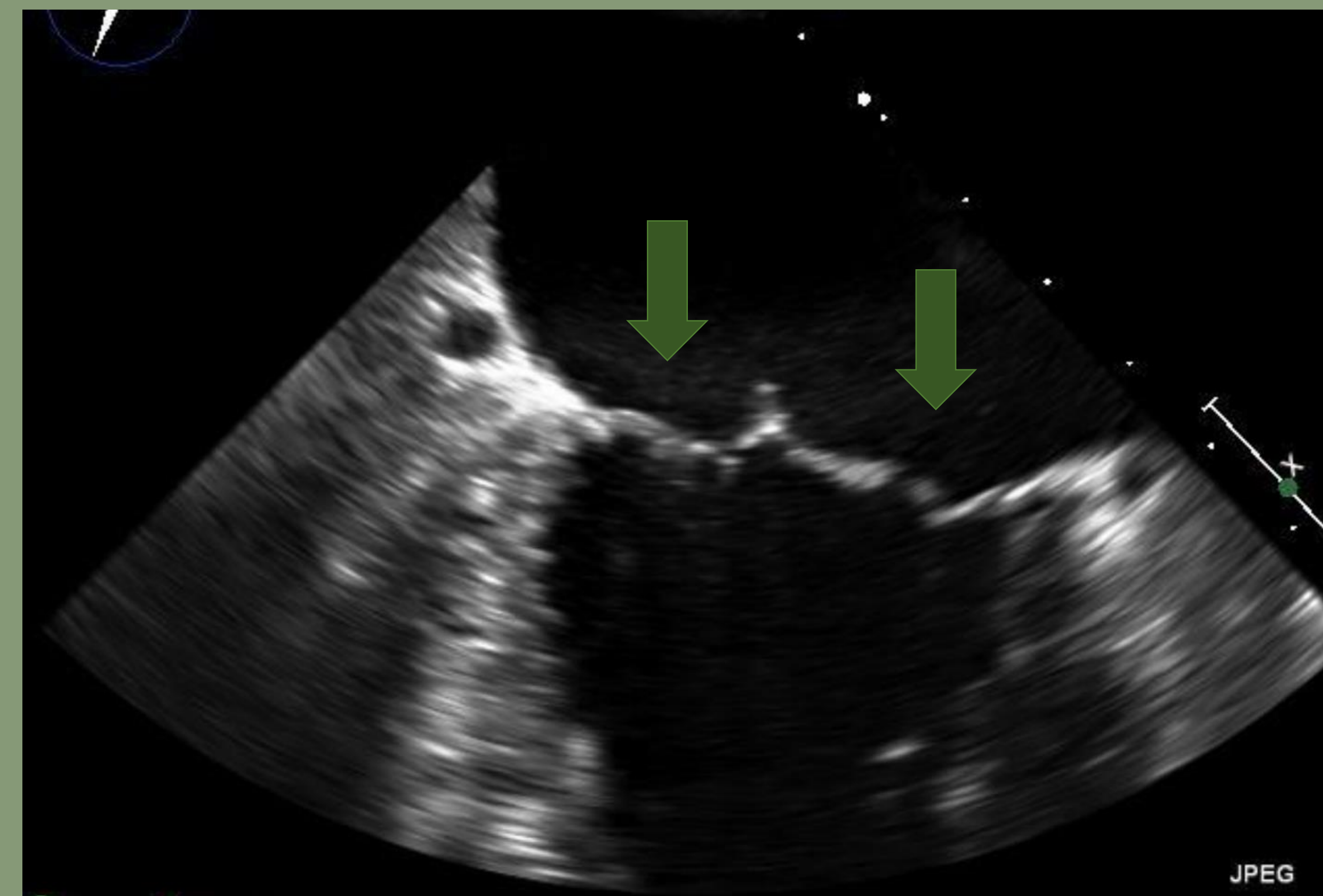
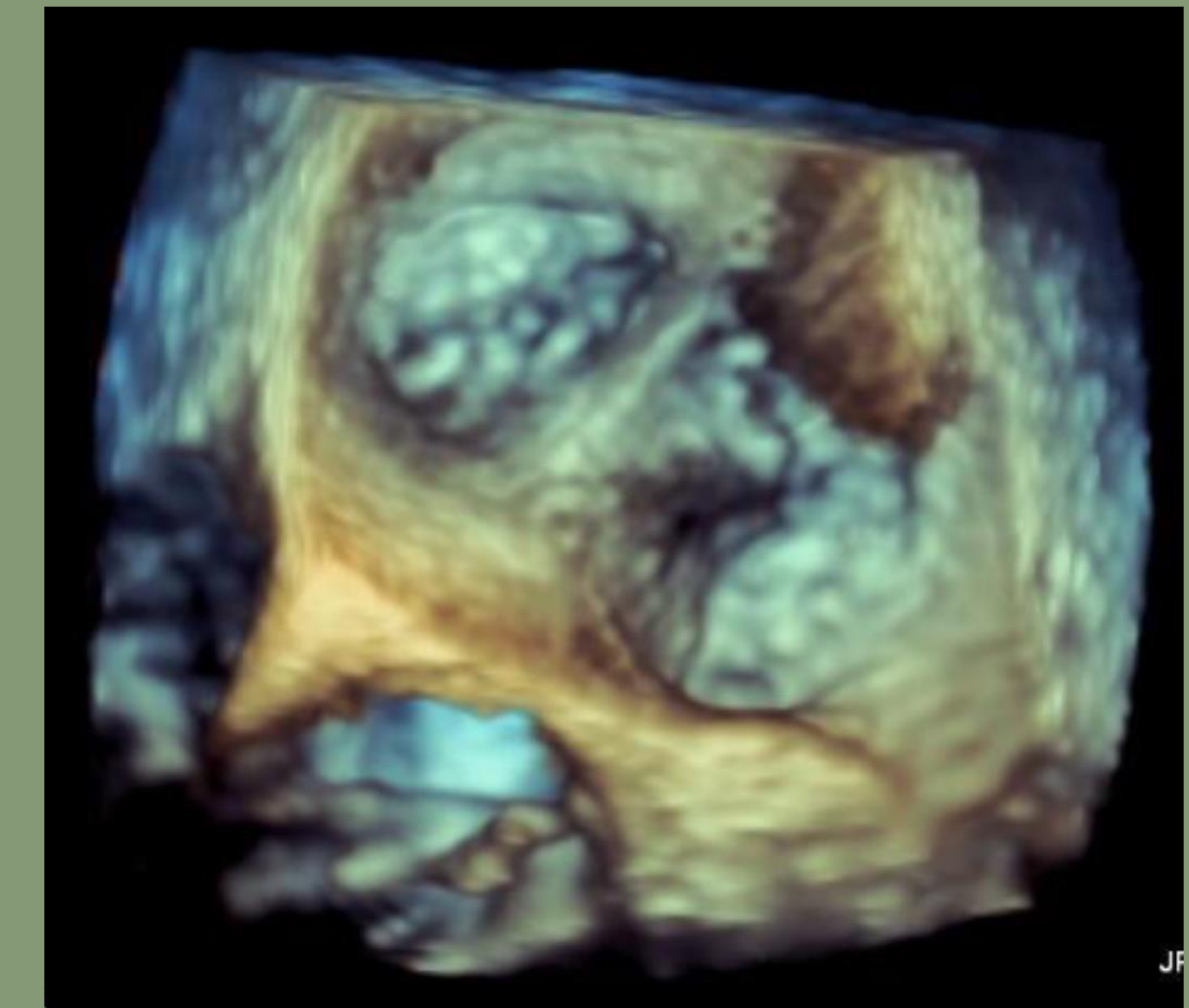
## Case Presentation

- 38 year old woman presenting for evaluation of new onset heart murmur
- Reports dyspnea with exertion and occasional palpitations over 1 year
- **ROS:** SOB, snoring, palpitations, leg swelling, headaches, easy bruising and decreased concentration. No chest pain, presyncope or syncope.
- **Vitals:** BP 122/74, Pulse 76, RR 20, Weight 148.8kg (328lbs)
- **Physical Exam:** Harsh midsystolic grade 2/6 murmur heard best at the upper right sternal border radiating to the neck; Bilateral lower extremity 1+ pitting edema; Moderate abdominal distention; Lungs clear to auscultation bilaterally
- **Pertinent Investigations:** Na 143, K 4.1, Ca 9.2, BUN 19, Cr 0.70
- **ECG:** NSR
- **TTE:** Limited by body habitus. No evidence of cardiac structural abnormalities. LVEF 60-70%.
- Although TTE was unremarkable, physical exam findings indicated need for further workup
- **TEE:** Isolated DOMV with complete bridge, mild valvular stenosis and trace regurgitation.
- Regular cardiac monitoring and lifestyle changes were suggested for management given preservation of mitral valve function

### 2D TEE: Double Orifice Mitral Valve



### 3D TEE: Double Orifice Mitral Valve



## Discussion

- Recognition of DOMV is critical to monitor for progression of valvular disease and to address symptom management
- Patient history and physical exam findings should help guide cardiac evaluation
- TTE is used to detect congenital anomalies including DOMV in most patients but was found to be unreliable in an obese patient
- Further evaluation with TEE was indicated in this case

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# Pneumocystis jirovecii Pneumonia After COVID-19 in an Immunocompetent Host

Stacy Ploom<sup>1</sup> Dr. Laura Nichols, MD<sup>1,2</sup>  
University of North Dakota School of Medicine and Health Sciences<sup>1</sup>, Sanford Health<sup>2</sup>

## Introduction

### Severe COVID-19: <sup>1,2,3</sup>

- Hyperinflammation & cytokine storm syndrome
  - ARDS, multisystem organ failure, death
- Treatment w/ systemic corticosteroids reduces mortality
- Increased reports of fungal infections

### Pneumocystis jirovecii Pneumonia (PJP): <sup>3,4,5</sup>

- 67% of infections occur in patients w/ pre-existing immunosuppression; HIV & long-standing corticosteroid therapy
- Other risk factors: structural lung disease, diabetes, heart disease
- Typical features:**
  - Diffuse, bilateral lung infiltrates, thin-walled cysts, & spontaneous pneumothoraxes w/ upper lobe predilection
  - Lymphopenia
  - Elevated LDH & beta-D-glucan levels

We present an atypical case of an 88-year-old immunocompetent female diagnosed w/ PJP following severe COVID-19

## Case Report

### Patient information:

- 88-year-old female, nursing home resident, not a recipient of COVID-19 vaccines
- Comorbidities: HTN, CAD, GERD, hypothyroidism, chronically elevated ALP, malignant breast neoplasm s/p lumpectomy

### Hospitalization I (07/17-07/20)

- ARDS secondary to COVID-19
- O2 therapy, 200 mg remdesivir, 6 mg dexamethasone for 10 days
- Discharged on home O2
- ALC: 800 cells/ $\mu$ L

### Hospitalization II (07/25-07/27)

- Asymptomatic HTN, NSTEMI w/ elevated TN, decompensated combined CHF
- Diuresed & treated w/ hydralazine & labetalol PRN
- Completed COVID-19 isolation, no home O2 requirements
- ALC: 1,200 cells/ $\mu$ L

### Hospitalization III (08/12-08/23)

- Multifocal pneumonia & acute respiratory failure w/ hypoxia & hypercapnia
- ALC: 5,200 cells/ $\mu$ L

### Emergency Department:

- Presented from nursing facility
  - Hypoxic w/SPO2 65% on RA, failure to improve w/ O2
- Drowsy, increased work of breathing, bilateral rhonchi & rales, no JVD or lower extremity edema, dry mucous membranes/skin

Vitals:				
BP	HR	RR	Temperature	SPO2
151/89 mm Hg	Regular 118/min	35/min	36.5 C	95% BiPAP 5L/min

### Laboratory Tests:

#### CBC

- Mild leukocytosis (13.3 K/ $\mu$ L) w/ lymphocytosis (5.2 K/ $\mu$ L)

#### Procalcitonin

- 2.1 ng/mL

#### Inflammatory Markers

- ESR 117 mm/hr
- CRP 101.4 mg/L

#### CMP

- Normal renal function (BUN 20 mg/dL, Cr 0.55 mg/dL)
- Chronically elevated ALP (1070 U/L)

#### VBG

- pH 7.30
- pCO2 62 mm Hg
- pO2 38 mm Hg
- O2 60%
- HCO3 31
- Base excess 2

### Imaging Studies:

- CXR (**figure-1**) and CTA (**figure-2**)



**Figure 1:** Extensive bilateral infiltrates & mild, bilateral pleural effusions



**Figure 2:** Bilateral, diffuse, multifocal infiltrates in upper lobes

- Pneumonia workup & empiric cefepime, vancomycin, doxycycline initiated

### Intensive Care Unit:

- Day 1: IV fluids, SPO2 stable on 4L/min O2 NC
- Day 2: worsening O2 requirements, 8L/min to maintain SPO2 > 90%
  - Repeat CXR (**figure 3**)
  - MRSA swab negative & vancomycin discontinued
  - Diuresed w/ Lasix 20 mg IV BID & empiric atovaquone 750 mg BID
  - Fungitell, LDH, PCR of sputum for *P. jirovecii*
- Day 3: oxygen requirements decreased
  - LDH: 288 U/L
  - Beta-D-Glucan: 85 pg/mL
  - Negative antigen tests for Blastomyces & Histoplasma
- Day 4: new onset a-fib w/ RVR of 130 to 170 BPM
  - Lasix discontinued; IV digoxin & amiodarone drip started
  - Echo: LV EF of 40%



**Figure 3:** Extensive bilateral infiltrates & moderate pleural effusions



**Figure 4:** Significant improvement in infiltrates

- Day 6:
  - Sputum culture: normal flora & no evidence of Cryptococcus
  - P. jirovecii* PCR positive
  - Atovaquone 21 days & prednisone 40 mg 5 days followed by 20 mg 11 days
- Day 7:
  - Repeat CXR (**figure 4**)
- Discharge:
  - Hemodynamically stable, rate-controlled w/ antiarrhythmics, SPO2 98% 2L/min NC, started on Eliquis
  - Antibiotic course completed & PJP treatment continued in outpatient setting

## Discussion

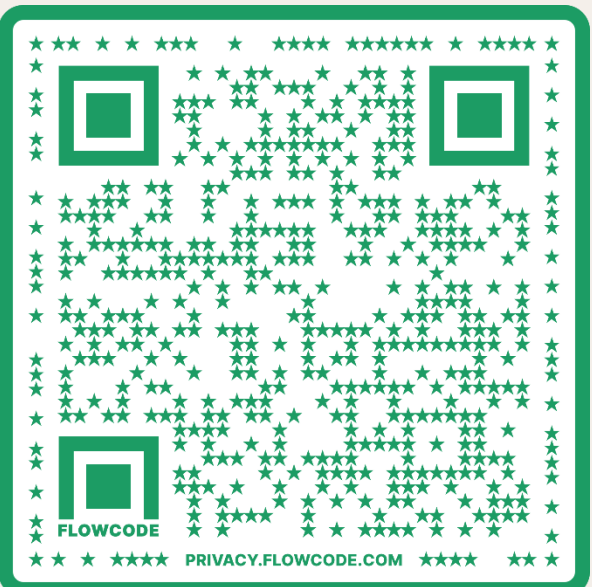
### Atypical case of PJP:

- Typical case: ALC < 800 cells/ $\mu$ L & CD4 T-cells <200 cells/ $\mu$ L<sup>5</sup>
- Our patients ALCs WNL, w/ lowest value of 800 cells/ $\mu$ L during admission of first hospitalization
- Potential risk factors for PJP in our patient:**
  - SARS-CoV-2 induced immunoparalysis in severe COVID-19 <sup>6,7</sup>
    - Profound depletion and dysfunction of CD4+ lymphocytes and NK cells
  - Treatment w/ glucocorticoids cause further immune suppression & promotion of opportunistic infection<sup>6</sup>
  - Age related immune dysfunction & reduced T-cell diversity impair ability to mount response <sup>8,9</sup>

## Conclusion

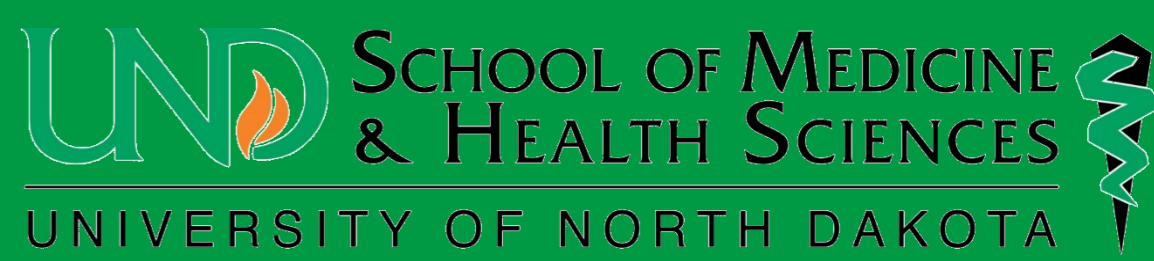
- Immunocompetent patients may develop PJP following treatment for severe COVID-19, despite typical risk factors
- In patients w/ suggestive clinical, radiological, & laboratory features, perform analysis w/ microbiological methods
- Recognition of PJP is crucial to prevent respiratory failure & complications

## References



# Retinal Vasculitis in a newly diagnosed SLE patient

Megan DeVillers, B.S. and Dr. Laura Nichols, M.D.



## Background

- Systemic lupus erythematosus (SLE) is a multisystem disorder that has an unknown cause. Patients affected are typically female of child-bearing age of African American or Caucasian descent<sup>7</sup>. Typically, the diagnosis is made through a combination of signs, symptoms, and laboratory values with sometimes additional imaging or biopsy.
- Antinuclear antibodies (ANA) are the first test completed, with a positive result having very minimal specificity. ssDNA and dsDNA, Anti-Ro, Anti-La, and Anti-Smith, along with low complements C3 and C4 are also often tested when diagnosing SLE. Anti-Smith antibodies are only seen in approximately 30% of SLE patients, however, have the highest specificity of 99% for SLE<sup>4</sup>.
- Patients with SLE are at a significantly higher risk of having retinal vasculitis than those in the general population<sup>2</sup>. This condition occurs in approximately 3% of SLE patients. Retinal vasculitis can result in hemorrhage or thrombotic occlusion of large retinal vessels with subsequent irreversible vision loss if not readily identified and treated<sup>8</sup>.
- Fundal abnormalities are most frequently seen in patients with an active flare of SLE that are examined by a retinal specialist<sup>3</sup>. However, this instance is rare as symptoms are often described vaguely, and patients are not always referred to a specialist<sup>6</sup>.

Table 1

Anti-dsDNA		Anti-Smith	SCL 70	Anti-Jo	ANA
30.3		>8.0	<.2	<.2	3.2
C3	C4	CCP	SSA/Anti-Ro		SS-B/La
28	5.3	4.0	2.8		<.2

Table 1 displays the laboratory values for the SLE patient.

## Case Discussion

- In this case, we present a 37-year-old female with retinal vasculitis in the setting of systemic lupus erythematosus. For the past several months, the patient had been undergoing a workup for autoimmune disorders due to fatigue, unintended 10-lb weight loss, sun-dependent rash, and diffuse joint pains. She was formally diagnosed with SLE after confirmatory labs which can be seen in *Table 1*.
- The patient presented to her optometrist with a chief complaint of 2-3 weeks of “a haze over her eyes, intermittent flashes in her vision, and bilateral eye soreness”.
- She was then seen by a retinal specialist who described florid evidence of retinal vasculitis on exam with bilateral cotton wool spots, bilateral retinal hemorrhages, and vascular sheathing on the right. Examples of cotton wool spots and retinal hemorrhage can be seen in *Images 1 and 2*, respectively.
- The patient was immediately sent to the emergency room for further evaluation and treatment. On exam in the ED, the patient had stable vitals, pigmented crusting lesions on her nose, cheeks, right upper arm and right leg. She had intact extraocular movements without conjunctival infection or scleral icterus.
- Laboratory results reveal leukopenia, mildly elevated ESR, microscopic hematuria, proteinuria of 30mg/dl, and normocytic anemia. She was tested for other sources of vasculitis using the Myeloperoxidase and Proteinase 3 antibodies, but those both returned negative.
- The patient was admitted to the floor for further treatment, which included 500 mg solumedrol daily and hydroxychloroquine 200mg twice daily. The patient’s symptoms significantly improved over three days and she was discharged home with follow up scheduled with rheumatology for further management.



Image 1 displays an example of cotton wool spots.

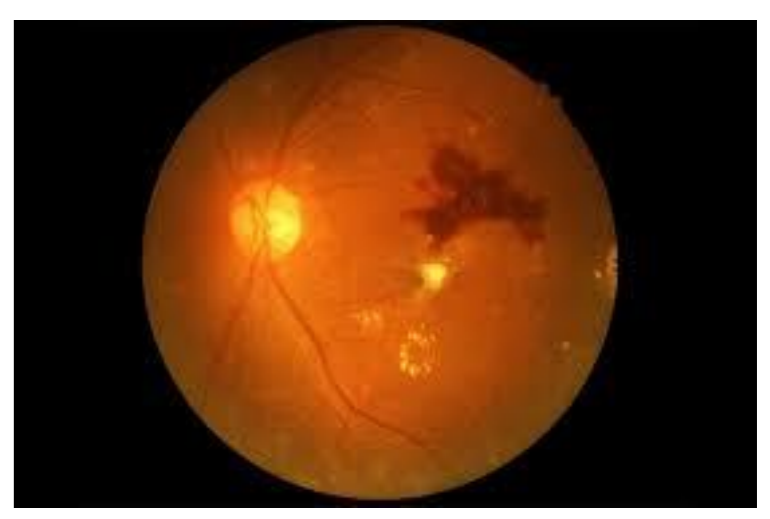


Image 2 shows an example of retinal hemorrhage.

## Discussion

- This case describe the onset of retinal vasculitis in a patient with SLE and the importance of a thorough ophthalmologic exam.
- Although retinal vasculitis is not a common presentation in SLE patients, it is one that should be accurately identified by both physicians evaluating for underlying SLE as well as ocular specialists.
- Recognizing the signs and symptoms of retinal vasculitis is vital for preventing further progression of the disease to irreversible vision loss or deficit.

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# Recurrent Pericarditis with Pericardial and Pleural Effusions in the Setting of Glutamic Acid Decarboxylase (GAD65) Associated Cerebellar Ataxia

Ellen Erie MS3; Covey Wong MS3; and Rajendra Potluri, MD

University of North Dakota School of Medicine and Health Sciences and Sanford Health-Fargo

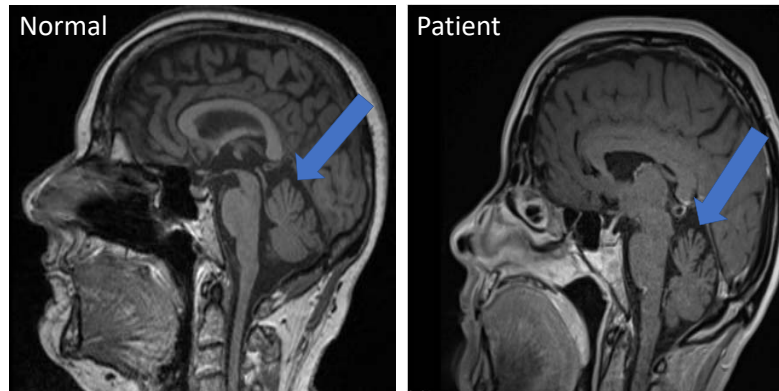
SANFORD  
HEALTH

## Case Description

40-year-old female with generalized seizure disorder and two recent occurrences of pericarditis, one requiring hospitalization and pericardiocentesis due to impending cardiac tamponade, presented to the emergency department (ED) with shortness of breath, fever, cough, and new-onset gait instability in late July 2022. Her first event of pericarditis occurred late May 2022 and was managed with a 6-week prednisone taper. The second event occurred in early July 2022 and was managed with high-dose ibuprofen and colchicine.

Initial evaluation in the ED included an unremarkable physical exam. Inflammatory markers were grossly elevated and CT chest showed bilateral pleural effusions and pericardial effusion without evidence of tamponade. MRI brain showed mild cerebellar vermian atrophy (Figure 1). Cardiology, rheumatology, and neurology were consulted. An echocardiogram was unchanged from previous studies. Lumbar puncture showed normal WBC and protein levels. Further workup was suggestive of a probable autoimmune process with some results still pending (Table 1). She was discharged on high dose prednisone because NSAID and colchicine therapy resulted in a short time recurrence when previously used. She was also discharged on Bactrim for PCP prophylaxis, Omeprazole for GI prophylaxis, and Vitamin D for bone support.

After discharge, autoimmune encephalopathy panel came back positive for GAD65 autoantibodies. Neurology was consulted and recommended continuation of high dose prednisone and IVIG for probable autoimmune ataxia. She is currently responding well to therapy and has had no subsequent episodes of pericarditis.



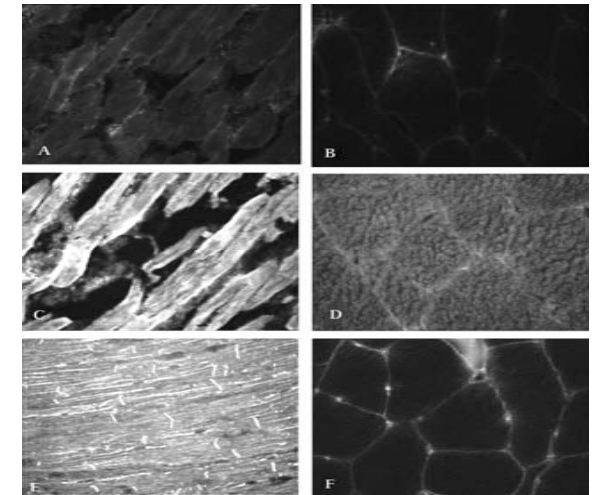
**Figure 1: Normal Sagittal Brain MRI vs. Patient MRI Showing Cerebellar Vermis Atrophy**

Source: <https://learningneurology.com/diagnostic-tests/approach-to-mri-brain/>

## Discussion

It has been well documented that GAD autoantibodies cause neurologic complications such as refractory epilepsy and myoclonus. GAD antibody associated ataxia is a rare sporadic form of cerebellar ataxia that typically onsets between ages 20 and 70 [1,2], mostly in the female population, many which also have concomitant autoimmune diseases such as thyroiditis, pernicious anemia, and type 1 diabetes mellitus [2,3]. The onset can either be subacute or slowly progressive and imaging studies and labs may not always be diagnostic. MRI can be normal or show pure cerebellar atrophy and CSF fluid sampling can be normal however two-thirds of patients show oligoclonal bands. Standard of diagnosis is made by measuring serum anti-GAD antibodies.

Recurrent pericarditis has been linked to the innate immune system overactivation via the production of IL-1. Pericardial disease also occurs in systemic inflammatory disorders including vasculitis and connective tissue disease [4]. Additionally, the anti-heart (AHA) and anti-intercalated disk (AIDA) autoantibodies have been strongly linked to autoimmune recurrent pericarditis. Positive AIDA status has been associated with a high number of relapses, hospitalizations and refractory symptoms and higher AHA titers have been associated with longer symptom duration as well as high number of recurrences. AHA and AIDA can both be stained for and seen on immunofluorescence (Figure 2); however, it still needs to be seen whether these markers will be of clinical use [5].



**Figure 2: AHA immunofluorescence patterns.** Normal human atrium (left panels) and skeletal muscle (right panels) stained with AHA-negative serum from a normal subject (A,B). No myocyte or muscle staining is present. Serum from a patient with idiopathic recurrent acute pericarditis (IRAP), containing cross-reactive (partially organ-specific) AHA. A fine striational fluorescence is visible on atrial tissue; skeletal muscle is weakly positive (C,D). Serum from a patient with IRAP, containing both organ-specific AHA and anti-intercalated-disk autoantibodies (AIDA). Organ-specific AHA give a diffuse cytoplasmic indirect immunofluorescence technique staining on atrial myocytes, AIDA produce a linear staining of the intercalated disks between cardiac myocytes; skeletal muscle is negative (E,F).

## Conclusion

- GAD autoantibodies are a known cause of neurological complications.
- Recurrent pericarditis due to autoimmune dysfunction has been linked to other systemic inflammatory disorders as well as AHA and AIDA antibodies.
- Further research is warranted to explore potential associations between GAD antibodies and recurrent autoimmune pericarditis.

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**Table 1: Patient's Autoimmune Work-up Results**

Autoimmune Testing	Patient's Results
GAD-65 Autoantibodies	278 (H)
ANA	positive
Myeloperoxidase	Positive
Anti dsDNA	38.8 (H)
C3 Complement	67 (L)
C4 Complement	8.1 (L)
Rheumatoid Factor	35 (H)
CCP Antibodies	30 (H)

# Non-infectious post-operative fever in the setting of adult-onset Still's disease flare

Ellen Erie B.S.; Dinesh Bande, MD; and Riley Clark, MD

University of North Dakota School of Medicine and Health Sciences and Sanford Health-Fargo

SANFORD  
HEALTH

## Case Description

A 74-year-old male with a known history of polyarticular juvenile rheumatoid arthritis and adult-onset Still's disease (AOSD) presented to the emergency department with fever and chills 48 hours after undergoing lumbar laminectomy for spinal stenosis. The patient also endorsed worsening left lower extremity pain, new onset left upper extremity pain, and a sore throat. Initial evaluation revealed serosanguineous drainage from the surgical incision site, tachycardia, and temperature of 39.4 C. Urinalysis, chest x-ray, and blood cultures were negative. MRI of the lumbar spine showed typical post-surgical changes. CT abdomen/pelvis was negative for any infectious or non-infectious source of fever but did show hepatomegaly. He was started on vancomycin, cefepime, and metronidazole.

A flare of AOSD was suspected due to the patient's left shoulder pain, left hip pain, and then subsequently right hip pain in the setting of his abnormal laboratory findings (Table 1) fulfilling Yamaguchi's Criteria for AOSD (Table 2). He had not experienced a flare of AOSD or received any active treatment for approximately 14 years prior to this episode. An extensive work-up was completed, including serum electrophoresis, to rule out other causes of his symptoms. He started celecoxib 200 mg twice a day on hospital day 3. Over the next several days his fever, anemia, thrombocytopenia, LFTs, and CRP significantly improved. On hospital day 8 the patient was fluid overloaded with small bilateral effusions and started furosemide. He was also transitioned to dexamethasone 4 mg three times per day at this time. At discharge, the patient's pain and edema were significantly improved. He was discharged home on a long-term dexamethasone taper, doxycycline, and metronidazole. He was seen by rheumatology three days after discharge and reported that he was still symptom free.

Laboratory Result	Present in Patient?
Elevated Erythrocyte Sedimentation Rate (ESR)	Yes
Elevated C-Reactive Protein (CRP)	Yes
Leukocytosis (> 10,000)	No
Thrombocytopenia	Yes
Elevated Ferritin	Yes
Anemia (hemoglobin < 10 g/dL)	Yes
Elevated liver function tests	Yes
Negative rheumatoid factor (RF)	Yes
Negative anti-nuclear antibody (ANA)	Yes

Table 1: Laboratory anomalies associated with AOSD

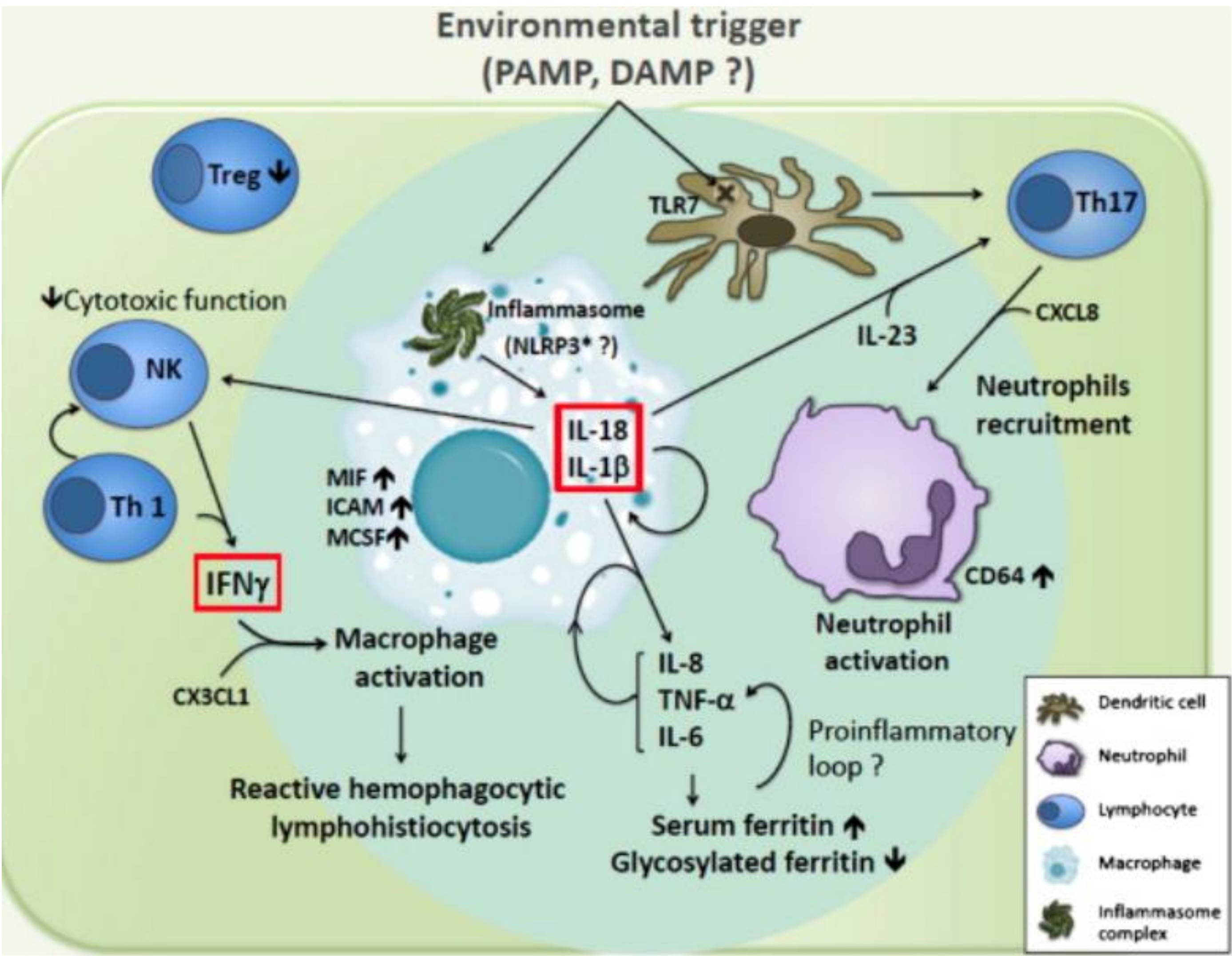


Figure 1: Proposed pathogenesis for AOSD<sup>2</sup>

## Discussion

Adult-onset Still's Disease (AOSD) is an uncommon systemic inflammatory disorder with unknown etiology. Both infectious triggers and genetic factors may be implicated but no causal relationship has been determined.<sup>1</sup> However, overstimulation of the innate immune system and interplay between proinflammatory cytokines, most notably IL-18, leading to a cytokine storm is key to pathogenesis (Figure 1).<sup>2</sup> AOSD is recognized clinically by the triad of daily fevers, arthritis, and evanescent rash. Most patients have added symptoms including pharyngitis, lymphadenopathy, splenomegaly, hepatomegaly, pericarditis, pleural effusions, and hepatitis. Fatal complications like disseminated intravascular coagulopathy and macrophage activation syndrome may occur.<sup>3</sup> While diagnosing AOSD is challenging due to the non-specific symptoms and absence of serological markers, various laboratory anomalies (Table 1) as well as the Yamaguchi criteria (Table 2) are useful in diagnosing the initial presentation and flares of AOSD.

Nearly 1/3 of patients with AOSD are categorized into the "intermittent pattern" which is defined by one or more disease flares with complete remissions between episodes.<sup>3</sup> Corticosteroids are considered first-line for AOSD flares as most patients respond to treatment within several days.<sup>3</sup> Both vaccinations and various infections have been associated with AOSD flares via over-activation of the innate immune response resulting in overproduction of proinflammatory cytokines and subsequent flares of rheumatologic conditions, including ASOD.<sup>4</sup> While it is well-established that the post-operative period is characterized by massive production of pro-inflammatory cytokines<sup>5</sup>, no association has yet been made between AOSD flares and recent surgery to our knowledge. Thus, ASOD flare is an important diagnosis to consider in cases of non-infectious post-operative fever with an unknown etiology.

Presence of 5 or more criteria, of which at least 2 are major (96% sensitivity 92% specificity) diagnoses Still's Disease

Major	Temperature > 39 C for > 1 week Leukocytosis > 10,000 mm <sup>3</sup> with >80% neutrophils Typical rash Arthralgias for > 2 weeks
Minor	Pharyngitis or sore throat Lymphadenopathy Splenomegaly Liver dysfunction Negative ANA or RF
Exclusion Criteria	Infection, malignancy, other inflammatory disease

Table 2: Yamaguchi's Criteria for AOSD

## Conclusion

- Infections and vaccinations are associated with adult-onset Still's Disease (AOSD) flares via overproduction of proinflammatory cytokines.
- While the post-operative period is characterized by massive production of proinflammatory cytokines, no association has been made between AOSD flares and recent surgery.
- Recognition of AOSD flares is crucial as administering corticosteroids prevents fatal complications and rapidly improves symptoms.

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# Hydralazine-Induced Vasculitis: A Rare Etiology of Diffuse Alveolar Hemorrhage

Covey Wong MS3; Hallie Thompson, MD, PGY-2 ; Anil Sriramoju, MD PGY-1; and Mohamed Toumeh, MD

University of North Dakota School of Medicine and Health Sciences and Sanford Health-Fargo



## Introduction

Hydralazine is well-associated with drug-induced lupus as a serious yet common side effect. However, it can rarely cause hydralazine-induced ANCA vasculitis that most commonly targets the kidneys. This case report demonstrates a case of pulmonary-renal syndrome with diffuse alveolar hemorrhage secondary to hydralazine use.

## Case Description

The patient is a 64-year-old male with a history of frontal lobe glioblastoma status post resection, and adjuvant chemotherapy and radiation who initially presented to an outside facility with complaints of cough and hemoptysis. Chest X-ray revealed opacities and small bilateral pleural effusions. Due to concern for a potential atypical infectious process, he was started on ceftriaxone and azithromycin and transferred to a higher level of care.

Upon admission, the patient’s hemoglobin was 7.9 g/dL, creatinine was 2.45 mg/dL, and he had ongoing shortness of breath. He was transfused with 1 unit of packed red blood cells, given intravenous furosemide, and started on supplemental oxygen. Due to abnormal fibrinogen and thromboelastography, 1 unit of fresh frozen plasma was also given. Pulmonology and nephrology were consulted, and bronchoscopy and bronchoalveolar lavage were performed which revealed diffuse alveolar hemorrhage. Results from an autoimmune panel (MPO, PR-3 antibodies, ANA, anti-double-stranded antibodies) supported the diagnosis of pulmonary renal syndrome, most likely due to hydralazine-induced vasculitis.

Hydralazine was discontinued, and the patient was started on high dose intravenous corticosteroids. On hospital day 5, the patient’s creatinine and shortness of breath improved, and his hemoptysis resolved. Amlodipine was started for blood pressure optimization. After a thorough discussion with nephrology and oncology, the patient was discharged on a prednisone tapering dose.

Laboratory Values on Admission		Reference Range			Reference Range
Hemoglobin	7.9 g/dL	13.5-17.5 g/dL	ANA	Positive	Negative
Creatinine	2.45 mg/dL	0.73-1.18 mg/dL	ANCA	Positive	Negative
eGFR	27	>60	Anti-dsDNA	384 IU	0-29.9 IU
MPO	>8		PR-3	7.3	

Figure 1: Patient's pertinent laboratory findings

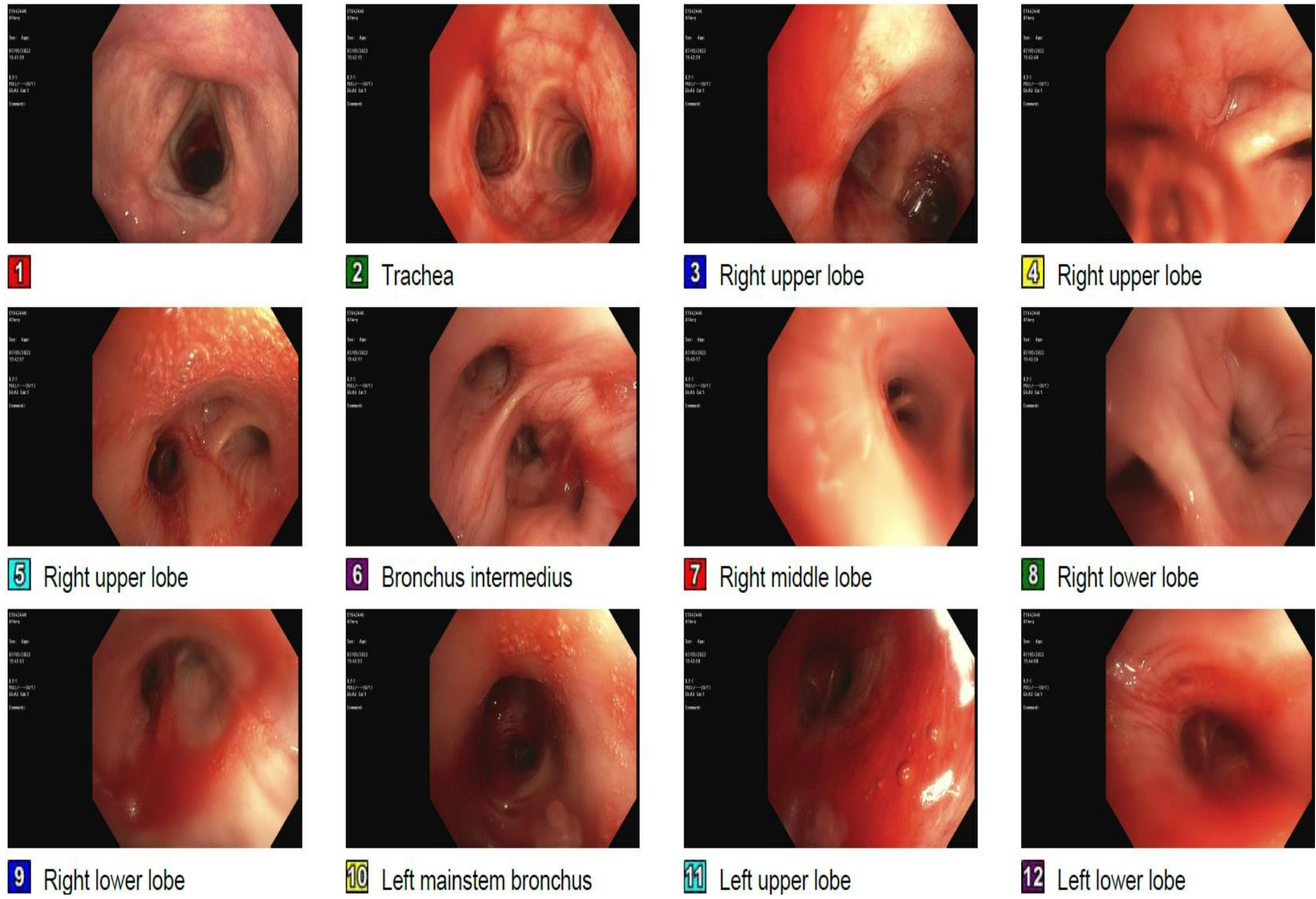


Figure 2: Patient's bronchoscopy showing diffuse alveolar hemorrhage

## Hydralazine-Induced Vasculitis

Etiology	Subset of ANCA-associated vasculitides that is a rare side effect of hydralazine use.
Epidemiology	Incidence of 5.4% in patients on 100 mg/day to 10.4% with 200 mg/day for >3-years duration, Female gender, thyroid disease <sup>1,3</sup>
Pathophysiology	Pathogenic autoantibody production against myeloperoxidase and proteinase 3. Potentially binds to myeloperoxidase (MPO) in neutrophils leading to apoptosis a release of cytotoxic products or it decreases DNA methyltransferase expression, which affects the suppression of MPO and proteinase 3 (PR3). <sup>1,4</sup>
Presentation	Shortness of breath, fatigue, weight loss, hemoptysis, polyarthralgia, petechiae <sup>1,2</sup>
Differential Diagnosis	Systemic lupus erythematosus, Acute heart failure with pulmonary edema and cardiorenal syndrome, Acute renal failure with pulmonary edema and uremic hemoptysis, Respiratory tract infection with pre-renal renal failure and/or postinfectious glomerulonephritis, Cryoglobulinemic vasculitis <sup>1</sup>
Treatment	Discontinuation of hydralazine, Corticosteroids for more severe presentations such as pulmonary-renal syndrome

## Conclusions

- Diffuse alveolar hemorrhage is a rare, yet severe complication of hydralazine use.
- Clinical presentation can mimic more common diagnoses and can arise years after being on a stable dose.
- Early detection and diagnosis is critical for treatment to discontinue hydralazine use and start corticosteroids.

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# An Unusual Case of Severe Acute Transaminitis

**Carter Schimke, MS3; Dinesh Bande, MD**

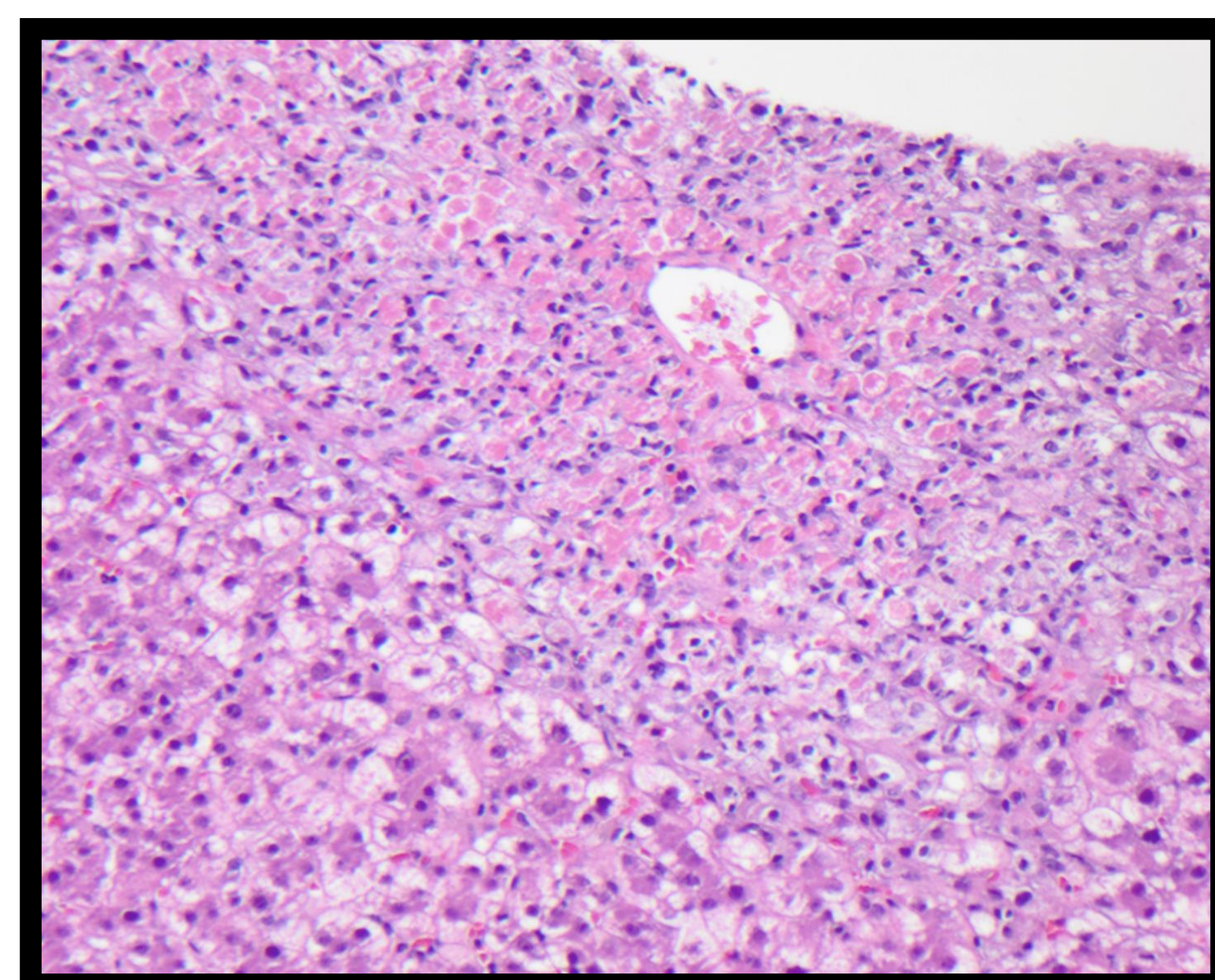
University of North Dakota School of Medicine and Health Sciences and Sanford Health-Fargo

**SANFORD**  
HEALTH

## Case Description

A 37-year-old obese male with a history of alcohol use disorder and high-risk HIV exposure on Truvada was recently admitted to the hospital for severe hypotension, lactic acidosis, rash, and supraventricular tachycardia. He was given ceftriaxone during that hospitalization and discharged with Augmentin and an increase in metoprolol succinate. One day later, he presented to the emergency department with complaints of double vision, nausea, and lower back pain. On admission he was noted to have severe transaminitis (ALT: 2,125; AST: 3,872) not present previously. Patient also had an INR of 2.1 and a total bilirubin of 3.0. Infectious hepatitis panel, autoimmune hepatitis panel, and Tylenol levels returned negative. Ultrasound was performed and did not show hepatic vein or portal vein thrombus. CT of the abdomen and pelvis was unremarkable. Rheumatologic diseases including AOSD and MAS were considered but thought unlikely. MRI of the brain showed a lesion consistent with previous pontine myelinolysis, likely due to a previous hyponatremia correction. Due to the lack of acuity on imaging, it was thought that the patient's liver dysfunction had led to an inability to compensate for this lesion, resulting in his chief symptoms. Hepatotoxic drugs including Truvada, Abilify, Rocephin, and Augmentin were discontinued. Over the next few days, the patient's symptoms began to improve with supportive care, and his lab abnormalities began to normalize.

The patient was discharged on hospital day five with a presumed diagnosis of a combined alcoholic hepatitis, ischemic hepatitis, and drug-induced hepatitis. Needle core biopsy of the liver exhibited severe steatosis and centrinuclear hepatocyte necrosis consistent with drug/toxin mediated injury, ischemia (shock liver), and other causes.



**Figure 1: Centrinuclear hepatocyte necrosis (H&E 100x)<sup>1</sup>**  
Contributed by Krutika S. Patel, MBBS, MD and Annika L. Windon, MD

Laboratory Test	Value
ALT/AST*	4,113/4,202
INR	2.2 (Ref. Range 0.9-1.1)
Albumin	2.8 (Ref. Range 3.5-5.2 g/dL)
ANCA/Anti PR3/Anti-MPO	Neg/Neg/Neg
Anti-CCP/Rheumatoid Factor	Neg/Neg
Anti-Smooth Muscle/Mitochondrial Ab/Liver-Kidney Microsome Type 1 Ab	Neg/Neg/Neg
ANA	0.17 (Ref. Range: 0.00-0.99)
Flow Cytometry**	Negative for listed antibodies
EBV DNA/EBV IgG/EBV IgM	Undetected/Pos/Neg
Varicella Zoster	Negative
HIV 1 Ag HIV 1/2 Ab	Negative
HSV1 IgG/HSV2 IgG	Neg/Neg
Hep BsAg/Hep BcIgM/Hep C Ab/Hep A IgM/CMV IgG/CMV IgM	Neg/Neg/Neg/Neg
Erlichia-Anaplasma Blood Smear	None Seen
Fungitell	Negative
Babesia smear/NAD	Neg/Neg
Ferritin	3,683 (Ref. Range: 22-275 ng/mL)
LDH	6,453 (Ref. Range: 125-220 U/L)
TSH	3.26 (Ref. Range: 0.35-4.94)
AFP	4.1 (Ref. Range: 0.0-8.8)

**Figure 2: The patient's laboratory results. \*Represents peak on HD2.**  
\*\*Flow cytometry: CD4,5,20,10,8,3,45,19

## Discussion

Acute Liver Injury is defined as peak ALT  $\geq 1000$  U/L.<sup>2</sup> Based on reported data, ischemic hepatitis is the most common cause.<sup>2</sup> The second most common cause is drug-induced liver injury.<sup>2</sup> Other causes include viral, hepatobiliary, autoimmune, and alcohol related hepatitis. While data is limited, one meta-analysis found that the average ALT and AST in ischemic hepatitis are 2423 U/L and 1893 U/L respectively.<sup>3</sup> One study found that the average ALT and AST in amoxicillin-clavulanate-DILI 362 and 171 respectively.<sup>4</sup> Patient with alcoholic hepatitis typically have aminotransferase elevations below 500.<sup>5</sup> The most common causes of severe transaminitis at levels similar to this patient include acetaminophen, mushroom poisoning, and autoimmune disease.<sup>6</sup>

Diagnosis should be suspected in patients with elevated liver function tests that have a history of alcohol use disorder, overuse of Tylenol or other hepatotoxic drugs, or etiologies of hypoperfusion (shock, thromboembolism, severe hypotension, etc.). Aminotransferase levels typically peak at 1-3 days and return to normal within 7-10 days after treatment.<sup>7</sup> Treatment should be aimed at addressing the underlying etiology and providing supportive cares. Depending on the individual, liver transplant may be a viable option and should be considered.

This case is of interest because the patient exhibited much more severe transaminitis than typically seen with ischemic hepatitis, warranting thorough evaluation for other etiologies. This case may justify increasingly judicious use of hepatotoxic medications in patients with alcohol use disorder or other risk factors, even if their transaminase levels are within normal limits.

## Conclusion

- **This was an unusual case of severe acute transaminitis thought to be due to a combination of alcohol associated hepatitis, drug-induced hepatitis, and ischemic hepatitis.**
- **This may warrant more judicious use of hepatotoxic medications in patients with alcohol use disorder or other risk factors, even when transaminase levels are within normal limits.**

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# Endobronchial Valve Placement in a Patient with a Broncho-pleuro-cutaneous Fistula

Wyatt Lutt, MSIVa, Karol Kremens, MD, FCCPb

aUniversity of North Dakota School of Medicine & Health Sciences, Grand Forks, ND; bDepartment of Pulmonary and Critical Care, Essentia Health, Fargo, ND

## Introduction

- A bronchopleural fistula (BPF) is defined as a sinus tract between a mainstem, lobar, or segmental, bronchus and the pleural space [1].
- Most BPF's occur postoperatively with right-sided pneumonectomy or lobectomy being the most common risk factors [1].
- Other causes include persistent spontaneous pneumothorax, mechanical ventilation, necrotizing pulmonary infection, malignancy, and acute respiratory distress syndrome among many others [2].
- This connection between the pleural space and bronchus can lead to serious complications such as a pneumothorax or empyema [1].
  - Morbidity is estimated to be between 25% to 71% [3].

## Case Presentation

- 62-year-old female with non-small cell lung cancer post-radiation and chemotherapy presented to the ED after a fall resulting in dyspnea.
- Chest X-ray revealed severe subcutaneous emphysema likely secondary to pneumothorax (figure 1).
- Previous enhanced chest CT revealed a bronchopleural fistula (BPF) in the right upper lobe (figure 2).
- A thoracostomy was performed with minimal clinical improvement. Chest tube was placed within the cavity of the BPF.
- Spiration endobronchial valve placement via bronchoscopy was approved under humanitarian use exemption.
- On hospital day 9, a bronchoscopy was performed, and the chest tube was visualized due to the BPF (figure 3).
  - An endobronchial valve was placed in right upper lobe via bronchoscopy which improved the air leak and emphysema but did not eliminate it entirely (figures 4 & 5).
- 2 additional endobronchial valves were then placed in the right lower lobe on hospital day 12. This led to significant clinical improvement. Within a week the chest tube was clamped and eventually removed.
- On follow-up bronchoscopy 8 weeks later, valves were stable, and the patient was doing well clinically and currently still is.

Figure 1: Chest x-ray revealing severe subcutaneous emphysema



## Discussion

- The standard for BPF repair is video-assisted thoracoscopic surgery. However, this is an invasive procedure and is not optimal for patients who are not good surgical candidates [4]
- The Spiration endobronchial valve (EBV) is a one-way valve placed under bronchoscopy that allows air to flow out of but not into the section of the lung where the valve is positioned (figure 6). This prevents hyperinflation while also sealing an air leak that may be present [5].
  - Their only FDA approved use in the U.S. is for reducing lung volume in emphysema [5].
  - However, placement of the valves can be approved on a case-by-case basis by applying for humanitarian use exemption. This was the case in our patient. IRB approval was received.
- There have been multiple instances in which these valves have successfully treated air leaks in patients with a BPF.
  - A similar case was reported in which a patient with squamous cell carcinoma of the lung developed a bronchopleural fistula and subsequent pneumothorax. A Spiration valve was placed, and the leak resolved [6].
- Long-term potential complications of endobronchial valves include valve migration, granulation, expectoration of the valve, and infection [5]. However, EBV's are often removed at 4-6 weeks to minimize the risk of complications [5].
- A study by Song et al. looked at the outcome of 26 patients with a BPF who underwent EBV placement. The study had a successful treatment rate of 73.1%. Complications included one patient with a bronchial hemorrhage, one with valve migration, and another with granulation tissue [7]. Song et al. stated that the most significant disadvantage to EBV placement for BPF is the current cost. However, the advantages, such as safety in critically ill patients as well as the ability to remove the valves if needed, make EBV placement an enticing option for qualifying candidates with a BPF [7].
- The patient in our case was a poor surgical candidate due to lung function. Endobronchial valves were the perfect solution to seal the continuous air leakage.

Figure 2: Enhanced CT demonstrating bronchopleural fistula



Figure 3: Chest tube visualized on bronchoscopy



Figure 4: Enhanced CT demonstrating endobronchial valve in right upper lobe

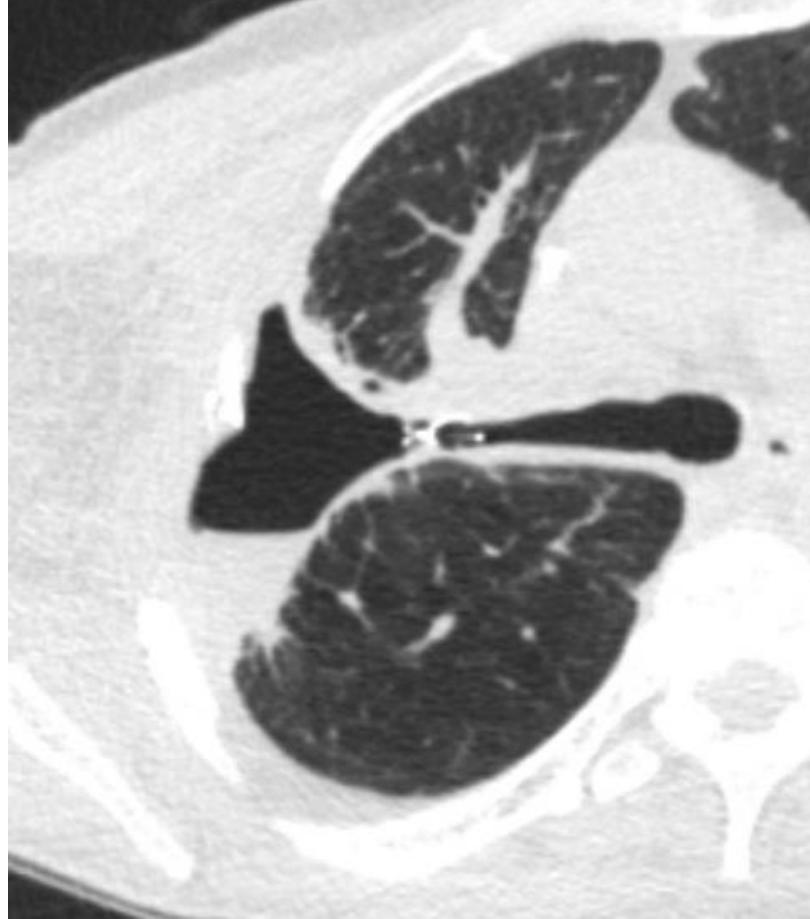


Figure 5: Right upper lobe endobronchial valve on bronchoscopy

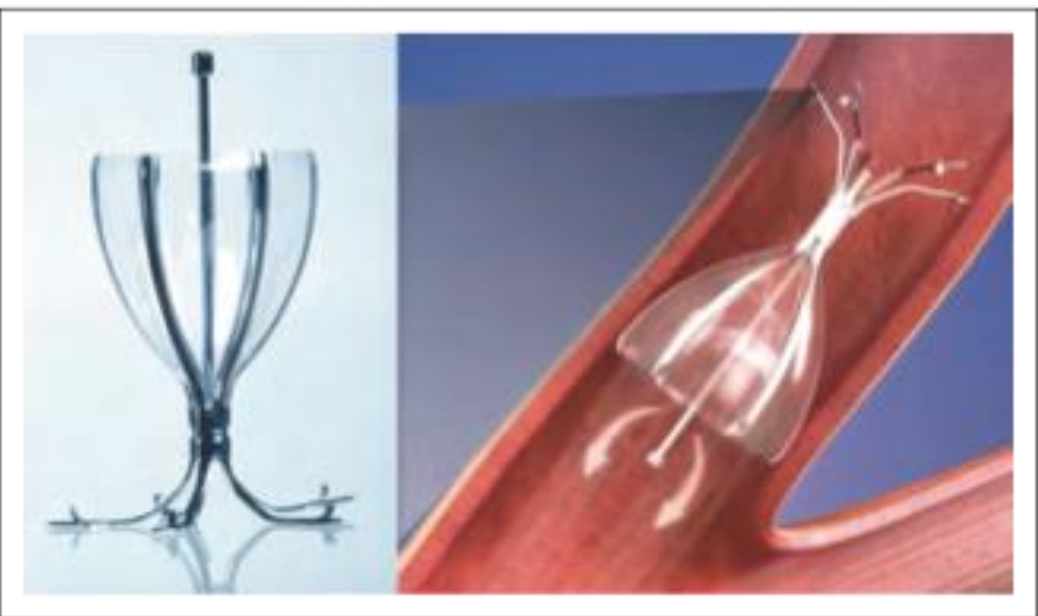


Figure 6: Spiration endobronchial valve.  
Image courtesy of Spiration Inc. & Giddings et al.

## Conclusion

- Bronchopleural fistulas are atypical connections between the bronchus and pleural space. They can lead to complications such as pneumothorax due to persistent air leakage.
- BPF's are commonly a result of cancer due to the destruction of normal airway anatomy. They rarely occur spontaneously.
- Endobronchial valves are one-way valves that allow air to flow out of the lung, but not into it. Currently, they are only FDA approved for the treatment of hyperexpanded lungs in patients with emphysema.
- However, small studies have shown EBV's to be effective at treating persistent air leaks and improving patient outcomes.
- More research needs to be conducted to look at the efficacy and complication rate of EBV placement as this procedure seems to have the potential to improve treatment options for bronchopleural fistulas.

# A Rare Case of COVID-19 Infection and MINOCA

Ajdin Ekic MS3, Puvanalingam Ayyadurai MD, Sunil Kartham MD

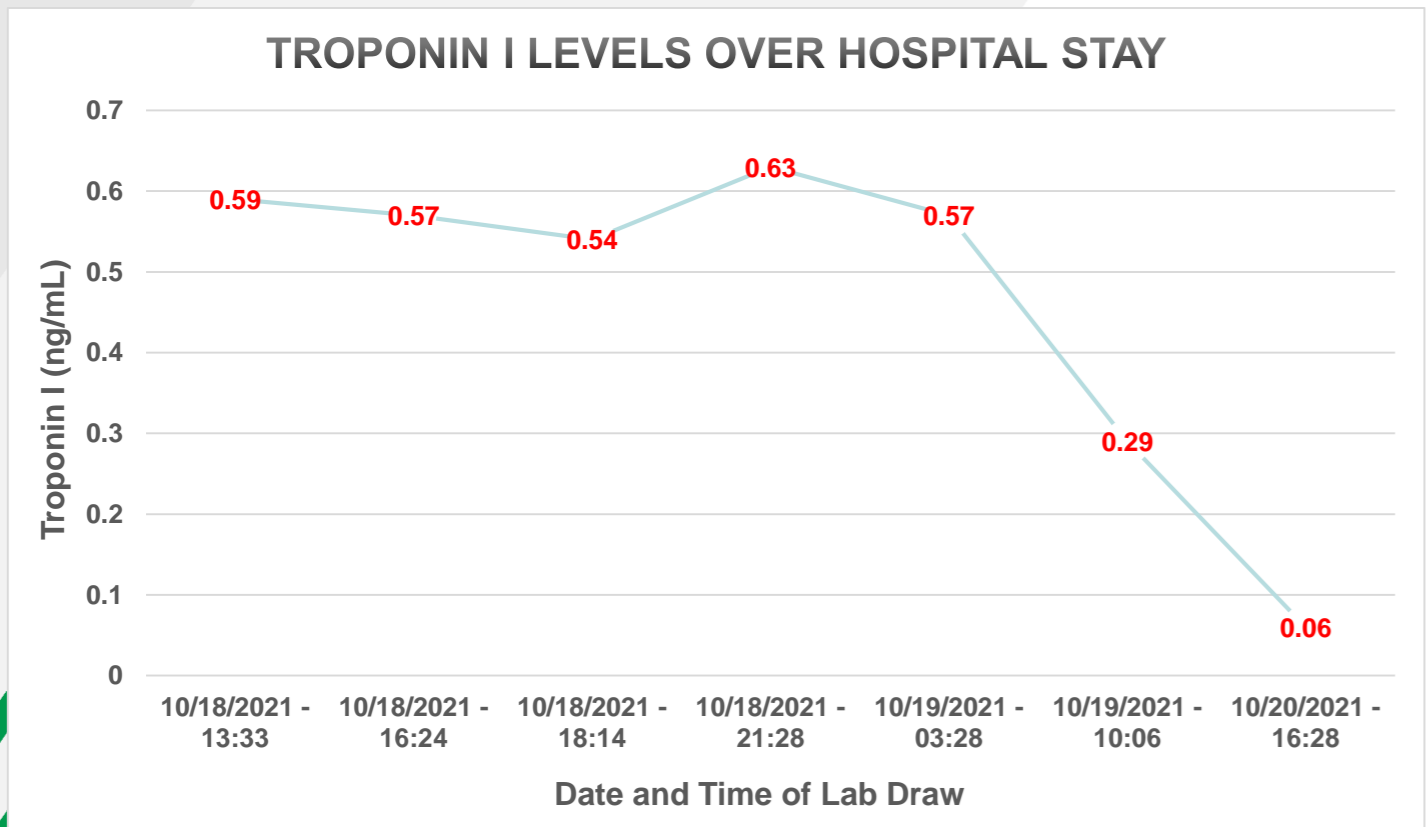
University of North Dakota School of Medicine and Health Sciences – Grand Forks, ND | Altru Health System – Grand Forks, ND

## Introduction

- Cardiac manifestation of COVID-19 include:
  - Myocarditis, pulmonary embolism, acute coronary syndrome from a prothrombotic state, and pericarditis<sup>1,2</sup>
  - Research has shown these manifestations lead to worse prognoses and higher mortality<sup>1,2</sup>
- Myocardial infarction with nonobstructive coronary arteries (MINOCA): Evidence of myocardial infarction with normal or near-normal coronary arteries on angiography (<50% stenosis)<sup>3</sup>
  - Mechanisms<sup>3</sup>:
    - Epicardial vascular causes: plaque rupture, coronary spasm, spontaneous coronary dissection
    - Microvascular causes: coronary thromboembolism, coronary microvascular dysfunction, microcirculation spasm
- With COVID-19's cardiovascular involvement, it could be theorized that COVID-19 is a possible trigger of MINOCA
- We report a case of MINOCA in a COVID-19 infected patient

## Case

- 41-year-old female presented with complaints of episodic retrosternal chest pain and associated dizziness
- Significant past medical history:
  - Type 2 diabetes mellitus, asthma, obesity, tobacco use, left-ventricular hypertrophy, and hypertension
- Tested COVID-19 positive two weeks prior to her presentation
- At time of presentation, she had an elevated troponin level of 0.59 (normal < 0.1) (See Table 1 below)



- EKG showed no signs of acute coronary syndrome
  - Was similar to EKGs from days prior
- Was started on heparin and nitroglycerin
- Underwent cardiac catheterization and coronary angiogram
  - Showed no significant obstructive disease
- Her D-dimer was elevated at 1,170 ng/mL (normal  $\leq$  500)
  - Subsequent CT chest ruled out pulmonary embolism
- Transthoracic echocardiogram findings:
  - Normal EF and wall motion, but left ventricular hypertrophy with grade 1 diastolic dysfunction was noted
- Over the next 24 hours, her troponins came back down to 0.57 and then 0.29
- On hospital day 3 the patient continued to have chest pain with unchanged EKGs and troponins that had normalized
  - At this time, it was felt medical management was appropriate
  - Outpatient follow up scheduled for cardiac MRI, was discharged home on aspirin 325 mg, imdur 60 mg, protonix 40 mg
- Subsequent cardiac MRI was done
  - Transmural mid-inferior wall infarct consistent with ischemic etiology, confirmed myocardial infarction and MINOCA (image 1)

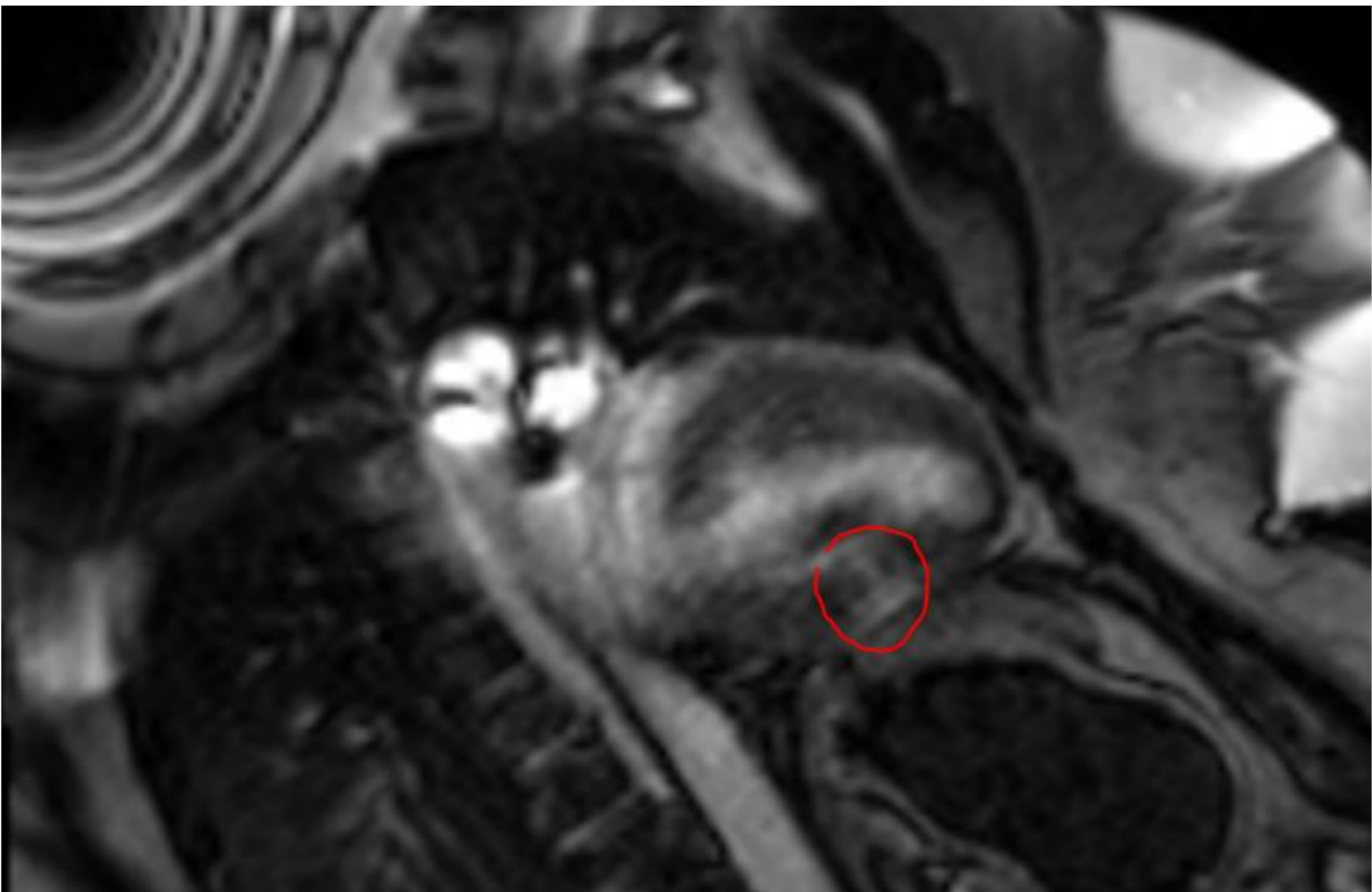


Image 1: Transmural infarct in mid-inferior wall

## Discussion

- COVID-19 has been shown to cause myocardial injury from:
  - Direct viral effects on cardiomyocytes, inflammatory response viral infection triggers, and oxidative stress it puts on cells.<sup>1,2</sup>
  - These are possible explanations for studies showing hypercoagulability is more frequently observed in patients with COVID-19<sup>4</sup>
- It could be theorized that COVID-19 is a possible trigger of MINOCA, however, further studies and research would need to be done to explain the processes involved between the two
  - One way is through imaging techniques like cardiac MRI.
  - Studies show a multimodal approach of diagnosis that includes cardiac MRI can help identify causes of MINOCA in patients<sup>5</sup>
- Patients with cardiovascular disease and its risk factors (eg, diabetes, hypertension) have worse COVID-19 infection outcomes and at a baseline are at increased risk for acute cardiovascular damage<sup>2,4</sup>
  - Thus, early identification and treatment is important

## Conclusion

- Cardiovascular involvement of COVID-19 leads to worse outcomes for patients, and one possible manifestation is MINOCA
- Cardiac MRI could play a crucial in the diagnosis of MINOCA as the infarct could be missed without this imaging method
- In patients with COVID-19 infection and elevated troponins, it is reasonable to consider cardiac MRI when trying to deduce the underlying cause of troponin elevation.

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# Rhubarb Induced Oxalate Nephropathy: Case Report and Review of the Literature

Sam Wilke<sup>a</sup>, Adelina Luong-Player MD<sup>b</sup>, and Xiaoying Deng MD<sup>c</sup>

<sup>a</sup>University of North Dakota School of Health Sciences; <sup>b</sup>Sanford Health Department of Pathology - Fargo; <sup>c</sup>Sanford Health Department of Nephrology - Fargo

## Introduction

Oxalate nephropathy is defined as a decline in kidney function secondary to deposition of calcium oxalate crystals in the kidney.<sup>1,2</sup> Two large studies showed the prevalence of oxalate nephropathy to be approximately 1% of kidney biopsies.<sup>3,4</sup> The etiology of oxalate nephropathy is related to increased endogenous production of oxalate or increased absorption of oxalate from the gut.<sup>5-8</sup> Many cases can be attributed to either of these causes, however, many patients have secondary factors that predispose them to develop oxalate nephropathy at that time. This report aims to describe a case of oxalate nephropathy, from arriving at a diagnosis to management. This paper will also discuss the wide variety of factors that cause, or leave a patient predisposed, to develop oxalate nephropathy, discuss the current treatment regimens used, and long-term outcomes related to oxalate nephropathy.

## Case Report

The patient is a 74-year-old man with a past medical history of hypertension, coronary artery disease, pulmonary hypertension, chronic kidney disease stage IIIB, and COPD. These chronic issues were controlled with various breathing treatments, aspirin, and atorvastatin. He also took thiamine,  $\alpha$ -lipoic acid, vitamin B12, an iron supplement, and vitamin C. The patient's baseline serum creatinine (sCr) was between 1.3-1.5 mg/dL. It was noted that his sCr rose to 4.62 mg/dL six days prior to admission. He presented to an outside clinic and, and sCr was measured to be 6.67 mg/dL, blood urea nitrogen was 99 mg/dL, eGFR 8 mL/min/1.73m<sup>2</sup>. Other notable investigations on the day of admission included an anion gap of 26 mEq/L with metabolic acidosis, and a kidney ultrasound disclosed no evidence of obstruction or hydronephrosis. The patient noted he had been experiencing diarrhea and decreased urine volume for the last two weeks, as well as fatigue. His vital signs on the date of admission included a blood pressure of 160/103 mmHg, an irregular heartbeat of 97 bpm, temperature of 98.1°F, and 18 respirations per minute. This was initially felt to be secondary to prerenal azotemia from persistent diarrhea. He was placed on a sodium bicarbonate drip at 125 mL/h.

With no improvement by day 3 of admission, and the elevation of the patient's FeNa, this was felt to be acute tubular necrosis with prerenal factors. Further testing over the hospital course included a mildly low C3 at 59 mg/dL, C4 of 17.2 mg/dL, weakly positive ANA of 1.24 U, serum protein electrophoresis showing no monoclonal protein and 24-hour urine collection demonstrating a low creatinine clearance of 2.1 mL/min/1.73m<sup>2</sup>.

A biopsy was performed, which disclosed oxalate nephropathy with moderate to severe arteriosclerosis (Figure 1). It was discovered the patient had added rhubarb to his diet six months ago. He reported he had been consuming approximately 500 mL of rhubarb juice daily during this time. At this time vitamin C, which he had been taking for general health improvement for nine months, was discontinued, and the patient was educated on a low oxalate diet with increased dairy consumption. An oxalate panel revealed a plasma oxalate of 17.6  $\mu$ mol/L. On hospital day 10, the patient had developed uremic symptoms, and hemodialysis was initiated. The patient was discharged with a sCr level of 3.88 mg/dL on hospital day 14.

The patient had remained dialysis dependent for five months since discharge. There was no evidence of renal recovery during this time. The patient passed away five months after discharge due to respiratory failure related to suspected pneumonia.

It was concluded that the consumption of rhubarb and vitamin C, coupled with his baseline chronic kidney disease and diarrhea, led to the development of oxalate nephropathy.

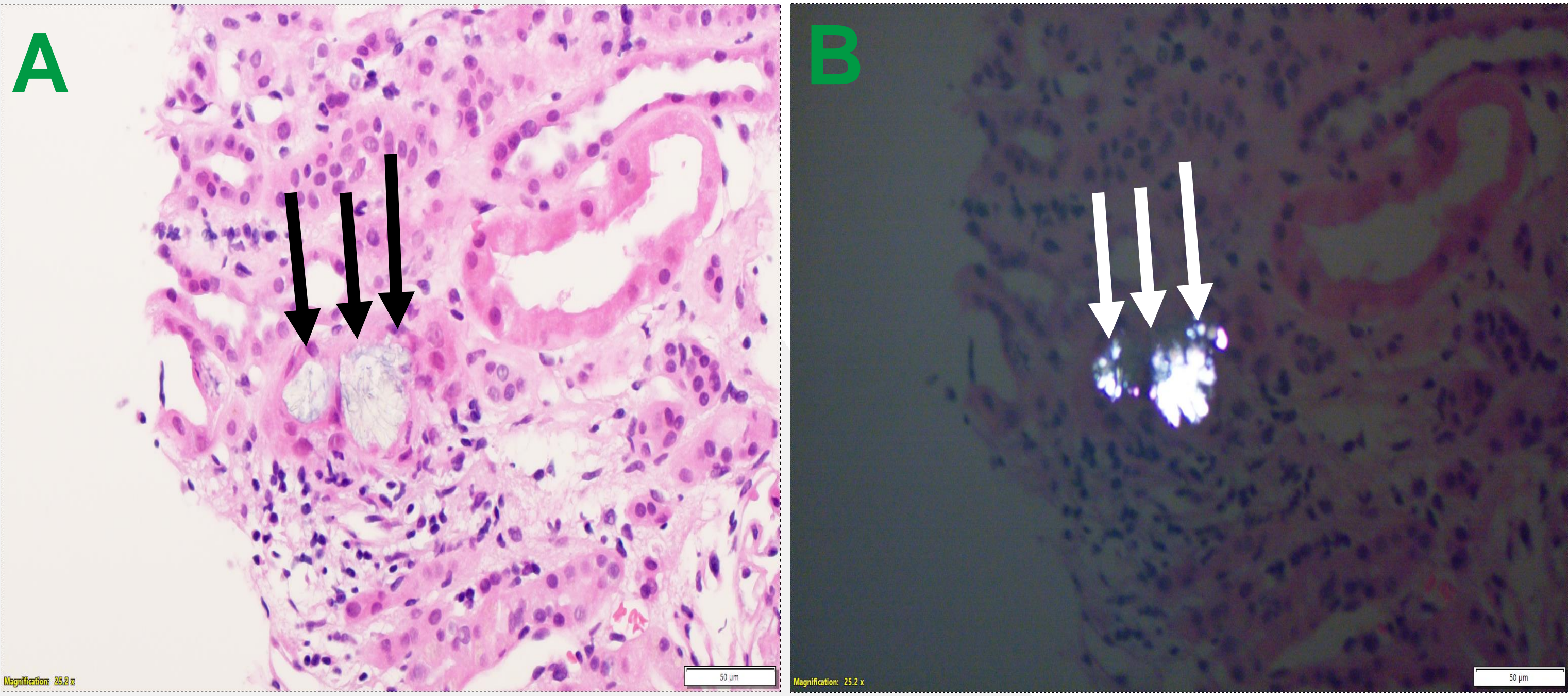


Figure 1. Light microscopy slide showing a calcium oxalate crystal (black arrows) on H&E stain in high power (A) and polarization showing birefringence of calcium oxalate (white arrows) (B)

## Discussion

Oxalate nephropathy (ON) is defined as kidney injury due to biopsy proven calcium oxalate crystal deposition.<sup>1,2</sup> The prevalence of ON has been stated by Geraghty et al., who found calcium oxalate crystals in 1% of native kidney biopsies,<sup>3</sup> and Buysschaert et al. showed the prevalence of crystal deposition in nearly 1% of 2265 native kidney biopsies over a 9-year period.<sup>4</sup>

Calcium oxalate deposition in the kidneys cause damage to the tubules and interstitium from direct injury, as well as causing epithelial apoptosis and necrosis through free radical formation and lipid peroxidation.<sup>12</sup> This pathophysiology is thought to occur through activation of the NLRP3 inflammasome, which creates an inflammatory response, and thus worsening the kidney injury.<sup>6,14,15</sup> On biopsy, the crystals have a clear appearance and are birefringent. Around the crystals, there is tubular injury and atrophy, as well as interstitial fibrosis.<sup>3</sup>

Patients with ON present with acute kidney injury, or acute on chronic kidney disease, most with large elevations in serum creatinine. Lumlertgul et al. conducted an analysis of patients who developed ON, and on urinalysis, 69% of patients had proteinuria, 32% had hematuria, and 26% had calcium oxalate crystals.<sup>17</sup>

ON is caused by either increased endogenous production of oxalate or increased intestinal absorption.<sup>8</sup> Three main etiologies fall into these categories, with the former being primary hyperoxaluria (PH), and the latter being enteric hyperoxaluria (EH) or increased ingestion of oxalate, or its precursors.<sup>2,8,18,19</sup>

PH is a group of autosomal recessive disorders that are defined by enzymatic deficiencies of oxalate metabolism.<sup>4,17</sup> These disorders lead to overproduction of oxalate, leading to increased oxalate in urine, and recurrent kidney stones and deposition of calcium oxalate in other tissues. Our patient had an elevated plasma oxalate, however, due to his age of presentation and no prior history of kidney stones, it was felt unlikely that our patient had PH.

EH causes ON due to increased oxalate bioavailability. EH is the most common secondary cause of ON.<sup>4</sup> Increased oxalate bioavailability can occur secondary to fat malabsorption, altered colonic permeability, or altered intestinal degradation of oxalate.<sup>5-8</sup> In conditions that cause fat malabsorption, calcium binds to free fatty acids, which leaves calcium unavailable to bind oxalate, thus oxalate is absorbed. Conditions that commonly lead to fat malabsorption that have been associated with oxalate nephropathy include Roux-en-Y, celiac disease, pancreatic insufficiency, and Crohn's Disease.<sup>5-7</sup>

Finally, systemic sclerosis has been implicated as a contributory factor of ON by Ligon et al. and Mpofu et al, related to recurrent episodes of small intestinal bacterial overgrowth and malabsorption.<sup>12,25</sup>

Enteric hyperoxaluria can also occur due to altered colonic permeability, which was described by Pandey et al. when a patient developed ON during an infection *Clostridioides difficile*, which disrupts tight junctions, leading to increased paracellular oxalate absorption. Altered intestinal degradation of oxalate has also been implicated in ON. Mainly, the bacteria *Oxalobacter formigenes* is noted to degrade oxalate. Surgery on the intestines and antibiotic use, as well as the Western diet can alter the intestinal microbiome and lead to decreased amounts of these bacteria.<sup>19,26</sup> Our patient was noted to have a two-week history of diarrhea. It is important to note any gastrointestinal pathology in the setting of acute kidney injury, as this may guide you to a diagnosis of ON.

Increased ingestion of oxalate or its precursors is another known cause of ON, as was seen in our case. Oxalate levels are high in foods such as rhubarb, spinach, cocoa, almonds, peanuts, soy, figs, raspberries and coffee, but low in meats.<sup>8,19,27</sup> In the literature, various case reports cite the ingestion of rhubarb,<sup>16</sup> vitamin C,<sup>5,7,10,30-32</sup> nuts,<sup>11,27</sup> star fruit,<sup>33,34</sup> various vegetable consumption,<sup>21,22</sup> and ethylene glycol<sup>13</sup> as causes of biopsy proven ON. Our patient had been taking 500 mg of vitamin C for general health improvement, over a nine-month period prior to presentation, which also contributed to the development of ON. With the increasing popularity of various diets, increasing focus on organic foods and natural supplements, as well as more alternative treatments, is important to take a dietary history and discuss any alternative treatments a patient may be undergoing.<sup>5,27,30</sup>

Although, each of these causes, primary hyperoxaluria, enteric hyperoxaluria and increased ingestion of oxalate or its precursors can cause ON, Reddy et al. stated the development of ON may be due to a multi-hit process.<sup>2</sup> Our patient had both ingestion of increased oxalate in rhubarb and vitamin C, as well as had pre-existing CKD. He also presented with diarrhea over a two-week period, which may have produced an acute dehydration, allowing calcium oxalate crystals to precipitate and cause ON.

Other case reports noted patients with decreased fluid intake,<sup>1,7</sup> vomiting and diarrhea,<sup>16,23</sup> BPH,<sup>10,21</sup> as well as many having pre-existing chronic kidney disease in the setting of risk factors for enteric hyperoxaluria or increased ingestion of oxalate. Chronic kidney disease predisposes patients to ON due to reduced urinary excretion of oxalate.<sup>4,21</sup> Also in the literature, Waikar et al. and Nasr et al. reported that patients with diabetes mellitus have higher levels of urinary oxalate excretion, which makes diabetes a risk factor for ON.<sup>14,18</sup>

There is no treatment specified for ON, however, it closely parallels the treatment for kidney stones. Aggressive intravenous hydration was undertaken in all case reports. With enteric hyperoxaluria and increased ingestion of oxalate and its precursors, a low fat and low oxalate diet is recommended.<sup>4,5,16</sup> Mahmoud et al. also stated a diet high in calcium may help, with calcium citrate or calcium carbonate the most commonly used to bind oxalate in the gut.<sup>21</sup> Dialysis is a mainstay treatment if kidney injury progresses to uremic symptoms.

In the literature, the patients presented by Nair et al. and Lamarche et al. both received steroids due to their biopsies exhibiting interstitial inflammation.<sup>32,33</sup> The patient presented by Lamarche et al. developed ON from excessive vitamin C ingestion and was discharged on hemodialysis, but did become dialysis independent.<sup>32</sup> Nair et al. presented a patient who ingested star fruit juice and presented with a serum creatinine of 10mg/dL but became dialysis independent with a serum creatinine of 2.1mg/dL.<sup>33</sup> Steroids were not mentioned in other studies, however, the outcomes in these two case reports may show a new direction that would need to be investigated for the treatment of ON, as the pathophysiology has been shown to progress through activation of the NLRP3 inflammasome.<sup>6,14,15</sup>

Overall, the prognosis of ON is poor. Lumlertgul et al. reported that 55% of patients needed dialysis, 58% of these patients remained dependent on dialysis over a mean follow-up of 12.9 months. ON had a mortality rate of 33%. No patients in this systematic review had a complete recovery, and 42% of patients experienced a partial-recovery.<sup>17</sup> Fox et al. showed that 66% of patients needed hemodialysis at presentation.<sup>1</sup> Kidney transplant can be undertaken, but ON can recur in the transplanted kidney.<sup>3,19</sup> Our patient needed hemodialysis in the hospital, as well as remains dialysis dependent until he passed away five months after initial discharge.

## Conclusions

Oxalate nephropathy is a decline in renal function due to calcium oxalate deposition in the kidney. The etiology of oxalate nephropathy is from supersaturation of the urine with oxalate from increased endogenous production of oxalate or increased absorption of oxalate, or its precursors. This case exemplifies the importance of obtaining a dietary history and investigating supplements a patient may be taking when evaluating acute kidney injury. The review of the literature shows the wide variety of gastrointestinal conditions and secondary factors that can predispose a patient to develop oxalate nephropathy, as well as explores the common treatments used for oxalate nephropathy, and the relatively poor prognosis related to oxalate nephropathy.

# Diabetes: An Unrecognized Cause of Cerebral/Renal Salt Wasting

Dakota Snustad, Siddharth Singhal MD FACP, and Adarsh Arya MD

## Abstract

Diabetes mellitus has been known to cause hyponatremia; however, it has not been known to cause cerebral/renal salt wasting (C/RSW). In this case report, the clinical features of hypovolemia and various laboratory studies in the presence of hyponatremia were supportive of C/RSW.

## Introduction

- **C/RSW:** Continued loss of sodium in the urine despite the presence of hyponatremia and hypovolemia<sup>1</sup>
- **Causes of C/RSW include:**
  - Injury to the proximal convoluted tubule
  - Increased production of natriuretic factors
  - Decreased sympathetic tone
- **Common causes of C/RSW<sup>2</sup>**
  - Bartter syndrome
  - Gitelman syndrome
  - Cisplatin
  - Congenital primary adrenal insufficiency
  - Hypothyroidism
  - Subarachnoid hemorrhage
  - Craniopharyngioma
  - Tubercular meningitis
  - Severe sepsis
  - Guillain-Barre Syndrome

## Patient History

- The patient is a 91-year-old male with a past medical history of diabetes mellitus (A1c 9.3%)
- Two hospitalizations with sodium of 123mEq/L and 120mEq/L
- Presented with fatigue, gait instability, nausea, polyuria, polydipsia and hyperglycemia
- **Physical Exam**
  - Orthostasis positive
  - Thin built, moist mucus membranes, no peripheral edema, lungs clear to auscultation

## Laboratory Values

Test Name	Result	Reference Range	Test Name	Result	Reference Range
Glucose; mg/dL	156	74 - 109	TSH; mIU/mL	2.70	0.5 – 5.0
Creatinine; mg/dL	0.9	0.7 - 1.2	AM Cortisol; ug/dL	18.4	3.0 – 23.0
Sodium; mEq/L	129.0	136 - 145	Plasma uric acid; mg/dL	3.8	3.4 - 7
Potassium; mEq/L	5.1	3.5 - 5.0	Urinary uric acid; mg/dL	21.4	---
Chloride; mEq/L	93	98 - 107	Urinary creatinine; mg/dL	29.9	---
CO2; mEq/L	25	22 - 29	FE uric acid; %	16.95	---
Urinary osmolality; mOsm/kg	488	390 – 1,000	BNP NT-PRO; pg/mL	930.0	0 - 450
Serum Osmolality; mOsm/kg	289	280 - 305	Renin; ng/mL/h	0.92	0.25 - 5.82
Urinary Sodium; mEq/L	55.0	---	Aldosterone; ng/dL	3	3 - 28

## Discussion

- **Diagnostic Dilemma of C/RSW**
  - Difficult to differentiate from SIADH due to similar lab values
  - Can be differentiated via fractional excretion of uric acid<sup>1</sup>
  - Treatment strategies differ for renal salt wasting and SIADH

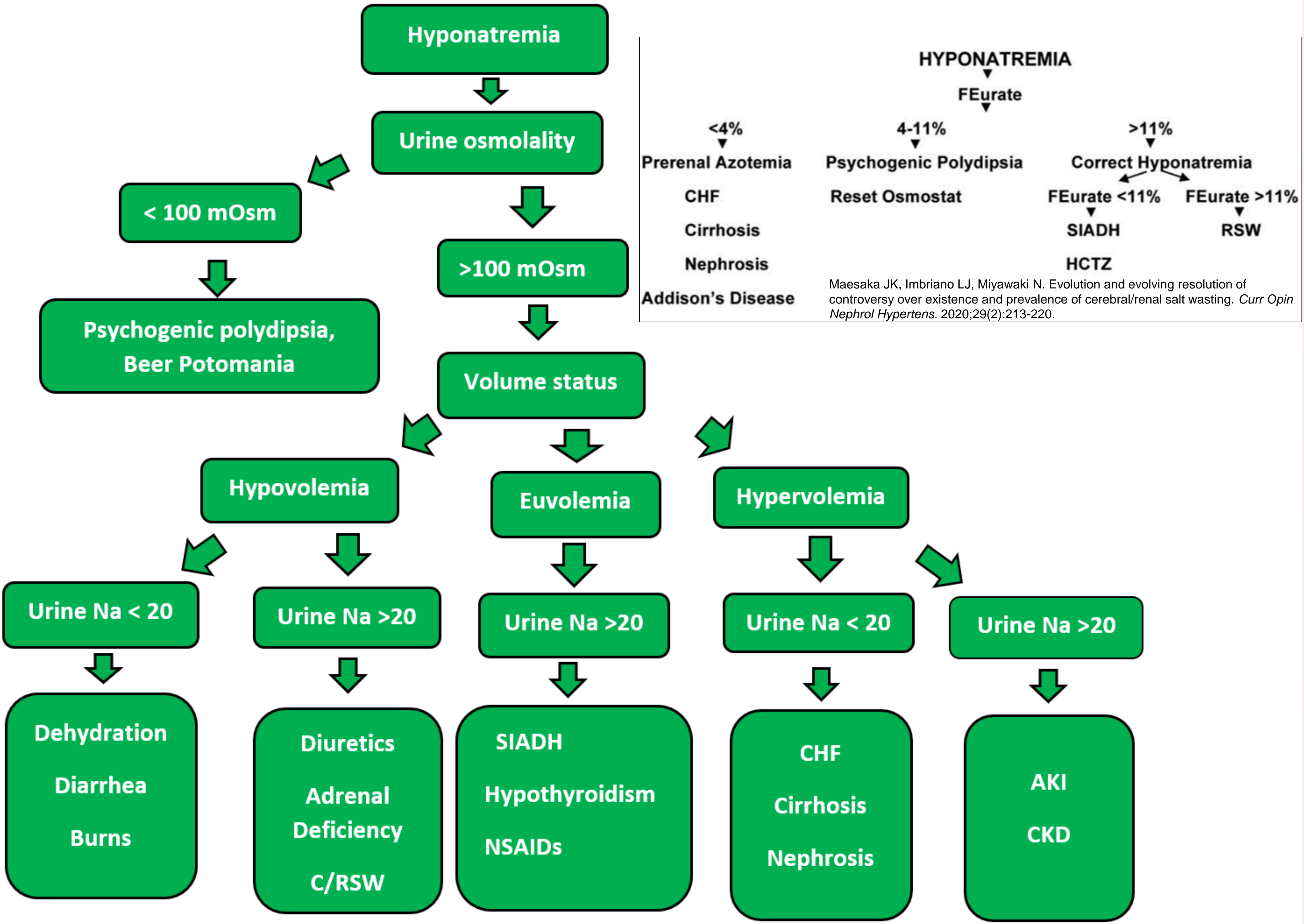
	C/RSW	SIADH
Extracellular volume	↓	↑
Hematocrit	↑	N
Albumin	↑	N
BUN/Creatinine	↑	↓
Uric acid	N or ↓	↓
Treatment	Normal saline	Fluid restriction

- To the best of our knowledge this is the first report of diabetes as the cause of cerebral/renal salt wasting
- Due to the patient’s orthostatic hypotension, hyponatremia, high urinary sodium loss, elevated FE uric acid, elevated A1c, elevated BNP, elevated potassium, and low aldosterone, it was concluded that the patient’s hyponatremia was due to C/RSW induced by uncontrolled diabetes mellitus
- Likely mechanisms include increased production of natriuretic factors (BNP)<sup>4</sup> and sympathetic dysautonomia<sup>5</sup> resulting from chronic hyperglycemia
  - Hyporeninemic hypoaldosteronism
- Limitations and uncertainties included renin and aldosterone values within reference range
- Management included optimal control of diabetes and oral salt supplementation

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## Hyponatremia Algorithms<sup>3,4</sup>



# Trimethoprim/Sulfamethoxazole-Induced Agranulocytosis Complicated with Aseptic Meningitis

Olivia Harris, MS, MS3; Logan Schmaltz, MD; Alexis Kokett, PharmD; Regan Miller, PA; Kimberly Hammer, PhD

## Introduction

Acute agranulocytosis is a rare, life-threatening blood dyscrasia that occurs in 1-5 case per million population per year, characterized by a neutrophil count of less than 500/microL, and most associated with medication use.<sup>2</sup> High-risk drugs include antithyroid drugs, clozapine, and trimethoprim/sulfamethoxazole (TMP/SMX)<sup>2</sup>. The latter is a combination antimicrobial frequently used in the treatment of urinary tract infections such as epididymitis and prostatitis.<sup>1</sup> TMP and SMX together inhibit successive steps in the folate synthesis pathway which are essential for purine synthesis<sup>4,1</sup>. The following case serves as a distinctive example of acute agranulocytosis caused by TMP/SMX in an immunocompetent patient.

## Case Report

A healthy 39-year-old male with no known allergies presented to the Veterans Affairs (VA) Emergency Department (ED) with worsening left testicular pain, frequency, and urgency for 2 days. He was diagnosed with left epididymo-orchitis and sent home on a two-week course of TMP-SMX. Thirteen days later, the patient returned to the ED with fever, chills, headache, generalized body aches, urinary retention, loose stools and nonspecific chest pressure. Serum labs revealed significant neutropenia (900/cmm) and leukopenia (2300/cmm) and the patient was admitted for hospital observation. Initial inpatient tests including serum lab work, urinalysis, chest and abdominal x-ray, EKG were unremarkable. On day two of admission, the veteran noted a persistent headache, new ankle edema, and lower leg tenderness. Multiple imaging studies and repeat labs only revealed leukocytosis with left shift and fever of unknown origin.

## Lab Results

	Day 0 1 <sup>st</sup> ED	Day 13 2 <sup>nd</sup> ED & Admission	Day 14	Day 15 Discharge	Day 32 Follow-up
WBC (#/cmm)	7.1	2.3 (L)	16.3 (H)	6.9	5.3
ANC (#/cmm)	5.1	0.9 (L)	15.1 (H)	4.8	2.5
Abs Lymph	1.2	1.3	0.4 (L)	1.2	1.7
Imm Gran Abs	0	0	0.1 (H)	0	0

Table 1: White Blood Cell Count Trend

Appearance	Clear, colorless
Protein	45 mg/dL
Glucose	67 mg/dL
Gram stain	No epithelial cells seen Many WBCs No organisms seen
Mycology culture	Negative
Anaerobic/aerobic culture	Negative
WBC (#/cmm)	44
Monocytes	33%
Neutrophil	60%
Lymphocytes	6%
Basophils	1%
RBC	1.00

Table 2:  
Cerebrospinal  
Fluid indicating  
aseptic  
meningitis

He discontinued TMP-SMX, received supportive care, and improved except a persistent headache and fever. Infectious disease was consulted and collected CSF studies which were consistent with a diagnosis of aseptic meningitis due to TMP/SMX. He recovered spontaneously prior to discharge with a normalized CBC and appropriate follow-up was arranged.

## Discussion

It was concluded that the agranulocytosis and aseptic meningitis were likely a result of TMP/SMX as supported by the improvement upon discontinuing the medication and subsequent worsening upon restarting the suspected drug. This is unusual because the patient was a healthy immunocompetent male, and this condition is seen more frequently in immunocompromised patients. Spontaneous recovery was possible in this case though in more severe or complicated cases of agranulocytosis, filgrastim may be indicated. Since agranulocytosis is asymptomatic, this case highlights the need for surveillance of blood cell counts in patients using TMP/SMX.

## Learning Points

- TMP/SMX has the rare potential for acute agranulocytosis in immunocompetent patients.
- Agranulocytosis is an infrequent but serious and potentially permanent side effect of TMP/SMX.

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# Kappa light chain deposition disease in a previously healthy woman

Christy Jesme, MSIV<sup>1</sup>, Mohamed Toumeh, MD<sup>2</sup>

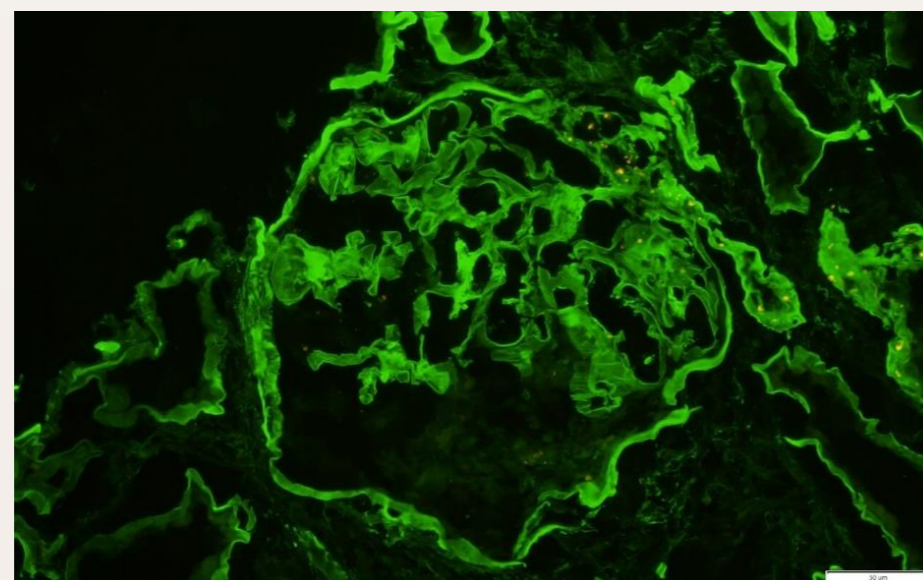
<sup>1</sup> University of North Dakota School of Medicine and Health Sciences Grand Forks, ND

<sup>2</sup> Sanford Health Fargo, ND



## Introduction

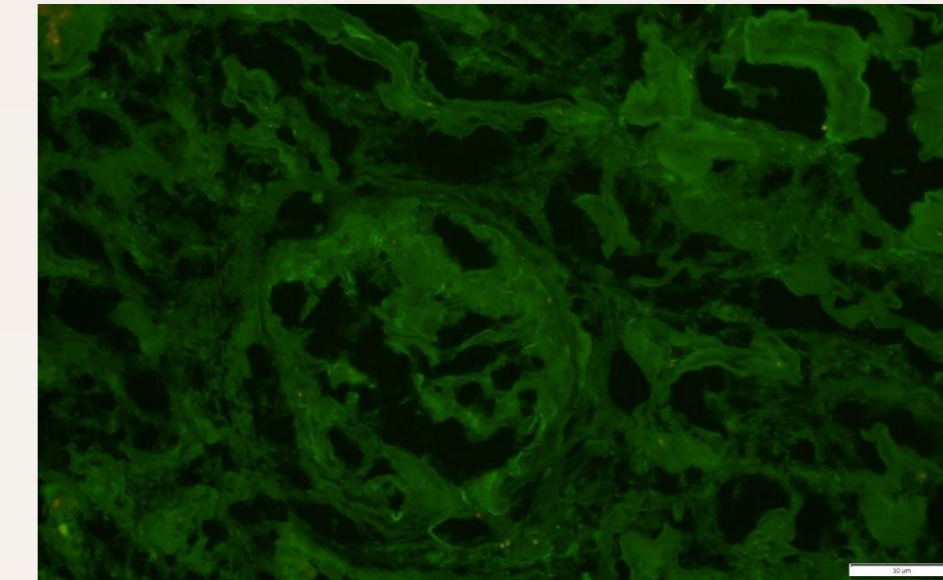
- Light chain deposition disease (LCDD) is an uncommon monoclonal gammopathy characterized by deposition of immunoglobulin light chains in the kidney, with the potential for progression to severe renal dysfunction.
- Each immunoglobulin molecule is composed on two heavy chains and two light chains.
- Light chains consist of the kappa and lambda isotypes which are normally overproduced by 40% in the body and subsequently filtered by the kidney.<sup>1</sup>
- Plasma cell dyscrasia can result in a higher-than-average burden of free light chains (FLCs) which are primarily removed by the proximal tubular cells of the kidney.
- Within the kidney, LCDD can affect the mesangium, the glomerular and tubular basement membranes, and blood vessels.<sup>1</sup>
- Diagnosis is made with immunohistochemistry confirming a single light chain in the mesangium, glomerular basement membrane or Bowman's capsule.
- Although patients with LCDD can have an associated multiple myeloma (MM), about 50% of patients with LCDD are not diagnosed with MM, highlighting the need to screen for lymphoplasmacytic disorders.<sup>2</sup>
- Another diagnostic difficulty presented in LCDD is the potential lack of monoclonal antibody production in serum or urine. This highlights the need for testing via immunohistochemistry staining for FLCs.



**Figure 1.** Glomeruli with 3+ diffuse linear glomerular positivity for kappa light chain.

## Case Description

- A Caucasian female in her mid-60's presented to the clinic with suprapubic pain, dysuria, dark urine and urinary frequency for 11 days at the onset of a diarrheal illness.
- Past medical history was noncontributory, and she was not on any medication.
- PE: BP 110/56, temp 37.2 °C. Suprapubic area tender to palpation. No CVA tenderness. Bowel sounds normoactive.
- Initial labs: RBC 3.31 M/ $\mu$ L, Hgb 9.8 g/dL, WBC 7.0 K/ $\mu$ L, Creatinine 8.77 mg/dL, BUN 57 mg/dL, BUN:Cr 6.5, K+ 5.5 mEq/L, eGFR 5 mL/min/1.73 m<sup>2</sup>. UA: hematuria 3+ and proteinuria 2+. Urine culture: >100,000 CFU/mL *Citrobacter freundii* complex and >100,000 CFU/mL *Serratia marcescens*.
- Patient was referred to higher level care and ceftriaxone was initiated.
- Urine protein: creatinine was 777 mg/g suggesting an underlying glomerular disease
- Serum C3,C4, glomerular basement membrane IgG Ab, ANA, ANCA, MPO Ab, PR3 Ab, HBsAg, Hep C Ab and HIV were negative or within normal limits.
- Serum protein electrophoresis (SPEP) and urine protein electrophoresis (UPEP) with immunofixation showed no monoclonal protein.
- Protein free light chain testing showed serum kappa elevation at 15.4 mg/dL (N 0.03-1.94 mg/dL) and mildly elevated lambda at 2.64 mg/dL (N 0.57-2.63 mg/dL).
- Renal biopsy revealed bright linear glomerular and tubular basement membrane for kappa light chain by immunofluorescence consistent with kappa type LCDD (Figure 1 and 2).
- BM biopsy revealed a plasma cell dyscrasia with increased monoclonal kappa plasma cells (5%). Skeletal survey was negative.
- Patient was started on Cyclophosphamide, Bortezomib, Dexamethasone and Daratumumab.



**Figure 2.** Glomeruli with negative immunofluorescence for lambda light chain.

## Discussion

- LCDD commonly presents with proteinuria, hematuria, and hypertension due to a single clone producing light chain, commonly of the kappa type, which deposits in the kidneys and other organs.
- Immunofluorescence examination is a critical step in the diagnosis of LCDD, revealing the presence of monotypic light chains.
- Early treatment has been found to delay progression to renal failure and postpone death from extrarenal complications or lymphoplasmacytic disorder.<sup>3</sup>
- Autologous stem cell transplantation and Bortezomib treatment have been found to produce sustained hematologic responses in patients with LCDD.<sup>4</sup>

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