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Acute kidney injury in pregnancy: the thrombotic microangiopathies

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Abstract

Acute kidney injury (AKI) is a rare but serious complication of pregnancy. Although prerenal and ischemic causes of AKI are most common, renal insufficiency can complicate several other pregnancy-specific conditions. In particular, severe preeclampsia/HELLP syndrome, acute fatty liver of pregnancy (AFLP) and thrombotic thrombocytopenic purpura (TTP) are all frequently complicated by AKI, and share several clinical features which pose diagnostic challenges to the clinician. In this article, we discuss the clinical and laboratory features, pathophysiology and treatment of these 3 conditions, with particular attention to renal manifestations. It is imperative to distinguish these conditions to make appropriate therapeutic decisions which can be lifesaving for the mother and fetus. Typically AFLP and HELLP improve after delivery of the fetus, whereas plasma exchange is the first-line treatment for TTP.

Key words: *Acute fatty liver of pregnancy, Acute renal failure, Preeclampsia, Pregnancy, Thrombotic thrombocytopenic purpura*

Introduction

Acute kidney injury (AKI) is an unusual but dreaded complication of pregnancy. Fortunately, the incidence of AKI in pregnancy has dramatically decreased over the last 50 years, owing mainly to the decreased rate of septic abortion and improved obstetric care (1-3). Pregnancy is associated with a physiologic increase in glomerular filtration rate (GFR) of 50%-80%, accompanied by an increase in plasma volume (4). Together, these result in a normal gestational fall in serum creatinine, which can easily mask mild AKI. Indeed, a consensus definition of AKI in pregnancy has not been established. The Risk of Renal Failure, Injury to Kidney, Failure of Kidney Function, Loss of Kidney Function, and End-stage Renal Failure (RIFLE) criteria, a classification scheme based on changes in urine output or changes in serum creatinine from baseline, have been shown to have prognostic utility in nonpregnant patients (5), but there are few studies reporting their application in pregnancy (6). Nevertheless, they provide a reasonable benchmark for clinicians evaluating pregnant subjects. Proteinuria also increases with normal pregnancy (up to 300 mg/day) without necessarily implying renal pathology (7). As in the causes of AKI in the general adult population, those during pregnancy can be broadly categorized into prerenal, postrenal (obstructive) and intrinsic renal injury. Although any form of AKI that affects adults of child-bearing age can also affect pregnant women, several causes are particularly common in pregnant women (Tab. I).

Prerenal azotemia is the most common cause of AKI in pregnancy, most often occurring in the setting of conditions such as hyperemesis gravidarum and uterine hemorrhage due to uterine laceration or postpartum bleeding. Obstructive uropathy due to ureteral obstruction is a rare cause of acute renal failure in pregnancy, though physi-

TABLE I
PREGNANCY-ASSOCIATED CAUSES OF ACUTE KIDNEY INJURY

Renal hypoperfusion (prerenal)	
	Hyperemesis gravidarum
	Obstetrical hemorrhage
	Placental abruption
	Postpartum hemorrhage
Acute tubular injury, including acute cortical necrosis	
	Severe hypovolemia or hemorrhage (see above)
Sepsis-associated	
	Pyelonephritis
	Septic abortion
	Endometritis and chorioamnionitis
	Pneumonia
Thrombotic microangiopathy	
	Acute fatty liver of pregnancy
	Preeclampsia/HELLP syndrome
	Thrombotic thrombocytopenic purpura (TTP)
Ureteral obstruction (rare)	
	Nephrolithiasis
	Bilateral ureteral obstruction due to distended gravid uterus

ologic hydronephrosis is common. Ischemic AKI can occur in association with severe postpartum hemorrhage, placental abruption or sepsis, particularly with acute pyelonephritis, a common complication of pregnancy. Primary or secondary glomerulonephritis, especially in association with systemic lupus erythematosus (which tends to affect young women), can present as acute or rapidly progressive glomerulonephritis in pregnancy.

Pregnant women are particularly prone to syndromes of thrombotic microangiopathy: acute fatty liver of pregnancy (AFLP), preeclampsia and the syndrome of hemolysis, elevated liver enzymes and low platelets (HELLP) and thrombotic thrombocytopenic purpura (TTP). These syndromes, all of which are frequently complicated by AKI, share several pathophysiologic features and can be difficult to distinguish clinically. The pathogenesis, diagnosis and management of AKI complicating these 3 syndromes will be the focus of this review.

HELLP syndrome and severe preeclampsia

Introduction

Severe preeclampsia and the HELLP syndrome account for about 40% of cases of AKI in pregnancy (8). Up to 20% of women with severe preeclampsia develop HELLP syndrome, a constellation of hemolysis, liver injury, and thrombocytopenia (9-11). Acute renal failure occurs in approximately 1% of women with severe preeclampsia (8) and 3%-15% of women with HELLP syndrome (12-14), and renal failure can occur either antepartum or in the early postpartum period (10, 11, 14).

Clinical features

Preeclampsia is defined as the new onset of persistent hypertension (systolic blood pressure ≥140 mm Hg or diastolic blood pressure ≥90 mm Hg) and proteinuria (>300 mg in a 24-hour urine collection) after 20 weeks gestation (15). Although preeclampsia can be asymptomatic, especially in the early stages or with mild disease, symptoms can include epigastric and right upper quadrant pain, nausea, vomiting, headache, blurry vision and the sudden onset of edema (13, 14).

The HELLP syndrome almost always occurs in the setting of preeclampsia, and is considered to be a form of severe preeclampsia. The characteristic laboratory abnormalities of HELLP syndrome include hemolysis (anemia, decreased haptoglobin, increased lactate dehydrogenase [LDH] and peripheral smear consistent with red cell destruction), elevated liver enzymes and low platelet count. The platelet count is a marker of the severity of the disease and coincides with liver impairment (9).

Thrombocytopenia is often the first sign of HELLP syndrome, hence any patient with a significant drop in platelet count during the antenatal period should be suspected of the disease. Severe thrombocytopenia is associated with a higher incidence of postpartum bleeding complications, and transfusion of platelets appears to improve outcomes (16). The platelet count tends to decrease until 24-48 hours after delivery. Recovery begins after the LDH level peaks followed by normalization of the platelet count (17). In women with severe thrombocytopenia (platelet count <20,000/mm^3) and microangiopathic hemolytic anemia, the diagnosis of TTP and initiation of

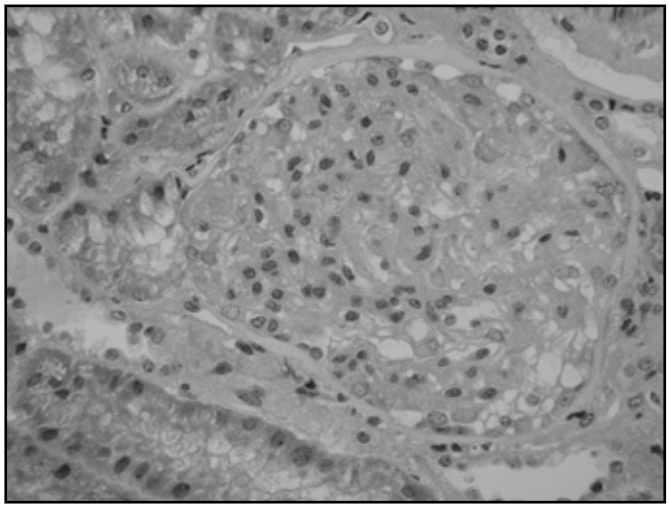

Fig. 1 - Glomerular endotheliosis in preeclampsia. Renal biopsy from a woman with preeclampsia at 22 weeks gestation. Note occlusion of capillary lumens by swelling of endocapillary cells (hematoxylin and eosin stain, magnification ×40) (light micrograph courtesy of I. Stillman, Beth Israel Deaconess Medical Center).

plasma exchange should be considered (see below).
Maternal mortality in HELLP syndrome is about 1%, and is most often due to cardiopulmonary complications, infection or ruptured hepatic hematoma (10). Perinatal mortality in HELLP syndrome ranges from 7%-20%, most often in association with severe prematurity, fetal growth restriction or placental abruption. When HELLP syndrome is complicated by AKI, the risk of perinatal death is even higher (26%) and increases with severity of the renal injury (12).

Renal complications

Estimates regarding the incidence of acute renal failure in HELLP syndrome/severe preeclampsia vary, likely reflecting wide variations in case mix and disease severity in various studies. The largest study estimated that AKI complicates 3% of severe HELLP syndrome cases (17). AKI most often develops in the setting of severe complications such as placental abruption, disseminated intravascular coagulation, sepsis, postpartum bleeding or fetal death (10, 12, 13), and the likelihood of renal failure increases with the severity of HELLP syndrome (9). Conversely, the presence of renal failure is associated with increased maternal morbidity, primarily due to cardiopulmonary complications including pulmonary edema, pleural effusions and cerebral edema (10). Maternal mortality in AKI complicating HELLP syndrome has been reported to be as high as 13% in studies performed in the 1980s (10); more recent reports suggest a much lower incidence (12, 18).
Patients with HELLP syndrome and acute renal failure require intensive monitoring and many (30%-50%) require transient dialysis (10, 11). Renal function typically improves following delivery. Persistent renal failure and the need for long-term dialysis is unusual but can occur, especially in women with preexisting hypertension (10, 11).
Renal biopsy is rarely needed because renal function typically recovers after delivery, hence data on renal pathology in HELLP are sparse. Thrombotic microangiopathy with endovascular damage and glomerular endotheliosis is the hallmark renal lesion associated with the severe proteinuria characteristic of preeclampsia (see Fig. 1). In the setting of acute renal failure and HELLP, limited case series suggest acute tubular necrosis as a nearly universal pathologic finding (19-22).

Management

Management of the HELLP syndrome is generally supportive, and the major management decision is the timing of delivery. The decision about when to deliver is based on the gestational age and the overall maternal and fetal condition; however, with severe maternal disease such as renal failure, expedient delivery is almost always appropriate.
A potential therapeutic role for corticosteroids in HELLP syndrome was first recognized in the 1990s. Several small uncontrolled trials suggested that antepartum or postpartum administration of high-dose steroids improves clinical outcomes (23-26). Unfortunately, the first large (n=132) double-blinded randomized controlled trial showed no significant benefit of steroids for the HELLP syndrome in terms of hospital length of stay, time to recovery of laboratory parameters or development of complications (27).
Based on the potential overlap with TTP (see below), some have suggested plasma exchange be considered in women with severe HELLP which persists for more than 72 hours after delivery, or if there is evidence of life-threatening microangiopathy. Unfortunately, there are no prospective clinical trials to support or discredit its use; but if the diagnosis of TTP is considered, plasmapheresis may be appropriate.
Intravenous magnesium sulfate is the standard of care in patients with severe preeclampsia, to prevent seizures. It is generally administered as a continuous infusion, and patients with renal impairment should be especially

closely monitored for signs of toxicity, as magnesium excretion may be decreased in these patients.
Supportive care should include antihypertensive medication, especially in women with severe hypertension (systolic blood pressure above 160 mm Hg or diastolic blood pressure above 110 mm Hg) (15). Labetalol, long-acting nifedipine, nicardipine and methyldopa are the most commonly used agents. Hydralazine, a popular choice among obstetricians for many years, has recently been associated with adverse maternal and fetal outcomes (maternal hypotension, maternal oliguria, placental abruption and low Apgar scores) and is no longer considered a first-line treatment (28). Sodium nitroprusside, angiotensin-converting enzyme inhibitors, and angiotensin receptor blockers should be avoided in pregnancy.

Long-term cardiovascular and renal outcomes after preeclampsia

Previously, women with preeclampsia were reassured that the syndrome remits completely after delivery, with no long-term consequences aside from increased preeclampsia risk in future pregnancies. Epidemiologic studies have refuted this claim: over 50% of women with preeclampsia develop hypertension later in life (29). The relative risks of subsequent ischemic heart disease, stroke and cardiovascular mortality are more than doubled in women who have had preeclampsia (29). Severe preeclampsia, recurrent preeclampsia, preeclampsia with preterm birth and preeclampsia with intrauterine growth restriction are most strongly associated with adverse cardiovascular outcomes. Preeclampsia has also recently been recognized as a major risk factor for chronic kidney disease: a large Norwegian study, using birth and renal registry data on over 570,000 women, showed that preeclampsia increases the risk of subsequent end-stage renal disease by almost fivefold (30). No data are available on long-term renal outcomes in women with AKI in the setting of preeclampsia/HELLP syndrome.

Acute fatty liver of pregnancy

Introduction

Acute fatty liver of pregnancy (AFLP) is a sudden catastrophic illness of acute liver failure with coagulopathy that affects women in the third trimester of pregnancy. Early diagnosis and immediate delivery are essential for maternal and fetal survival. AFLP is estimated to affect between 1/7000 and 1/20,000 pregnancies (31-33). Though uncommon, AFLP is important to recognize because delayed diagnosis can lead to significant maternal and perinatal morbidity and mortality.
Unfortunately, the literature on AFLP is limited to case series and small, retrospective studies. Early reports suggested maternal and fetal mortality rates as high as 85% in pregnancies complicated by AFLP (34). However, recent case series report much lower maternal mortality (0-12.5%) (31, 33, 35-37). This improvement in outcomes is attributed to earlier diagnosis, increased awareness of the disease, intensive obstetric monitoring and widespread availability of safe emergent delivery of the fetus. Hence, fetal and perinatal mortality rates have also improved, ranging from 6.6% to 15% (33, 35-37).

Clinical features

AFLP characteristically begins in the third trimester of pregnancy with a prodromal phase of nonspecific symptoms including fever, malaise, anorexia, myalgia, nausea, vomiting and epigastric pain. Jaundice typically follows several days later. The severity of liver involvement is highly variable, ranging from moderate isolated transaminitis to fulminant hepatic failure with encephalopathy and coagulopathy (31, 36, 37).
Characteristic laboratory abnormalities include hyperbilirubinemia, increased transaminases, hypoglycemia and leukocytosis. Evidence of coagulopathy is a key feature, with hypofibrinogenemia, prolonged prothrombin time, depressed antithrombin III levels, and thrombocytopenia (38). AFLP is a diagnosis of exclusion, once viral hepatitis and biliary obstruction have been excluded. Hepatitis E infection is a particularly common cause of viral hepatitis in pregnancy, and the absence of hypertension is a clinical clue which should suggest viral hepatitis rather than AFLP (39).

Acute kidney injury in acute fatty liver of pregnancy

AKI is a common complication of AFLP, though the exact incidence is unclear. Small case series of patients with AFLP (less than 30 subjects per report) describe rates of renal insufficiency that vary from 20% to 100%; however, criteria for the diagnosis of AKI in these reports are inconsistent (31, 36, 37). Renal insufficiency in AFLP is usually nonoliguric, although oliguria and acute tubular necrosis can occur in the setting of hemorrhage-induced hypovolemia (31, 37). Proteinuria and peripheral edema are common, usually reflecting coexisting preeclampsia (see below) (35, 37,

40). Renal recovery typically follows delivery, and dialysis is rarely needed (31, 37).

The renal lesion in AFLP is nonspecific, and the pathophysiology is obscure. It may be due to hemodynamic changes akin to those seen in the hepatorenal syndrome or to a thrombotic microangiopathy. Renal biopsy and autopsy studies have shown mild glomerular hypercellularity with thick, narrow capillary loops and tubular free fatty acid accumulation, suggesting that abnormal fatty acid oxidation may contribute to renal dysfunction. Electron microscopy shows diffuse subendothelial deposits of fibrin/fibrinogen, IgM, IgG and C3 (41).

Treatment

Early diagnosis, supportive care and prompt delivery are critical in the management of AFLP. Hemodynamic monitoring is occasionally needed to assess volume status and optimize renal perfusion. Transfusion of blood products is often needed to correct anemia and coagulopathy. Hepatic encephalopathy is treated with a high carbohydrate, low protein diet and oral lactulose. Continuous infusions of 10% dextrose are frequently needed to manage hypoglycemia (31, 37).

If the diagnosis is made early and delivery is undertaken promptly, outcomes are generally favorable. Since most cases resolve spontaneously after delivery, liver transplantation is rarely indicated (42, 43). Recently, case reports have described successful treatment of AFLP with molecular adsorbent recirculating systems (MARS), a high-flux hemofiltration system that removes albumin-bound toxins from the blood (44, 45). The role of MARS in routine management of AFLP is yet to be determined. Plasma exchange in the postpartum setting has also been described in AFLP (46), though strong evidence of benefit is lacking. Recurrence of AFLP in subsequent pregnancies is rare, with only 4 cases reported in the literature (47, 48).

Diagnosis of AFLP in the setting of preeclampsia and HELLP syndrome

Distinguishing AFLP from HELLP syndrome can be challenging, and sometimes impossible, as up to 50% of women with AFLP have concomitant preeclampsia (35, 37). The 2 disorders share many pathophysiologic and clinical features, hence are suspected by some to be part of the same spectrum of illness. In particular, fetal deficiency of long-chain 3-hydroxyacy-CoA dehydrogenase (LCHAD) is a predisposing factor in both conditions (see below) suggesting a common pathophysiologic pathway (49). Even liver biopsy can be nondiagnostic, as findings on liver pathology in HELLP syndrome can include microscopic fatty infiltration of the liver, which is the hallmark of AFLP (50, 51).

Clinical clues to distinguish AFLP and HELLP syndrome

The clinical distinction between AFLP and HELLP is arguably academic, since the appropriate treatment of both conditions is expeditious delivery of the neonate. The presence of hypertension and proteinuria is relatively unhelpful, as many women with AFLP have concomitant preeclampsia. Conversely, HELLP syndrome can occasionally occur in the absence of hypertension (9, 31, 37). However, the distinction may have prognostic value, and can inform management decisions such as the use of magnesium, intravenous steroids (which may have a role in HELLP) and decisions about future pregnancies. Several clues can be helpful in the common scenario of overlapping clinical features (Tab. II). Thrombocytopenia is moderate to severe in HELLP, whereas it is mild or absent in AFLP (35, 38). AFLP affects the synthetic function of the liver and therefore is frequently complicated by coagulopathy and hypoglycemia. Hyperbilirubinemia and hypofibrinogenemia are more prominent in AFLP than in HELLP syndrome. Profoundly depressed antithrombin levels or severe transaminitis also suggest AFLP (14, 31, 38, 52).

Acute liver disease of pregnancy and fetal fatty-acid oxidation disorder

Recent work has shown a strong association between acute liver disease of pregnancy (AFLP and possibly HELLP syndrome) and fetal mitochondrial fatty acid oxidation disorder, an inborn error of metabolism associated with deficiency of LCHAD (49). Children with this autosomal recessive disorder present with hypoglycemia and hepatic encephalopathy several months after birth. Heterozygous mothers are usually asymptomatic until pregnant with a homozygous fetus, at which time approximately 16% experience AFLP or the HELLP syndrome (49, 53). It is hypothesized that excess free fatty acids from the fetus cross the placenta, and the heterozygous mother is unable to fully metabolize the hepatotoxic free fatty acids. Genetic screening for the LCHAD mutations in neonates born to mothers with AFLP or severe HELLP syndrome is recommended, as early diagnosis and treatment of the neonate with dietary modification can be life-saving (54). In families with known LCHAD muta-

tions, prenatal diagnosis by chorionic villous sampling or amniocentesis to identify high-risk homozygous fetuses may be considered (55, 56).

Thrombotic thrombocytopenic purpura

Introduction

TTP is characterized by thrombocytopenia, hemolysis and variable organ dysfunction which can include neurologic changes and acute renal failure (57). The clinical and pathophysiologic distinction between TTP and hemolytic uremic syndrome (HUS) has evolved over the last several years and remains controversial. Recent consensus has considered HUS primarily a disease of children associated with diarrhea due to Shiga toxin–producing bacteria (57). In this review, we will focus on TTP, for which pregnancy can be a triggering event (58). Pregnancy-associated TTP usually occurs in the late second or third trimester or during the postpartum period (59, 60). TTP can occur de novo in pregnancy, or pregnancy can precipitate relapse in women with a history of TTP (61). Patients with congenital or familial TTP frequently have their first episode during pregnancy (62-65). Normal pregnancy is characterized by changes in several hemostatic variables, including increased levels of factor VIIa, factor VIII, von Willebrand's factor (vWF) and fibrinogen, decreased fibrinolytic activity and increased fibrin degradation products. These changes suggest mild local intravascular coagulation even in normal pregnancy (66). Deficiency in the von Willebrand's factor cleaving protease (ADAMTS13) has been linked to the pathogenesis of TTP in nonpregnant states, but has not been well-studied in pregnancy-associated TTP. However, levels of ADAMTS13 decrease during normal pregnancy from mean values of 94% during the first trimester to about 64% during the second and third trimesters (67, 68). This physiologic fall in ADAMTS13 activity in pregnancy may explain why the syndrome is more likely to manifest during pregnancy in susceptible individuals. In pregnancy-associated TTP, the deficiency can be quite severe, with about 20% of patients having ADAMTS13 levels less than 5% (69).

Diagnosis and clinical presentation

TTP in pregnancy can be difficult to distinguish from severe preeclampsia and HELLP syndrome. Patients with TTP typically present with nonspecific symptoms including easy bruisability, fatigue, nausea, vomiting and abdominal pain (57). Neurologic manifestations are also common (50%-80%) and range from mild symptoms such as lethargy,

TABLE II
COMPARISON OF LABORATORY ABNORMALITIES IN AFLP, HELLP SYNDROME AND TTP

Laboratory findings	AFLP	HELLP	TTP
Transaminitis (AST/ALT elevation)	+++	++	-/+
Hemolytic anemia	+/-	+/++	++/+++
Thrombocytopenia	+	++	++/+++
Antithrombin deficiency	+++	++	-
DIC	Common	Variable	Absent
Hypoglycemia	Common	Absent	Absent
Renal insufficiency	20%-100%	3%-15%	30%-80%

AFLP = acute fatty liver of pregnancy; DIC = disseminated intravascular coagulation; HELLP = the syndrome of hemolysis, elevated liver enzymes and low platelets; TTP = thrombotic thrombocytopenic purpura.
+++ severe; ++ moderate; + mild; - normal or absent.

confusion and headache to serious manifestations such as fluctuating focal deficits and seizures (57).
The diagnostic laboratory features of TTP in pregnancy are identical to those in the nonpregnant state: microangiopathic hemolytic anemia and thrombocytopenia. Evidence of red cell fragmentation (schistocytes and polychromasia) should be sought on the peripheral blood smear; elevated LDH and indirect hyperbilirubinemia are also seen. A negative direct Coomb's test is necessary to exclude autoimmune hemolytic anemia. The coagulation profile is generally normal although secondary disseminated intravascular coagulation can occur due to associated conditions such as placental abruption. Subtle evidence of clinical coagulopathy can occasionally be seen, with elevated D-dimer and fibrin split products. Liver function abnormalities can include hyperbilirubinemia and mild transaminitis.

Renal manifestations

Acute renal failure has been reported to affect 30%-80% of women with pregnancy-associated TTP in various case series, a rate somewhat higher than that seen in the absence of pregnancy (70-72). Unfortunately, there are scarce data on renal prognosis. Although recovery of renal function is typical, persistent renal injury, including the need for chronic dialysis or kidney transplantation, is not uncommon (72).
Proteinuria and hematuria are present in the majority of patients with TTP (73). Renal pathology in nonpregnant individuals with TTP typically includes microthrombi composed predominantly of platelets affecting 1 or a few segments of the glomeruli (74).

Treatment

The widespread introduction of therapeutic plasma exchange for TTP has decreased mortality from 90% to 10% (75). Studies on the treatment of TTP during pregnancy consist primarily of case series. Although no randomized clinical trials exist, plasma exchange is the standard of care for pregnancy-associated TTP, as it is for TTP in the absence of pregnancy. Widespread use of plasma exchange has been credited with the dramatic improvement in maternal mortality from over 50% prior to 1980 to 9% since 1996 (60).
Antiplatelet agents such as low-dose aspirin or dipyridamole and low-molecular-weight heparin have been discussed, alone or in combination with glucocorticoids (71, 72), but none have gained widespread support. In patients with a prior known history of TTP, serial monitoring of ADAMTS13 levels during pregnancy, with prophylactic plasma exchange and antiplatelet agents if levels are deficient, has been shown to result in good obstetric outcomes (75). For patients who are refractory to these treatments, second-line treatments including vincristine (72), rituximab (76) and splenectomy (71, 72) have been described during pregnancy with favorable outcomes.

Distinguishing TTP from HELLP syndrome

There is substantial clinical and pathophysiologic overlap between TTP and preeclampsia/HELLP syndrome, as both syndromes are characterized by a microangiopathic hemolytic anemia (Tab. II). Indeed, approximately 20% of women with pregnancy-associated TTP are clinically diagnosed with concurrent preeclampsia/HELLP syndrome (60). This ambiguity can present a challenge to management, as severe preeclampsia/HELLP is generally an indication for expedient delivery, while TTP typically responds to plasma exchange, with continuation of the pregnancy for weeks to months. Maternal mortality in patients with concomitant TTP and preeclampsia/HELLP can be very high (44.4%) (60), hence in this setting both delivery and plasma exchange are probably indicated to optimize chances for maternal survival.
The absence of coagulation abnormalities such as elevated antithrombin, elevated D-dimer and high fibrinogen levels (all of which are common in HELLP syndrome) can be suggestive of TTP (76). Though low or undetectable ADAMTS13 levels are characteristic of some forms of idiopathic TTP, clinically this test is not helpful for treatment decisions, as levels can be normal in TTP and can be low in HELLP syndrome without evidence of TTP (77).

Renal biopsy in pregnancy

Renal biopsy is safe when undertaken remote from term (78, 79); however, there are few reports on renal biopsy performed after 28 weeks gestation, and most nephrologists consider the procedure relatively contraindicated after this point in pregnancy. Biopsy is generally considered when there is a high index of suspicion for glomerular disease, especially glomerulonephritis. In particular, the presence of hematuria (which is atypical in AKI due to preeclampsia), hypocomplementemia and other characteristic laboratory and historical features in the setting of unexplained renal failure should lead to consideration of renal biopsy during pregnancy.

Summary

AKI during pregnancy and the early postpartum period requires a unique approach to differential diagnosis and management. In particular, 3 syndromes observed in pregnancy

– preeclampsia/HELLP syndrome, acute fatty liver of pregnancy and thrombotic thrombocytopenic purpura – are all associated with AKI and share several clinical features of thrombotic microangiopathy which make diagnosis challenging. Close collaboration with the obstetrician, including access to emergent delivery via labor induction or Cesarean section, and supportive care are the cornerstones of management for these challenging syndromes.

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