



Brief Reviews

Microangiopathic Hemolytic Anemia in Pregnancy

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Abstract

Microangiopathic hemolytic anemia (MAHA) in pregnancy is a rare but life-threatening condition with diverse etiologies. Differentiating pregnancy-related thrombotic microangiopathies (TMAs), such as thrombotic thrombocytopenic purpura (TTP), hemolytic uremic syndrome, disseminated intravascular coagulation (DIC), and hemolysis, elevated liver enzymes, low platelets (HELLP), is critical for timely intervention. This review explores the pathophysiology, diagnostic challenges, and management strategies for MAHA in pregnancy through a patient case. It offers a comprehensive overview of the disease mechanisms, distinguishing diagnostic criteria, and current treatment approaches to aid clinicians in recognizing and managing these complex conditions effectively.

BACKGROUND

Microangiopathic hemolytic anemia (MAHA) refers to a group of hemolytic anemia that causes destruction of erythrocytes in small blood vessels. Most MAHAs present evidence of hemolysis- schistocytes on peripheral blood smear, elevated reticulocytosis, elevated lactate dehydrogenase (LDH), decreased haptoglobin, and increased unconjugated bilirubin levels.¹ MAHA can occur as a consequence of direct red blood cell trauma, such as in a mechanical heart valve or infection. More commonly, MAHA is seen as a part of a thrombotic microangiopathy (TMA).² TMAs are typically characterized by the concurrent presence of MAHA and thrombocytopenia. TMAs can be associated with multiple different causes in the peripartum period and can be difficult to diagnose given the overlapping signs, symptoms, and laboratory values. This article aims to review the diagnostic and management approach of four distinct TMAs and a MAHA mimic in the pregnant population.

CASE PRESENTATION

A 37-year-old G10P3 female presented at 22 weeks and 4 days with abdominal pain, lightheadedness and vaginal bleeding secondary to placenta previa. She was found to have an intrauterine fetal demise and spontaneously went into labor. She subsequently underwent dilation and curettage complicated by postpartum hemorrhage. Prior to her presentation, she reported associated blurry vision, dyspnea, and elevated blood pressure readings at home and headaches. Lab values were significant for severe thrombocytopenia, with a nadir of $34 \times 10^9/L$ (reference

range $150-400 \times 10^9/L$). AST 326 IU/L (reference range 10-42 IU/L), ALT 96 UI/L (reference range 6-45 IU/L), total bilirubin 0.5 mg/dL (reference range 0.2-1.3 mg/dL), creatinine 11.79mg/dL (reference range 0.64-1.27mg/dL), with eGFR of 4 mL/min/1.73 m² (reference range >60 mL/min/1.73 m²), undetectable haptoglobin (reference range 35-250 mg/dL), LDH 2983 IU/L (reference range 119-265 IU/L), hemoglobin 6.4 g/dL (reference range 11.2-14.9 g/dL), ADAMTS13 activity level 48% (reference range 25-100%), PT/aPTT were within reference range, decreased C3 with a normal C4. Overall, the findings of hemolytic anemia, thrombocytopenia and renal dysfunction were highly suspicious for a thrombotic microangiopathic process. After delivery, the patient had improved but had persistent thrombocytopenia and hemolysis with progressively worsening renal function. She was started on eculizumab, a long-acting humanized complement C5 monoclonal antibody. Her thrombocytopenia and hemolysis normalized. However, she had slow recovery of her renal function and had to be initiated on hemodialysis in the interim. Renal biopsy demonstrated thrombotic microangiopathy with focal, global, and diffuse segmental glomerular sclerosis and interstitial fibrosis.

A. DISSEMINATED INTRAVASCULAR COAGULATION (DIC)

Pathophysiology

Disseminated intravascular coagulation (DIC) in pregnancy is usually a sequela of another process: placental abruption; amniotic fluid embolism; sepsis; intrauterine

Table 1. ISTH DIC scoring

Parameter	Score
Platelet count	
$\geq 100 \times 10^9/L$	0
$50-100 \times 10^9/L$	1
$< 50 \times 10^9/L$	2
Fibrin degradation products (D-dimer or FDPs)	
No increase	0
Moderate increase	2
Strong increase	3
Prolongation of PT (>3 sec from normal)	
< 3 seconds	0
3–6 seconds	1
> 6 seconds	2
Fibrinogen level	
> 1.0 g/L	0
≤ 1.0 g/L	1
Scoring System	
Compatible with overt DIC	≥ 5
Suggestive of non-overt or early DIC	< 5

fetal demise (IUFD); hemolysis, elevated liver enzymes, low platelet count (HELLP) syndrome; and hemorrhage, among others.³ The pathophysiology of DIC includes a large inflammatory response that releases proteases, cytokines, and hormones, eventually leading to microvascular endothelial damage. This is accompanied by vasodilation and capillary leak, causing the coagulation cascade's activation and thrombin creation, leading to microthrombus formation.³ This inflammatory state causes excessive clotting, consumption of coagulation factors, fibrinolysis activation, and bleeding.

Diagnosis

The International Society on Thrombosis and Hemostasis (ISTH) created the concept of non-overt DIC by developing a scoring system to identify patients at risk of developing DIC before developing clinical symptoms. The scoring system is dependent on platelet count, elevated d-dimer, prothrombin time, and fibrinogen level, as summarized in [Table 1](#).⁴ A total score of 5 or more makes DIC more likely, versus a score of less than 5 is more compatible with non-overt DIC. It is thought that early identification of non-overt DIC can improve outcomes. However, this score may not apply to this patient population due to the normal physiological changes, such as increased fibrinogen and decreased platelets, that naturally occur during pregnancy.³ Thus, a modified score incorporating platelet count, fibrinogen concentration, and prothrombin time difference (between the patient's PT time and the laboratory reference range) had an 88% sensitivity and 96% specificity in diagnosing DIC during pregnancy.³

Clinical signs of DIC will present as uncontrolled bleeding from multiple sites, such as oozing from intravenous (IV) sites, mucosal membranes, and uterine bleeding. Skin manifestations include petechiae and ecchymoses. Hypotension and consequent shock can develop in severe cases along with organ dysfunction, such as renal failure, liver dysfunction, and respiratory distress.⁴

Management

The cornerstone of management is treating the underlying cause. This may involve prompt delivery in DIC cases caused by HELLP syndrome or placental abruption, or initiating antibiotic therapy if sepsis is the source.³ Supportive therapy, such as blood, cryoprecipitate, fresh frozen plasma, and platelets, can be given if significant bleeding occurs. Patients in DIC frequently require higher levels of care for vasopressor support. Untreated DIC is associated with high mortality rates.

B. HEMOLYTIC UREMIC SYNDROME (HUS)

Pathophysiology

Hemolytic Uremic Syndrome (HUS) is a type of TMA associated with poor renal prognosis. It is characterized by hemolytic anemia, thrombocytopenia, and renal dysfunction. Furthermore, HUS can be divided into two categories: typical HUS and atypical (aHUS).⁵ Typical HUS usually occurs after a Shiga toxin-producing *Escherichia coli* (STEC) infection, accounting for 90% of HUS cases. Whereas aHUS is usually caused by uncontrolled complement activation or as a sequela of a co-existing disease. Atypical HUS accounts for only about 10% of cases.⁶ Seventy-five percent of pregnancy-related HUS occurs up to 3 months after delivery, making it the most common TMA to occur post-partum.⁷ Approximately 10-20% of aHUS is diagnosed during pregnancy.⁷ The normal physiology of pregnancy works on a few vascular pathways that work to amplify complement activation. Firstly, pregnancy is a prothrombotic state, which leads to platelet activation and the promotion of the complement cascade.

In aHUS, the complement pathway becomes unregulated due to mutations in alternative pathway initiator genes, regulatory proteins, or autoantibodies. The most common mutation in aHUS is a variant of the complement factor H (CFH), which creates the main regulatory protein in the alternative complement pathway.⁶ This mutation, along with a second inciting factor, such as infection or pregnancy, due to the presence of fetal cells and placental tissue in maternal circulation, enables aHUS to develop. Hormones, such as estrogen and progesterone, which both increase during pregnancy, also work to up-regulate C3 and C4 proteins and can increase complement activation.⁷

Diagnosis

Hemolytic uremic syndrome (HUS) presents with evidence of intravascular hemolysis, thrombocytopenia, and acute kidney failure. Typical HUS is classically associated with a preceding history of bloody diarrhea that occurs 2 to 3 days after exposure, along with vomiting, which presents in two-thirds of patients, and abdominal pain occurs in one-third of patients.⁶ The clinical presentation of atypical HUS includes nonspecific symptoms such as fatigue, pallor and somnolence. These symptoms can progress to signs of acute kidney injury.⁶

Management

The treatment for typical HUS is usually supportive. Most patients require volume resuscitation due to their gastrointestinal losses during acute illness. Antibiotics are typically avoided in HUS caused by STEC. In atypical HUS, early treatment is necessary to avoid permanent renal function and progression to avoid end-stage renal disease (ESRD). First-line treatment includes early use of complement inhibitors such as eculizumab or ravulizumab, recombinant monoclonal antibodies that inhibit C5 cleavage. Studies have shown that eculizumab treatment can decrease the progression to ESRD or death from 60% down to 6-15% in adults.⁸ Prior to complement inhibitors, plasma exchange was the standard of care for aHUS. Contraindications to complement inhibitors include Shiga toxin-mediated HUS as it will not be effective. Other contraindications include patients with a high-risk of meningococcal infection. Furthermore, patients are required to have meningococcal vaccination at least 2 weeks before initiating therapy with eculizumab.⁹ Patients who are started on complement inhibitor therapy emergently require bridging antibiotic therapy in addition to the administration of meningococcal vaccination.

C. HELLP SYNDROME (HEMOLYSIS, ELEVATED LIVER ENZYMES, LOW PLATELETS)

Pathophysiology

HELLP is a syndrome that occurs in pregnant and postpartum individuals that represents a severe form of preeclampsia. While the pathogenesis of HELLP is still unclear, it is believed to be in part due to complement dysregulation, which leads to microvascular endothelial damage and intravascular platelet activation, leading to TMA. Pathophysiology is also attributed to abnormal vascular tone, vasospasm, and coagulation defects.¹⁰ It presents antepartum in 69% of patients and postpartum in 31% of patients.¹⁰

Diagnosis

The Tennessee criteria can be used to diagnose HELLP. The criterion for diagnosis includes hemolysis, anemia, elevated liver enzymes, and thrombocytopenia. This criterion is similar to the American College of Obstetricians and Gynecologists (ACOG), as compared in [Table 2](#), which requires the following three criteria to be met in order to diagnose HELLP. Alternatively, HELLP can be classified based on platelet nadir. Class 1 is defined as less than $50,000 \times 10^9 / L$, class 2 is platelets between $50-100,000 \times 10^9 / L$ and class 3 is 100 to $150 \times 10^9 / L$. Class 1 is associated with a higher risk of maternal morbidity and mortality than patients in classes 2 and 3.¹⁰

Clinical signs are generally vague, such as generalized fatigue, epigastric pain, nausea, vomiting, headache, right upper quadrant abdominal pain, hypertension, proteinuria, and hepatic dysfunction.¹⁰ Right upper quadrant tenderness presents in approximately 90% of patients with HELLP.¹¹ Postpartum presentation typically occurs within the first 48 hours after delivery but can occur up to 7 days after delivery.

Management

Management of HELLP is dependent on the estimated gestational age (EGA). For EGA >34 weeks, the mainstay of management is prompt delivery. For EGA between 32-34 weeks, a course of betamethasone should be administered for fetal lung development before delivery is attempted after 48 hours.¹² In all cases of HELLP, magnesium should be given for maternal seizure prophylaxis.¹⁰ The most important factors to follow are maternal LDH and platelet counts.¹⁰ The peak of LDH levels signals the beginning of recovery and foreshadows normalization of platelet count.¹⁰ The platelet nadir can be somewhat predictive of hemorrhagic complications. There is a higher incidence of hemorrhagic complications with platelet counts under $40 \times 10^9 / L$.¹⁰ Liver enzymes do not correlate with the severity of HELLP syndrome. Patients who have a history of HELLP have a 19-27% risk of developing HELLP in subsequent pregnancies.¹⁰ The United Preventive Services Task Force (USPSTF) guidelines recommend that patients with one or more high risk factors should get prophylactic aspirin.¹³ These risk factors include a history of preeclampsia, multifetal gestation, chronic hypertension, diabetes mellitus, kidney disease and autoimmune disease.¹³ Corticosteroids have also been found to improve platelet count and reduce hospital and ICU stay; however, they do not significantly improve maternal mortality and overall morbidity rates.¹⁴ The evidence on the use of eculizumab in HELLP is limited, but isolated case studies have been reported, supporting the hypothesis that HELLP is a complement-mediated condition.¹⁵

Table 2. Tennessee versus ACOG diagnostic criteria for HELLP

Feature	Tennessee Classification	ACOG Criteria
Primary Purpose	Defines severe HELLP syndrome	Identifies mild and severe HELLP
Hemolysis (MAHA)	Required (schistocytes, low haptoglobin, elevated bilirubin >1.2 mg/dL)	Required (Peripheral smear evidence or bilirubin >1.2 mg/dL or low haptoglobin)
LDH (Lactate Dehydrogenase)	>600 IU/L	>600 IU/L
AST/ALT (Liver Enzymes)	AST/ALT >70 IU/L	AST/ALT $\geq 2 \times$ upper limit of normal (≈ 70 IU/L)
Platelet Count	$\leq 100 \times 10^9/L$	$\leq 100 \times 10^9/L$ (Class I) $100-150 \times 10^9/L$ (Class II & III)
Classification Tiers	only detects severe HELLP	Class I: Platelets $\leq 50 \times 10^9/L$ Class II: Platelets $50-100 \times 10^9/L$ Class III: Platelets $100-150 \times 10^9/L$

D. THROMBOTIC THROMBOCYTOPENIC PURPURA (TTP)

Pathophysiology

Thrombotic thrombocytopenic purpura (TTP) is a type of TMA caused by reduced activation of metalloprotease ADAMTS13. This metalloprotease works by cleaving von Willebrand factor, a protein involved in platelet adhesion and aggregation. A deficiency in ADAMTS13 can lead to microvascular thrombosis, thrombocytopenia and hemolytic anemia. There are two broad classes of TTP, immune and hereditary. Hereditary TTP occurs when there is a mutation in the ADAMTS13 gene leading to a congenital deficiency of the enzyme. Immune TTP occurs when acquired auto-antibodies inhibit ADAMTS13, leading to reduced enzyme activity.¹⁶ Pregnancy can precipitate acute episodes of both categories of TTP; they typically occur during the end of the 3rd trimester. Pregnancy-associated TTP accounts for 12-25% of adult TTP cases. The risk could be due to the normal physiological changes that occur during gestation – von Willebrand factor concentrations rise throughout pregnancy, peaking in the last trimester, while ADAMTS13 activity levels decrease.¹⁶ While TTP is much less common than HELLP and preeclampsia, it has a high fetomaternal mortality if left untreated, which requires providers to keep a high suspicion in the right clinical scenario.

Diagnosis

During an episode of TTP, laboratory values tend to be drastically out of range. Thrombocytopenia tends to be severe (i.e., $< 30,000/\mu L$) when compared to HUS, hemoglobin usually < 8.0 g/dL and LDH > 2 times the upper limit of normal with mild elevation in creatinine and transaminitis.¹⁷ One respective study found that an elevated LDH to AST ratio, over 70, in the post-partum period can help differentiate TTP from HELLP.¹⁶ The most sensitive and specific test would be an ADAMTS13 activity level $< 10\%$; however, this test is not readily avail-

able in all health systems and can often have a turnaround time of days to weeks. Clinically, TTP has neurologic manifestations similar to the other TMAs, such as headaches, confusion, abdominal pain, nausea and vomiting. The diagnosis of TTP should be based on clinical and laboratory studies. As soon as the diagnosis is suspected, treatment should be initiated. Some grading tools have been created to help providers distinguish between TTP and HUS, such as the plasmic score versus the French score, as outlined in [Table 3](#).¹⁸ However, the French score has reduced sensitivity in elderly patients, given the potential for baseline chronic kidney disease. The classic presenting pentad of TTP includes fever, thrombocytopenia, MAHA, neurologic abnormalities, and renal failure.¹⁵ However, it has been shown that this pentad is neither sensitive nor specific to diagnosing TTP, as a majority of patients do not have all five clinical symptoms.

Management

While TTP is a medical emergency, with early recognition and prompting initiation of treatment there is a 90% survival rate.¹⁹ Treatment includes plasma exchange (PLEX) and urgent delivery of the fetus in pregnancy-associated TTP. Besides delivery, the treatment for pregnancy-associated TTP is similar to typical cases of TTP. Although anti-CD20 therapy, such as rituximab, has been reported as a last resort therapy in life-threatening pregnancy associated TTP, rituximab should be avoided due to lack of high-quality evidence during pregnancy and should only be considered in the postpartum period.¹⁹ Other important treatment in all cases of TTP includes the initiation of corticosteroids for immunosuppression given development of an inhibitor to ADAMTS13. Daily PLEX should be started as early as possible and continued until the normalization of platelet counts.

Fresh frozen plasma infusions can be a temporary alternative when PLEX is not readily available. The goal is to correct the ADAMTS13 deficiency, which usually requires 10 to 15 mL/kg daily.¹⁹ Platelet transfusion is

Table 3. Comparing PLASMIC score to French score to differentiate TTP

Feature	PLASMIC Score (7 points)	French Score (3 points)
Primary Purpose	Predicts severe ADAMTS13 deficiency (<10%)	Predicts clinical likelihood of TTP
Platelet count	<30 × 10 ⁹ /L (1 point)	<30 × 10 ⁹ /L (1 point)
Hemolysis Evidence	Elevated bilirubin, low haptoglobin, or reticulocytosis (1 point)	Not included
Cancer Status	No active cancer (1 point)	Not included
Transplant History	No solid organ or stem cell transplant (1 point)	Not included
Coagulation (INR)	INR <1.5 (suggesting absence of DIC) (1 point)	Not included
Renal Function	Creatinine <2.0 mg/dL (1 point)	Creatinine <2.0 mg/dL (1 point)
MCV (Mean Corpuscular Volume)	MCV <90 fL (absence of macrocytosis) (1 point)	Not included
Neurological Symptoms & Fever	Not included	Presence of fever and/or neurologic symptoms (1 point)
Scoring Range	0–7 points	0–3 points
Risk Interpretation	0–4: Low risk TTP (≤5% ADAMTS13 <10%) 5: Intermediate risk (~50%) 6–7: High risk (≥90%) → Start PEX	0–1: Low probability of TTP 2–3: High probability → Start PEX
Sensitivity/Specificity	High sensitivity and specificity for severe ADAMTS13 deficiency	Simpler but less comprehensive
Best Use Case	More detailed; better for differentiating TTP from other TMAs	Quick bedside assessment for TTP

generally avoided unless there are signs of bleeding as this can lead to exacerbation of the TTP. Clinical remission is achieved when platelets and LDH normalize. If remission is achieved, then pregnancy can be carried on if safe for the maternal and fetal livelihood. Treatment during pregnancy should be determined by the severity of TTP. For more benign cases, steroids should be used to suppress autoantibody production; however, in more severe cases, PLEX may need to be continued throughout pregnancy and postpartum.¹⁹ ADAMTS13 levels should be checked monthly to ensure remission, to maintain activity levels > 10%. A target goal of an ADAMTS13 activity level > 20% is preferred after resolution of TTP, as this is the nadir of activity level during pregnancy, and reduced activity levels < 25% in the 1st trimester might be associated with increased risk of complications such as miscarriage.²⁰ The role of aspirin or low dose molecular weight heparin for thromboprophylaxis is controversial; however, some studies suggest it may be helpful in immune or hereditary TTP.²¹

E. ACUTE FATTY LIVER OF PREGNANCY

Pathophysiology

Acute fatty liver of pregnancy (AFLP) is an obstetric emergency. While the pathophysiology remains unclear, a small proportion of AFLP cases occur due to a defect in beta- fatty acid oxidation, specifically a deficiency in the long chain 3 hydroxy acyl CoA dehydrogenase (LCHAD) which is found in 20% of AFLP.²² In the third trimester, energy is more dependent on fatty acid metabolism. The genetic accumulation of maternal and fetal fatty acid oxidation enzymes can build up harmful

metabolites that the maternal liver cannot process. When the mitochondria are overwhelmed, it can lead to lipotoxicity, oxidative damage which can cause microvesicular fatty infiltration and necrosis of hepatocytes. This liver dysfunction can lead to coagulopathy and encephalopathy.²³ Recurrence of AFLP in subsequent pregnancies is usually rare. Risk factors include younger age, lower BMI, nulliparity and multifetal pregnancies.²²

Diagnosis

AFLP typically occurs in the third trimester between gestational weeks 30 and 38. AFLP is not considered a true MAHA however its presenting symptoms and lab values make it a MAHA mimic. The presenting symptoms are non-specific and can include malaise, nausea, vomiting, and epigastric pain in 50% of cases.²³ Aminotransferases are typically in the hundreds IU/L and can sometimes exceed 1,000 IU/L.²³ A metabolic acidosis with an elevated lactate acid is also common. As the disease progresses, patients become more altered and develop signs of hepatic encephalopathy. The most used diagnostic criteria is the Swansea Criteria for AFLP, the diagnostic criteria must include six or more of the clinical symptoms or laboratory values outlined in [Table 4](#), in the absence of an alternative diagnosis.²³ In a retrospective study involving 62 patients, the Swansea scoring system demonstrated a 100% negative predictive value and an 85% positive predictive value when evaluating the validity of its diagnostic criteria.²⁴ This means if a patient does not meet Swansea criteria, they are unlikely to have AFLP but if they do meet criteria there is a 15% chance of false positivity. Liver biopsy is not necessary for the diagnosis and is rarely performed due to rapid clinical deterioration. However, if

Table 4. Swansea Criteria for Acute Fatty Liver of Pregnancy

Swansea Criteria	
Vomiting	Persistent vomiting, often severe
Abdominal pain	Especially in the right upper quadrant
Polydipsia/polyuria	Excessive thirst and urination, may indicate diabetes insipidus-like picture
Encephalopathy	Confusion, altered mental status
Elevated bilirubin	>14 $\mu\text{mol/L}$ (about >0.8 mg/dL)
Hypoglycemia	<4 mmol/L (about <72 mg/dL)
Elevated uric acid	>340 $\mu\text{mol/L}$
Leukocytosis	White cell count >11 $\times 10^9/\text{L}$
Ascites or bright liver on ultrasound	Ultrasound findings suggestive of liver fatty infiltration
Elevated transaminases	AST or ALT >42 IU/L
Elevated ammonia	>47 $\mu\text{mol/L}$
Renal impairment	Serum creatinine >150 $\mu\text{mol/L}$
Coagulopathy	Prothrombin time >14 sec or APTT >34 sec
Microvesicular steatosis on liver biopsy	Histological confirmation

performed, a biopsy would demonstrate microfollicular fatty infiltration in hepatocytes.²³ AFLP can present similar to HELLP; however, compared to HELLP, AFLP is more associated with hypoglycemia and prolonged prothrombin time.²³

Management

Supportive care and prompt fetal delivery are the mainstays of treatment for AFLP. The American College of Gastroenterology (ACG) clinical guidelines recommend prompt delivery for AFLP.²⁵ Based on their guidelines, expectant management alone is not appropriate. Maternal supportive care with the goal of clinical stabilization of blood sugar, electrolytes, and blood counts should be initiated first along with continuous fetal heart rate monitoring.²⁵ The route of delivery depends on the risk of fetal or maternal decompensation. Cesarean delivery happens in many cases due to distress and high risk of deterioration.²³ ACG recommends platelets to be at a minimum 40,000 to 50,000 mcl for cesarean delivery to be safely performed.²⁵ Magnesium sulfate should be given to pregnancies under 32 weeks gestation for fetal neuroprotection and the prevention and treatment of seizures. However, magnesium is not standard treatment in AFLP as it does not treat the underlying cause of the disorder. A full recovery of hepatic function usually occurs after the days following delivery with no long-term sequelae.²³ If hepatic dysfunction does not reverse after pregnancy, the patient may benefit from undergoing liver biopsy and should be evaluated for liver transplantation.²³ After delivery, the child should undergo molecular testing of LCHAD deficiency.²³

CONCLUSION

This review highlights the importance of a systematic approach to evaluating and differentiating between thrombotic microangiopathies and mimics in pregnancy, including TTP, HUS, DIC, HELLP, and AFLP, as outlined in [Table 5](#). The patient discussed in this article most likely had atypical HUS. Her kidney biopsy results show decreased complement levels, which makes atypical HUS more likely. The resolution of her hemolytic anemia and thrombocytopenia after the initiation of a C5 monoclonal antibody suggests that the underlying diagnosis was due to inappropriate complement activation. DIC was excluded because even though she had signs of DIC, which was thought to be secondary to intrauterine fetal demise, prompt delivery of the fetus did not lead to resolution of her hemolysis and other lab abnormalities. TTP was also ruled out because her ADAMTS13 activity level was 48%. She fit both the Tennessee and ACOG diagnostic criteria for HELLP due to her LDH, hemoglobin, elevated liver enzymes and low platelets. She would be further classified as class 1 HELLP due to her severe thrombocytosis. She initially started on 900mg of eculizumab every week for her induction period and then transitioned to maintenance dosing of 1,200mg every other week. After 6 doses of eculizumab, her kidney function made a partial recovery, and she was taken off dialysis. She ultimately required dialysis for three months. Her creatinine improved to 3.22 mg/dL when she was taken off dialysis, most recently it was 2.41 mg/dL from an initial 10.96 mg/dL. She is currently being evaluated for renal transplantation due to a plateau of her renal function after discontinuation of dialysis. Due to the necessity for prolonged treatment of aHUS, she was transitioned to ravulizumab, as it is a longer-acting version of eculizumab that requires maintenance infusion once every eight weeks.²⁶ The resolution of her hemolysis and

Table 5. Comparing and Contrasting Between MAHA and MAHA-like entities

Feature	DIC	aHUS	HELLP	TTP	AFLP
Onset	Sudden	Late/Postpartum	3rd Trimester	Late pregnancy	3rd Trimester
Etiology	Secondary	Complement dysregulation	Endothelial dysfunction	Decreased ADAMTS13	FAO defect (LCHAD)
Classified as MAHA?	Yes	Yes	Yes	Yes	No
Hemolysis	+	+	+	+	+
Platelets	↓	↓↓	↓↓	↓↓↓	↓
Liver Enzymes	↑	Normal	↑↑	↑	↑↑
Renal Involvement	Often	Severe	Mild	Moderate	Mild
Coagulation (PT/aPTT)	↑	Normal	Normal	Normal	↑
Fibrinogen	↓	Normal	Normal	Normal	↓
Neurologic Symptoms	Possible	Rare	Rare	Common	Possible
Key Treatment	Supportive	Eculizumab	Delivery	Plasma exchange	Delivery
Prognosis	Variable	Poor without treatment	Good with delivery	High mortality without treatment	Good with early delivery

thrombocytopenia after initiation of eculizumab could be in part due to the theory that HELLP is partially driven by complement dysregulation. Hematologic emergencies in pregnancy present with overlapping clinical features but require distinct diagnostic approaches and treatment strategies.

- Final approval of the version to be published; AND
- Agreement to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

Disclosures/Conflicts of Interest

The authors declare they have no conflicts of interest

Author Contributions

All authors have reviewed the final manuscript prior to submission. All the authors have contributed significantly to the manuscript, per the International Committee of Medical Journal Editors criteria of authorship.

- Substantial contributions to the conception or design of the work; or the acquisition, analysis, or interpretation of data for the work; AND
- Drafting the work or revising it critically for important intellectual content; AND

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