

Preeclampsia and Eclampsia

Hepatic pathology, HELLP syndrome, and maternal vascular injury

A pathology-centered review of maternal vascular injury

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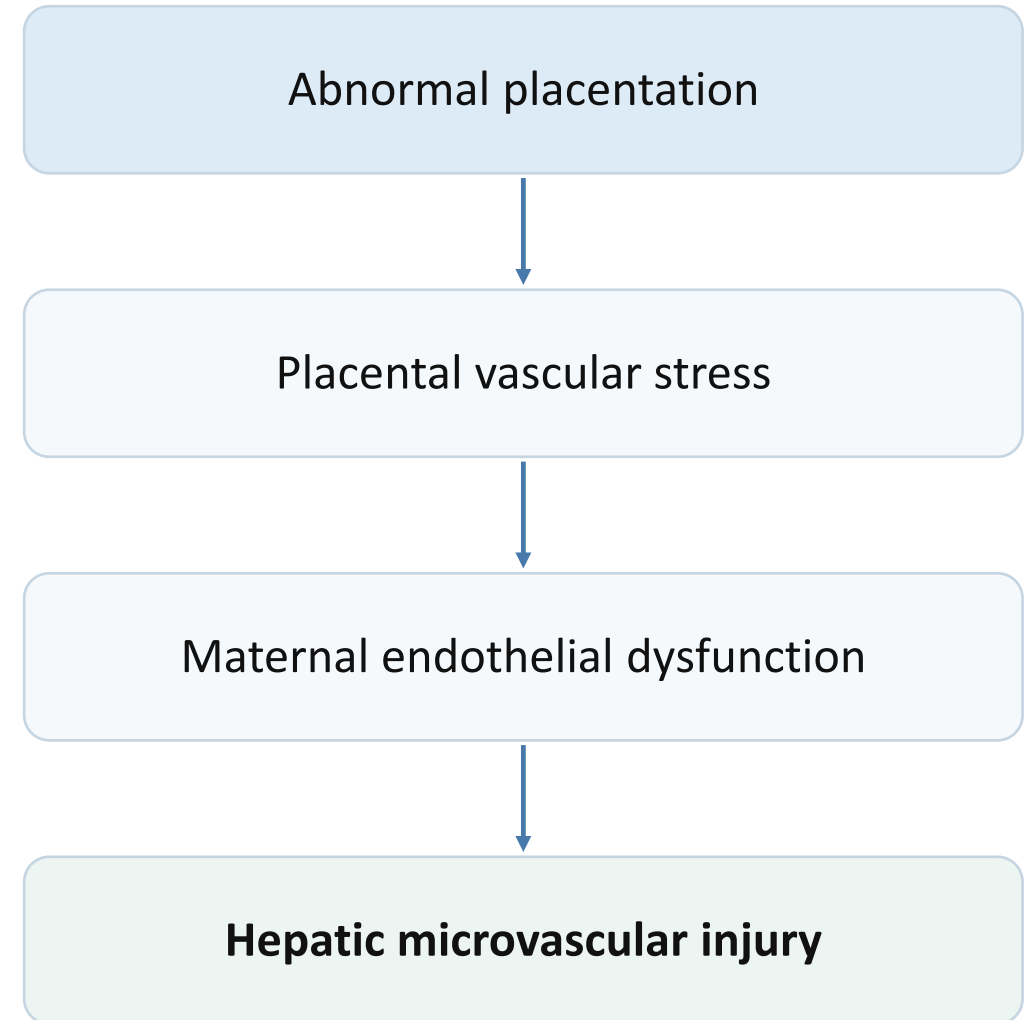
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Learning objectives

- Explain placental and maternal endothelial mechanisms of preeclampsia.
- Recognize periportal fibrin, hemorrhage, and hepatocellular necrosis.
- Relate HELLP syndrome to hepatic injury and systemic microangiopathy.
- Identify subcapsular hematoma, rupture risk, and key differentials.

A systemic syndrome with a hepatic phenotype

- Preeclampsia is a pregnancy-associated syndrome of maternal endothelial dysfunction.
- Hypertension accompanies variable renal, hematologic, neurologic, and hepatic manifestations.
- Liver abnormalities may be prominent despite limited preceding symptoms.



Preeclampsia is not synonymous with proteinuria

- The Chapter 22 definition emphasizes new hypertension after 20 weeks with additional clinical or organ findings.
- Proteinuria and edema are common manifestations, not a complete description of the syndrome.

Gestational hypertension

New pregnancy-associated hypertension

No other findings of preeclampsia

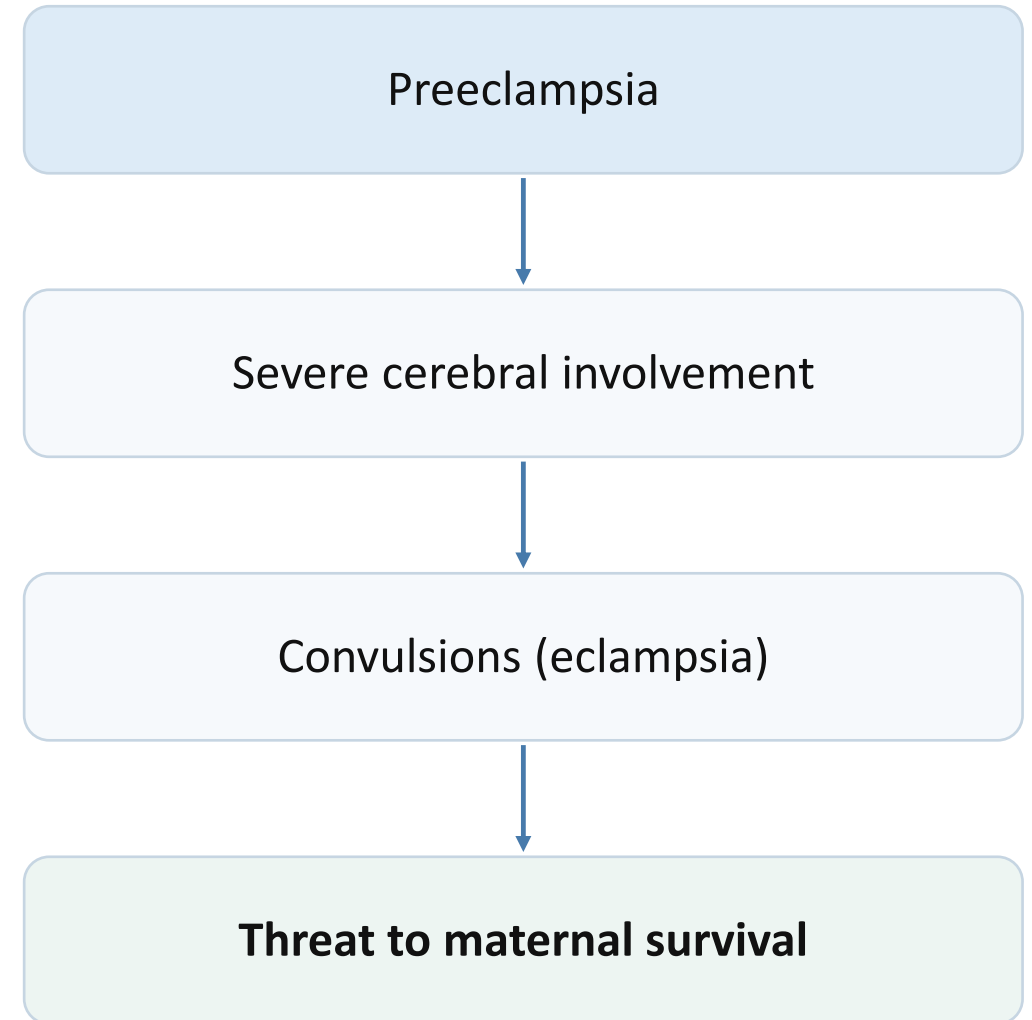
Preeclampsia

Hypertension plus systemic involvement

Renal, cerebral, hepatic, or vascular effects

Eclampsia denotes convulsive disease

- Seizures signal severe central nervous system involvement in preeclampsia.
- Neurologic progression may involve coma and death.
- Eclampsia can coexist with major hepatic hemorrhagic complications.



Clinical severity reflects multisystem injury

- Diffuse endothelial dysfunction links hypertension to organ injury.
- The liver is one target among kidney, brain, lung, and placenta.
- A normal-looking pregnancy course does not exclude evolving severe disease.

**Maternal
endothelium**

Kidney: Proteinuria /
failure

Liver: Enzyme elevation
/ bleeding

Brain: Headache /
seizures

Lung: Pulmonary
edema

HELLP identifies a distinctive clinical constellation

- HELLP combines hemolysis, elevated liver enzymes, and low platelet count.
- The triad reflects systemic microangiopathy and hepatic involvement.
- Hepatic disease may dominate the presentation of preeclampsia.

H — Hemolysis

EL — Elevated liver enzymes

LP — Low platelets

Pregnancy-related liver disorders need separation

- Chapter 18 discusses three major pregnancy-specific hepatic entities.
- Overlapping symptoms make clinicopathologic discrimination important.

Preeclampsia / HELLP

Endothelial injury,
fibrin, hemorrhage

Hypertension and
platelet abnormalities

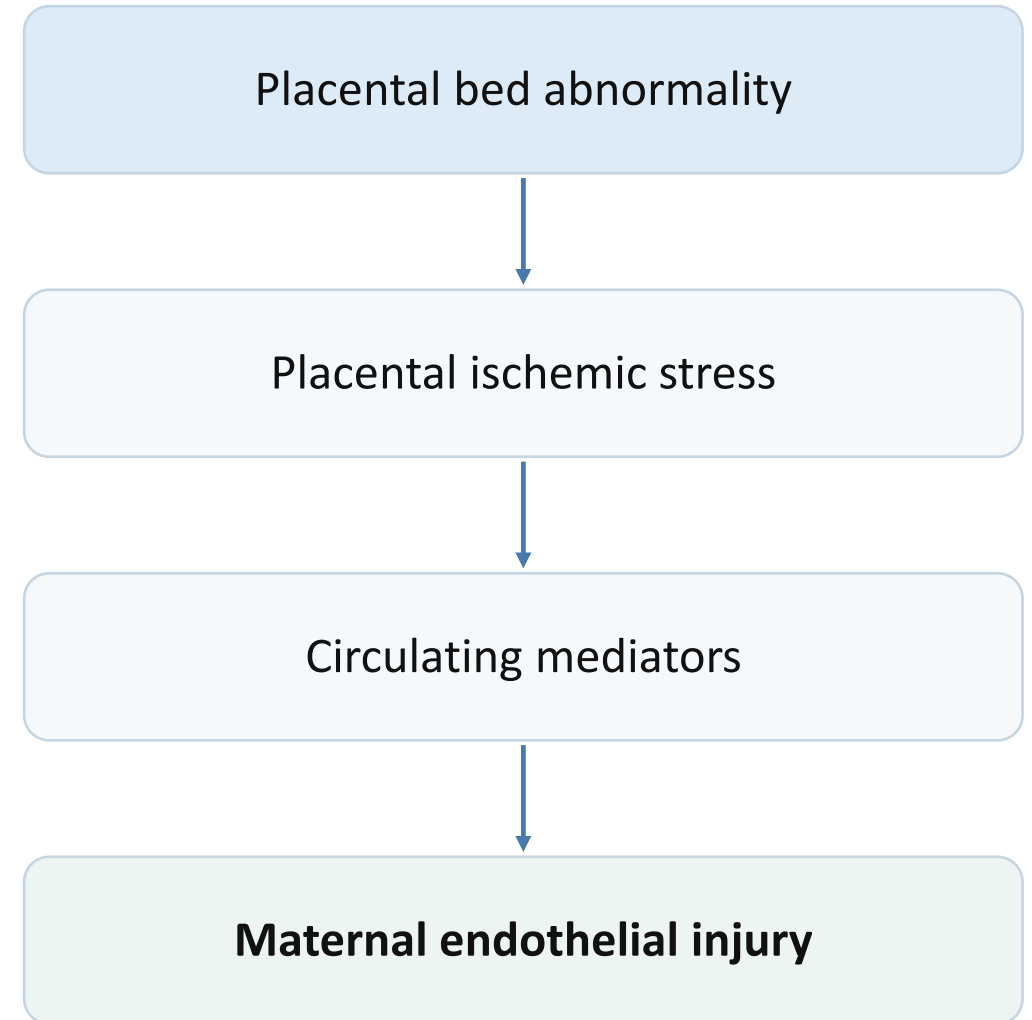
Other pregnancy liver disease

Acute fatty liver:
Microvesicular fat

Cholestasis: Pruritus,
bile retention

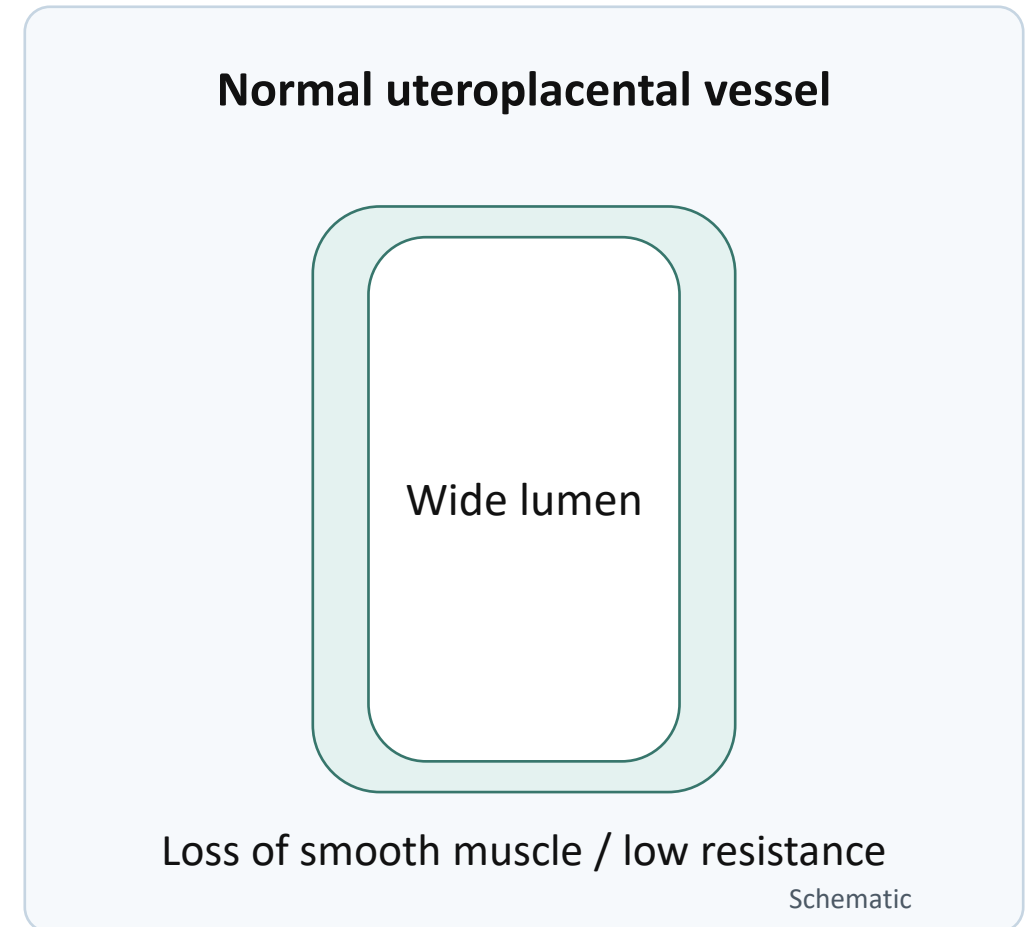
The placenta is central to pathogenesis

- Maternal symptoms usually regress after delivery of the placenta.
- Placental dysfunction precedes the maternal clinical syndrome.
- Placenta-derived circulating mediators help explain distant organ injury.



Normal spiral artery remodeling

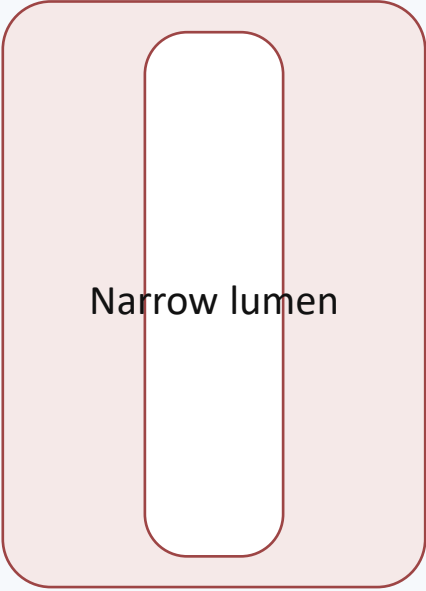
- Extravillous trophoblast remodels decidual spiral arteries early in pregnancy.
- Smooth muscle is replaced, producing dilated low-resistance vessels.
- This transformation supports increasing uteroplacental perfusion.



Failed remodeling increases placental resistance

- Shallow trophoblast invasion leaves maternal vessels inadequately remodeled.
- Persistent high-resistance vessels limit placental perfusion.
- Demand increases as gestation progresses, amplifying placental stress.

Inadequately remodeled vessel

A schematic diagram of a blood vessel. It consists of a light red rounded rectangle representing the vessel wall. Inside this rectangle is a white rounded rectangle representing the lumen. The white lumen is significantly narrower than the red vessel wall, illustrating a high-resistance state.

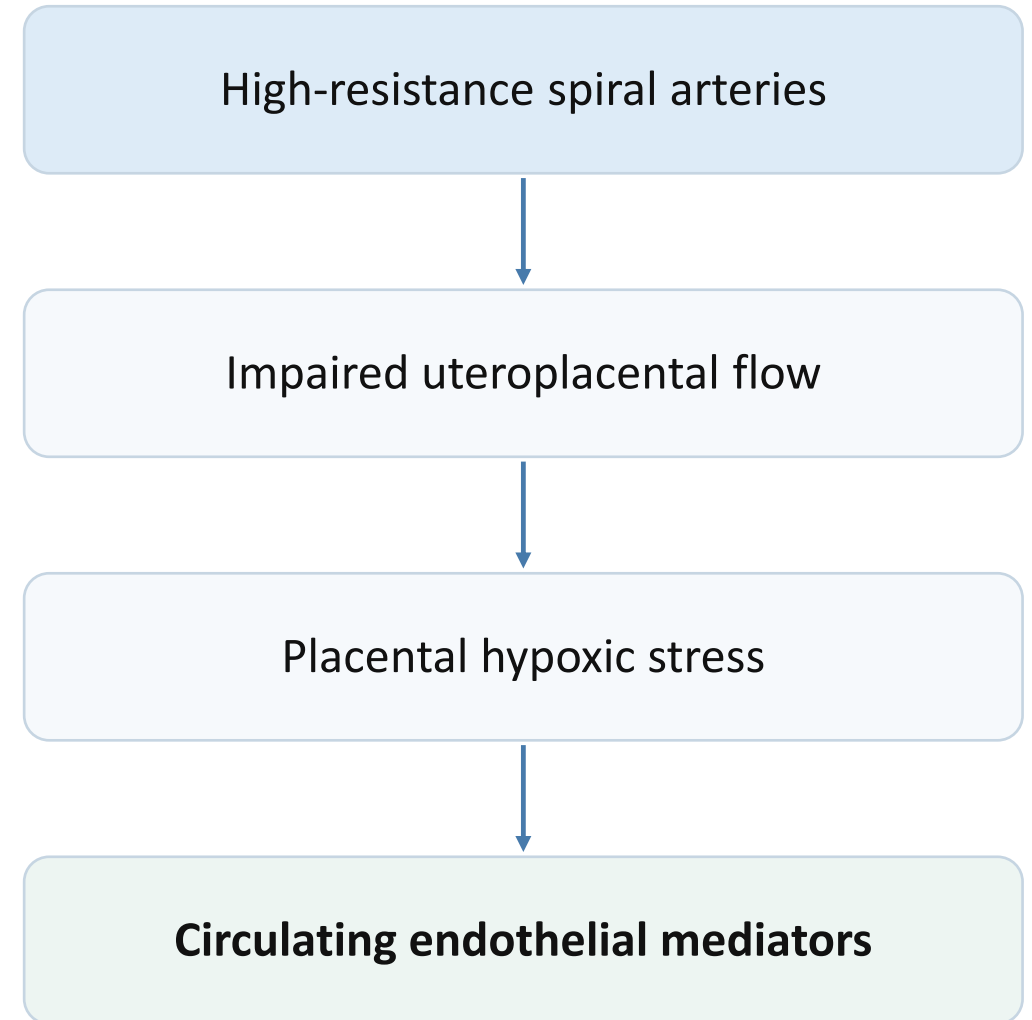
Narrow lumen

Persistent muscular wall / higher resistance

Schematic

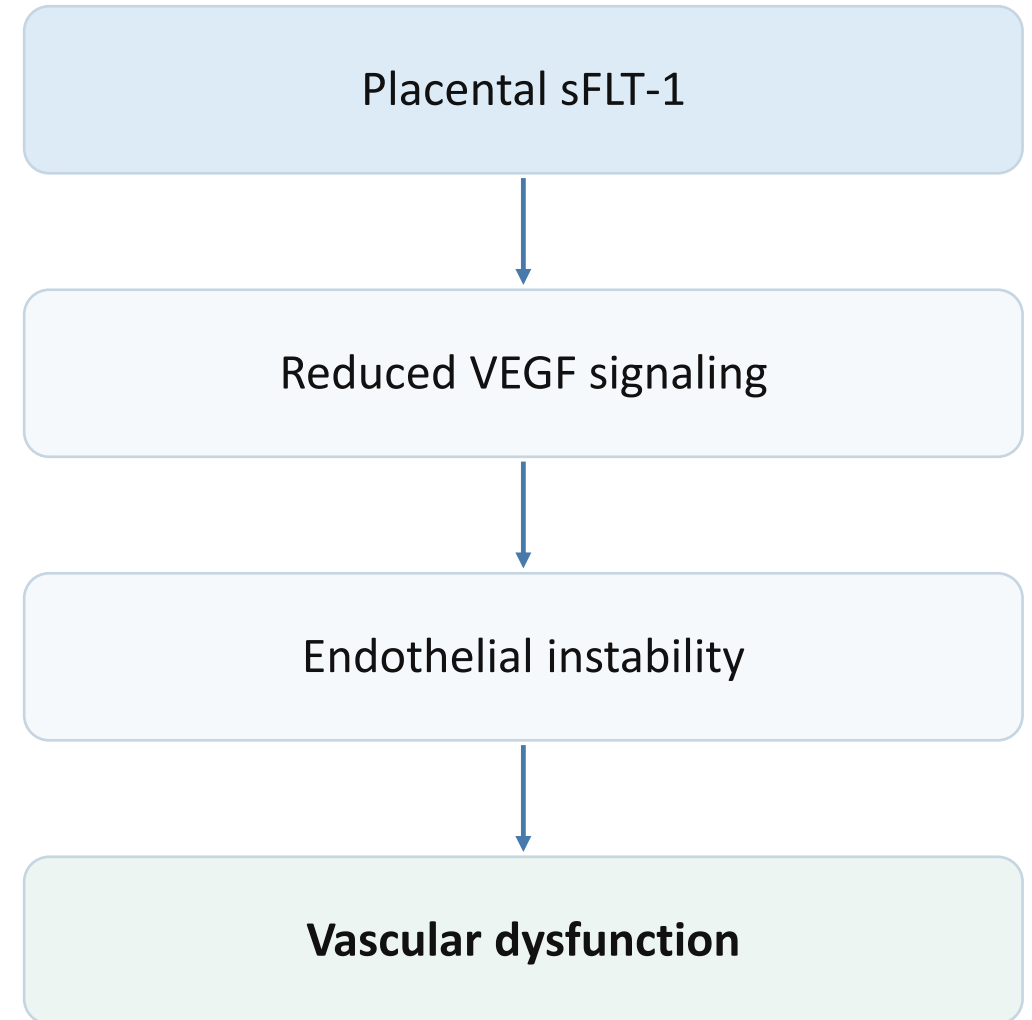
Placental ischemia is the mechanistic hinge

- Reduced perfusion establishes a setting for hypoxia and trophoblast stress.
- The ischemic placenta may release factors acting throughout the maternal vasculature.
- This helps connect an early implantation defect with late maternal disease.



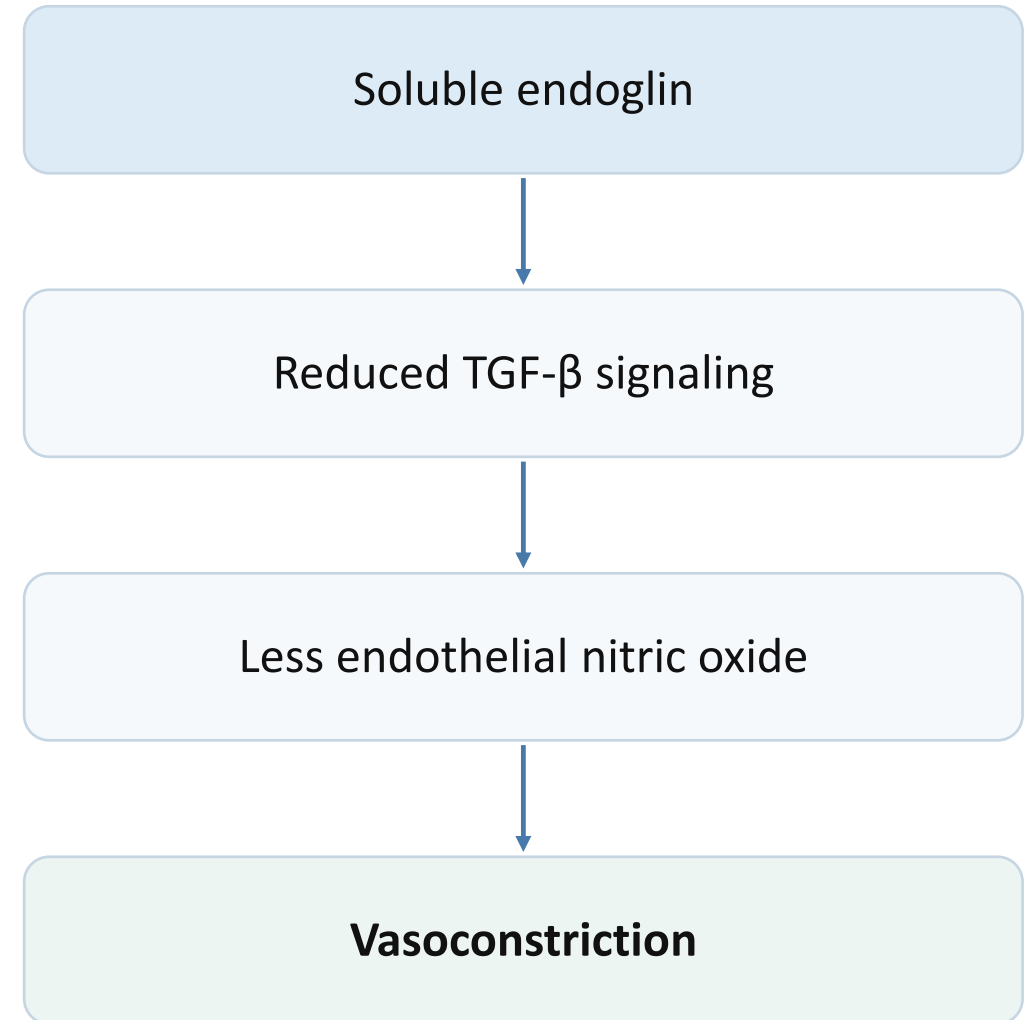
SFLT-1 antagonizes proangiogenic signaling

- Placental soluble fms-like tyrosine kinase-1 (sFLT-1) increases in preeclampsia.
- SFLT-1 antagonizes vascular endothelial growth factor (VEGF) activity.
- VEGF signaling loss contributes to endothelial dysfunction.



Soluble endoglin perturbs TGF- β signaling

- Circulating soluble endoglin rises in preeclampsia.
- It antagonizes transforming growth factor- β (TGF- β)-dependent pathways.
- Reduced nitric oxide generation may favor maternal vasoconstriction.



Antiangiogenic excess has systemic consequences

- Angiogenic imbalance disrupts vascular homeostasis rather than injuring only the placenta.
- VEGF and TGF- β pathway inhibition have complementary endothelial effects.

SFLT-1 excess

VEGF antagonism

Endothelial instability /
lower PGI₂

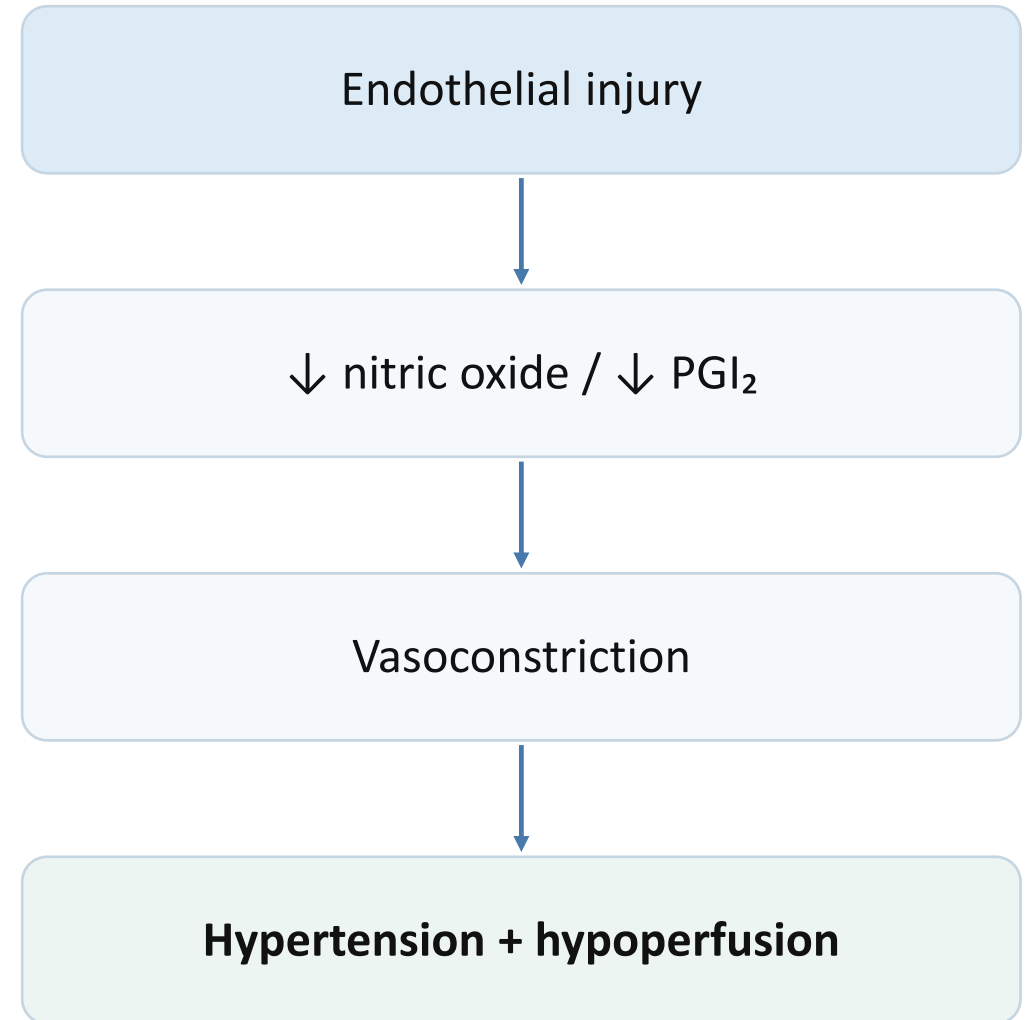
Soluble endoglin excess

TGF- β antagonism

Reduced NO-
dependent
vasodilation

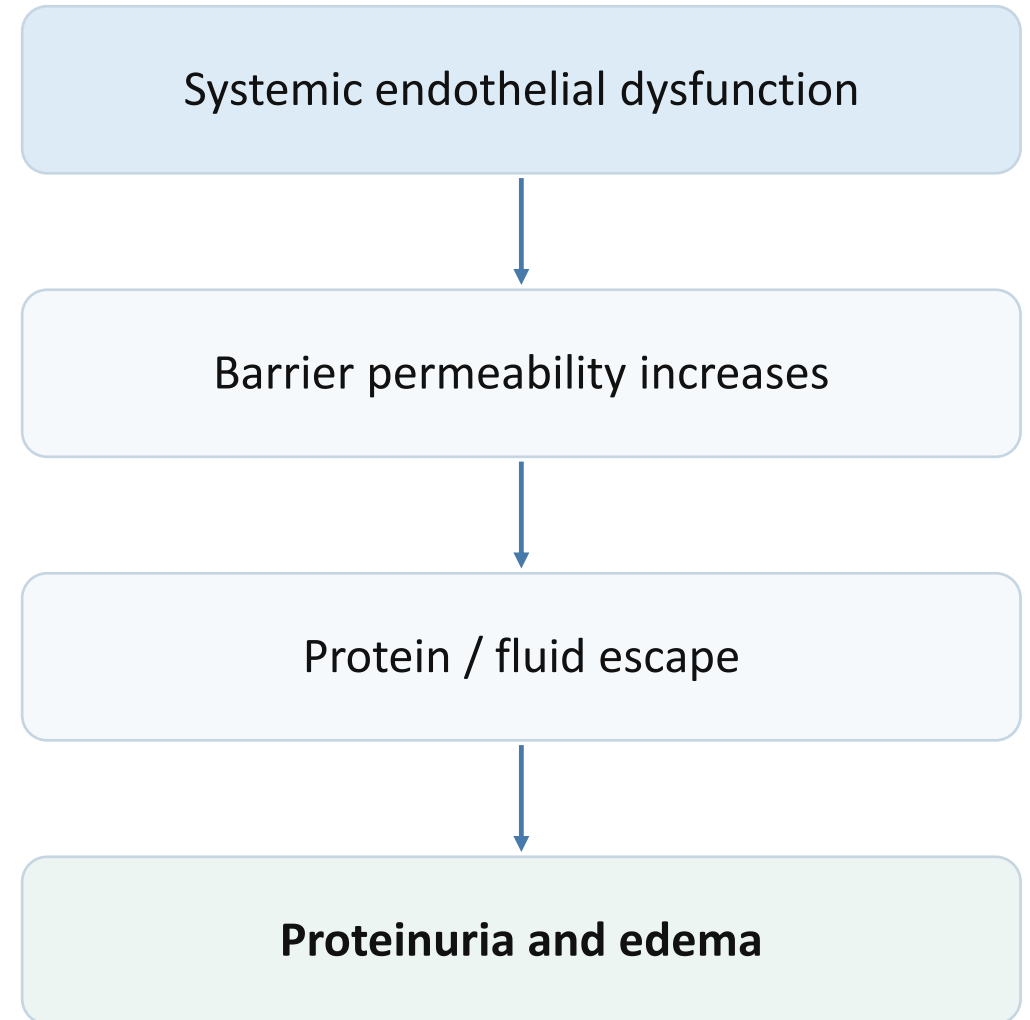
Reduced endothelial vasodilators favor hypertension

- Loss of nitric oxide signaling increases vascular tone.
- Reduced prostacyclin (PGI₂) removes vasodilatory and antithrombotic effects.
- Systemic vasoconstriction promotes hypertension and tissue hypoperfusion.



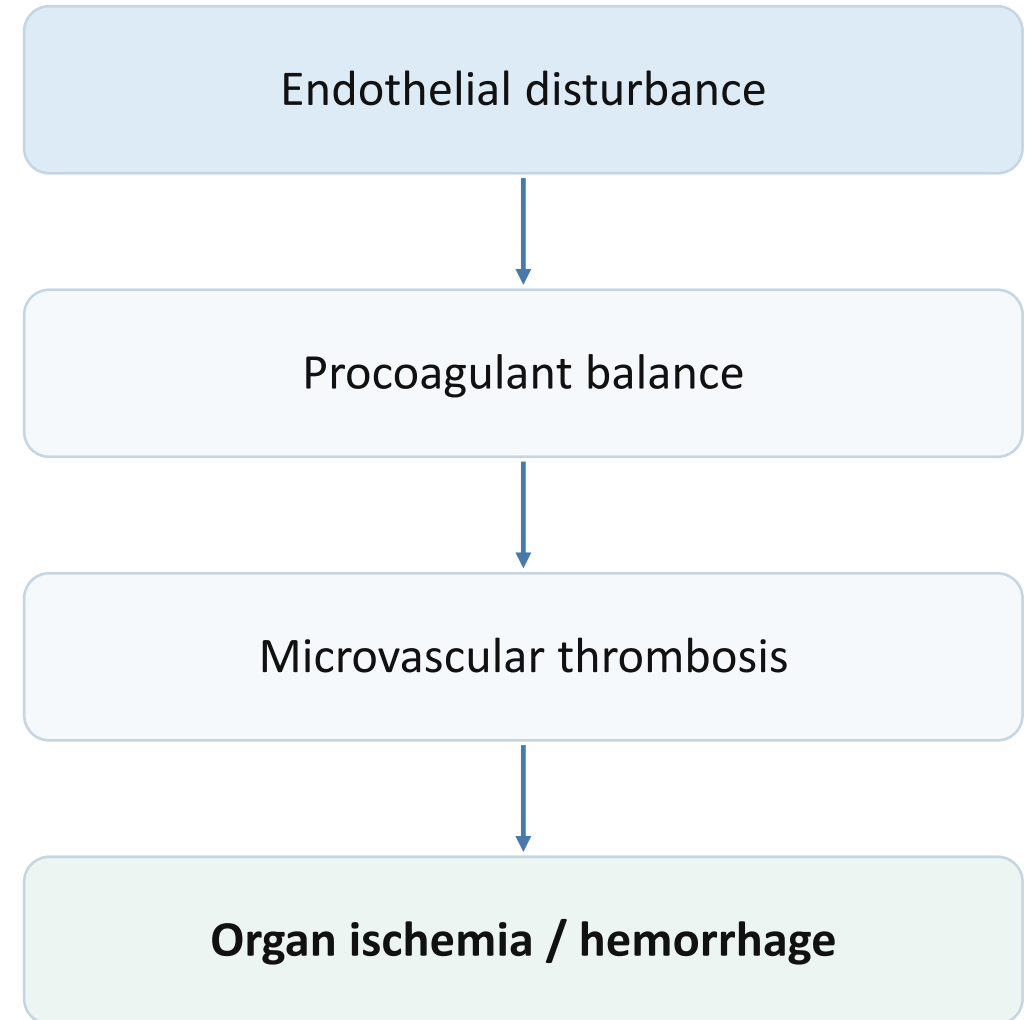
Increased permeability explains edema and proteinuria

- Endothelial barrier damage promotes abnormal movement of fluid and proteins.
- Renal vascular injury contributes to proteinuria.
- Peripheral and pulmonary edema reflect increased vascular leak.



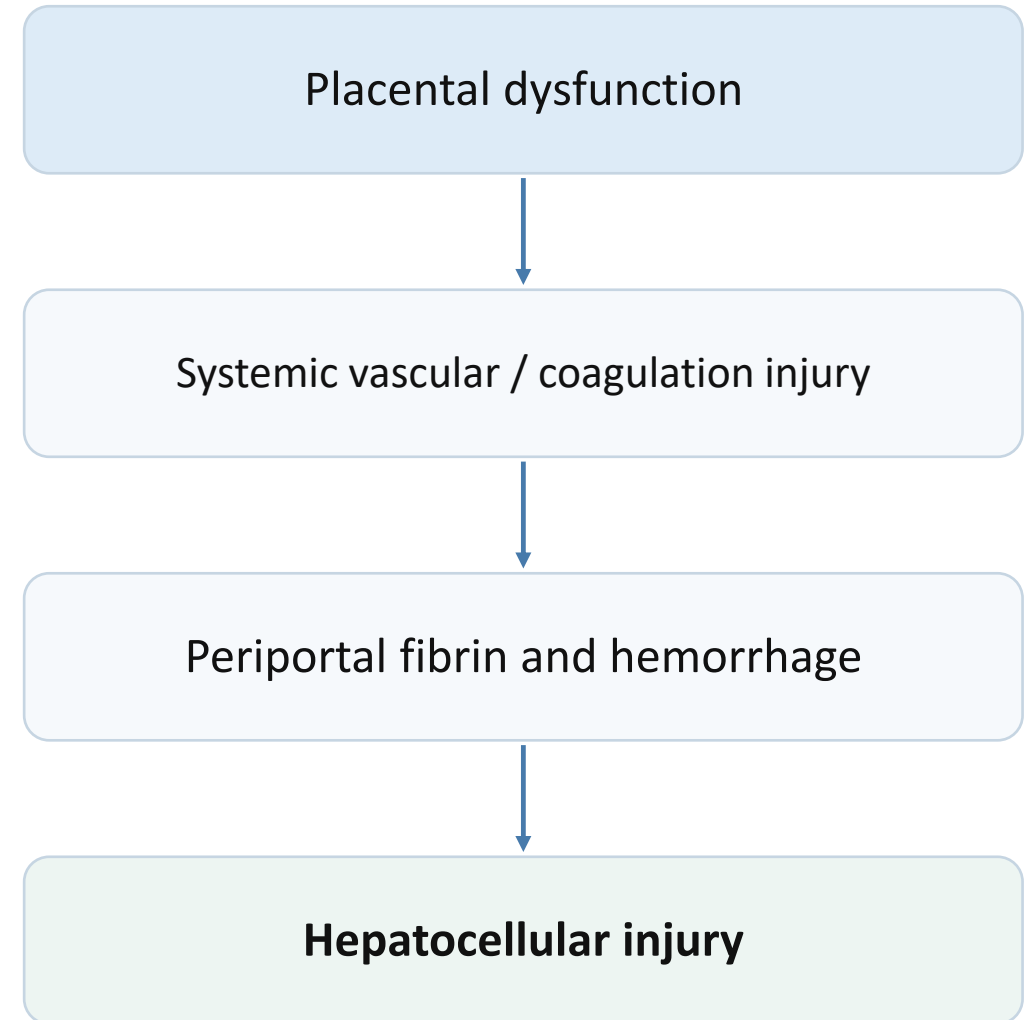
Hypercoagulability drives microvascular thrombi

- Preeclampsia produces a prothrombotic vascular environment.
- Small vessels in liver, kidney, brain, and placenta may contain thrombi.
- Reduced endothelial PGI₂ may contribute to local platelet activation.



Placenta-to-liver injury pathway

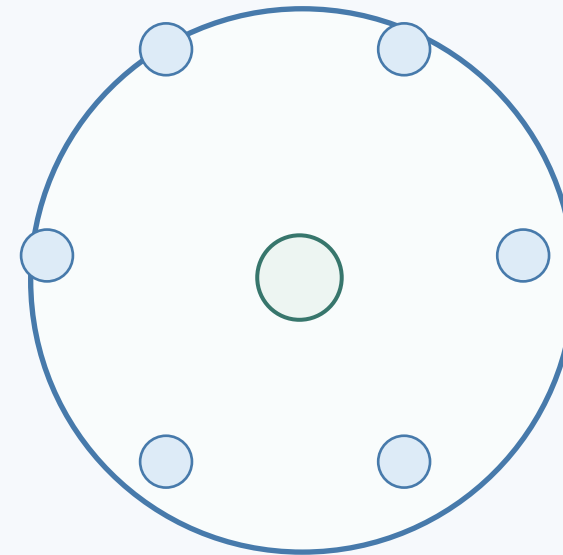
- Hepatic involvement arises downstream of the systemic vascular disorder.
- Fibrin deposition and hemorrhage occur in periportal microvasculature.
- Liver-cell necrosis and biochemical abnormalities can follow.



Hepatic injury must be mapped by lobular location

- Portal tracts lie at the lobule periphery;
Terminal hepatic venules lie centrally.
- The periportal region is the characteristic focus of fibrin-linked injury in preeclampsia.
- Zonal location helps distinguish other circulatory liver disorders.

Simplified hepatic lobule

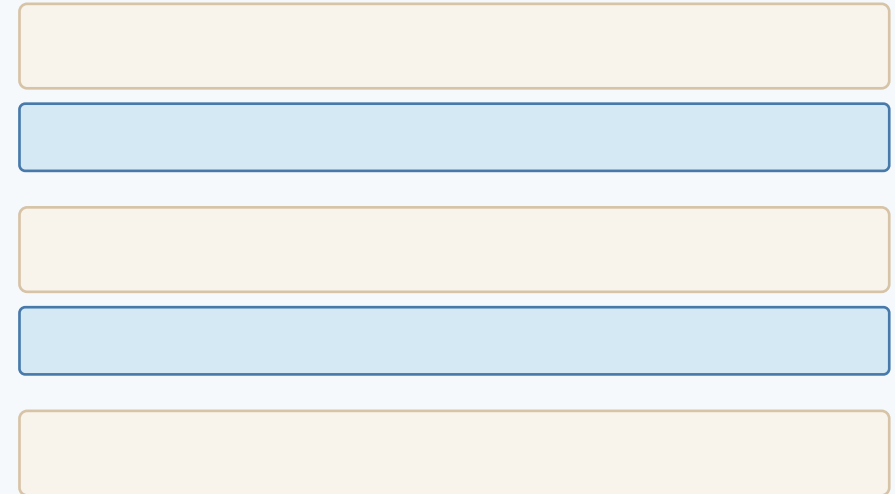


Portal tracts: Peripheral / periportal
Central venule: Center / centrilobular

The periportal sinusoid is a key injury site

- Sinusoids carry blood through hepatocyte plates and communicate with the space of Disse.
- Periportal microvessels are exposed to systemic coagulation and endothelial injury.
- Liver architecture provides the substrate for localized hemorrhage.

Simplified periportal microvasculature



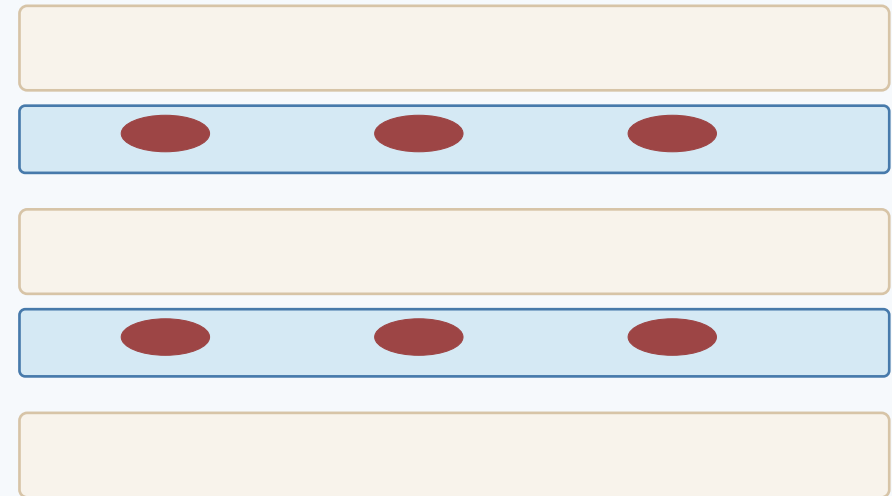
Blue sinusoids between tan hepatocyte plates

Schematic

Fibrin deposition begins the morphologic cascade

- Preeclampsia can deposit fibrin within periportal sinusoids.
- The finding reflects hepatic microvascular coagulation abnormalities.
- Fibrin deposition is linked to subsequent hemorrhagic parenchymal injury.

Simplified periportal microvasculature



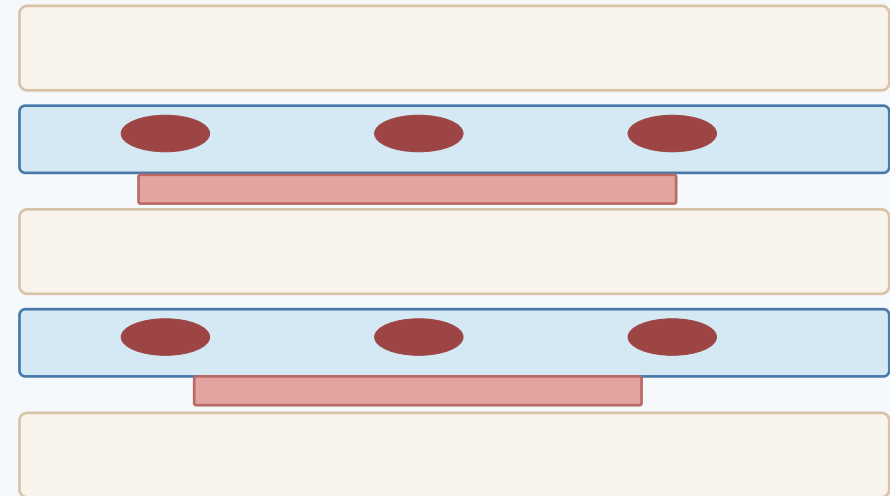
Red fibrin deposits lie within blue sinusoids

Schematic

Hemorrhage may extend into the space of Disse

- Periportal sinusoidal injury permits red-cell extravasation into the perisinusoidal space.
- Perisinusoidal hemorrhage compromises adjacent hepatocytes.
- Vascular injury and local tissue damage are anatomically continuous.

Simplified periportal microvasculature



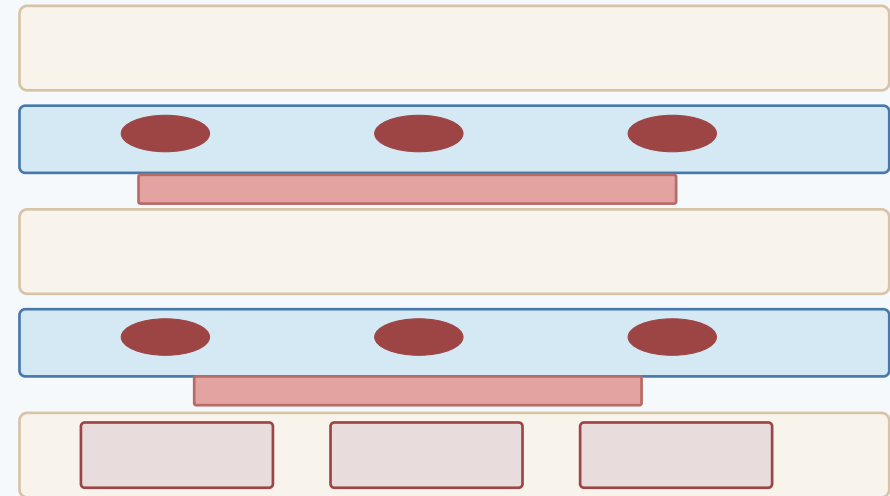
Hemorrhage crosses into perisinusoidal space

Schematic

Periportal hepatocytes develop coagulative necrosis

- Fibrin and hemorrhage are associated with periportal hepatocyte death.
- Coagulative necrosis in the affected parenchyma.
- Injury can be patchy and unevenly distributed.

Simplified periportal microvasculature

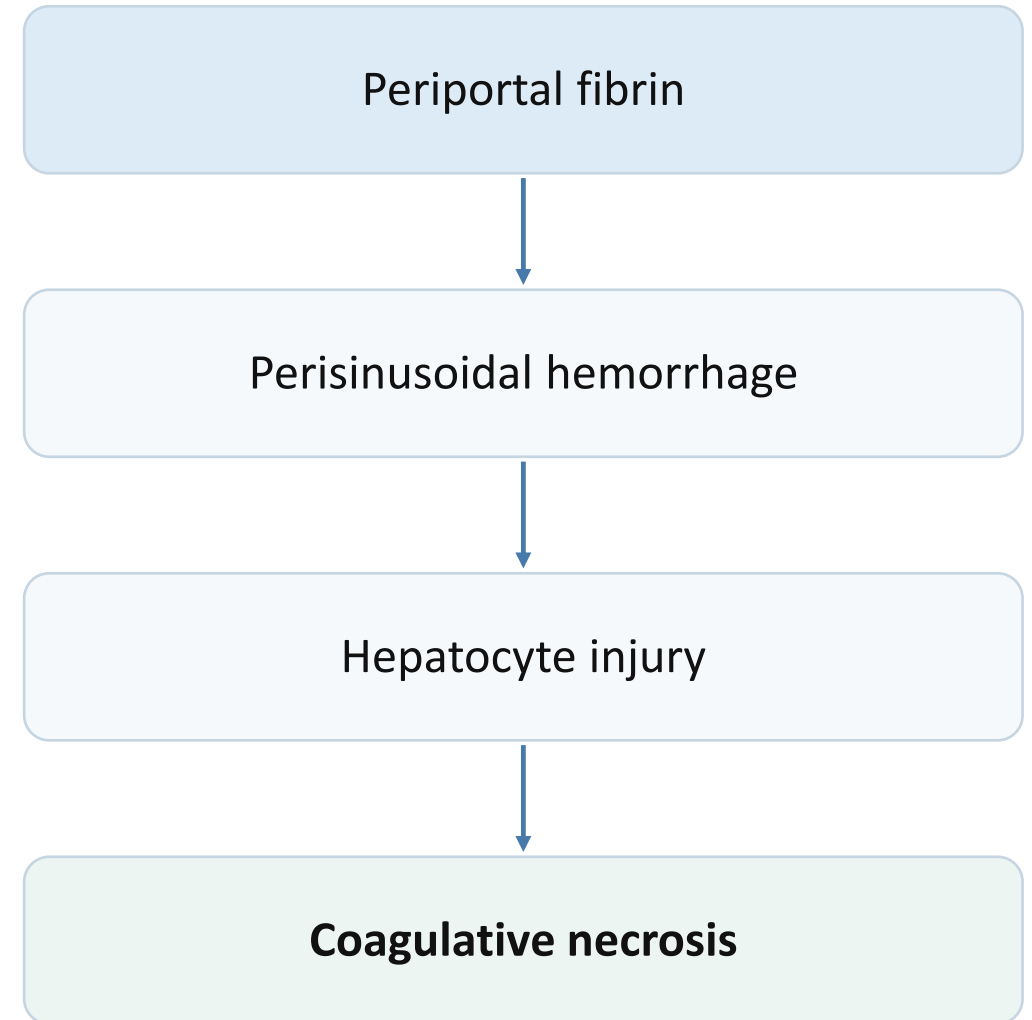


Hepatocytes injured adjacent to hemorrhage

Schematic

The hepatic histologic sequence is causal

- Microvascular fibrin obstructs or disrupts sinusoidal flow.
- Hemorrhage into the space of Disse accompanies vascular damage.
- Adjacent periportal hepatocytes undergo necrosis.



Liver damage may be focal rather than diffuse

- Chapter 22 describes irregular, focal hepatic hemorrhages.
- Subcapsular and intraparenchymal distributions may coexist.

Histology

Fibrin thrombi in portal capillaries

Foci of hemorrhagic necrosis

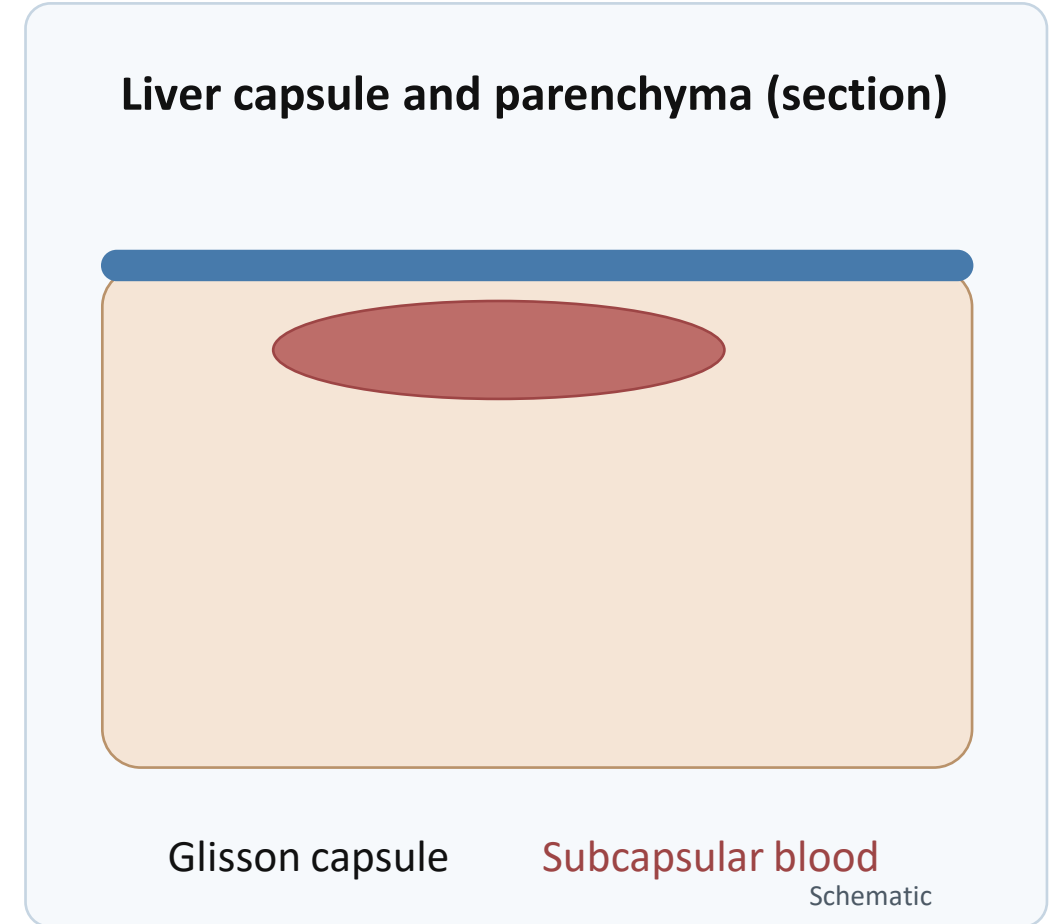
Gross distribution

Irregular parenchymal hemorrhage

Subcapsular bleeding / hematoma

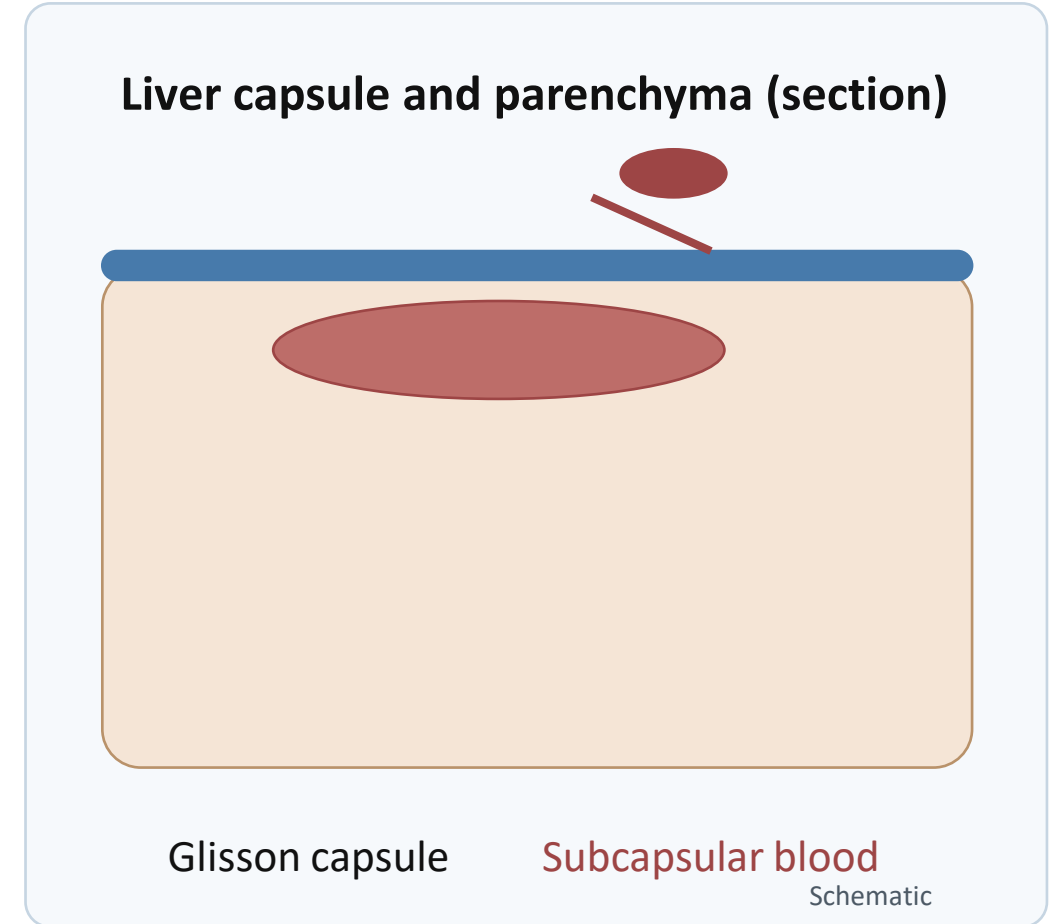
A subcapsular hematoma can develop

- Blood may dissect beneath Glisson capsule in eclampsia.
- The hematoma can expand while contained by the overlying capsule.
- This lesion is a high-risk manifestation of severe hepatic disease.



Subcapsular expansion threatens hepatic rupture

- Continued accumulation of blood raises mechanical stress on Glisson capsule.
- Capsular disruption can produce catastrophic hemorrhage.
- Morphologic recognition is essential because clinical deterioration can be abrupt.



Hepatic hematoma and rupture are distinct stages

- A contained collection and a disrupted capsule should not be conflated.
- Both lie on the spectrum of severe hepatic hemorrhagic injury.

Subcapsular hematoma

Blood dissects below an intact capsule

Potential for expansion

Hepatic rupture

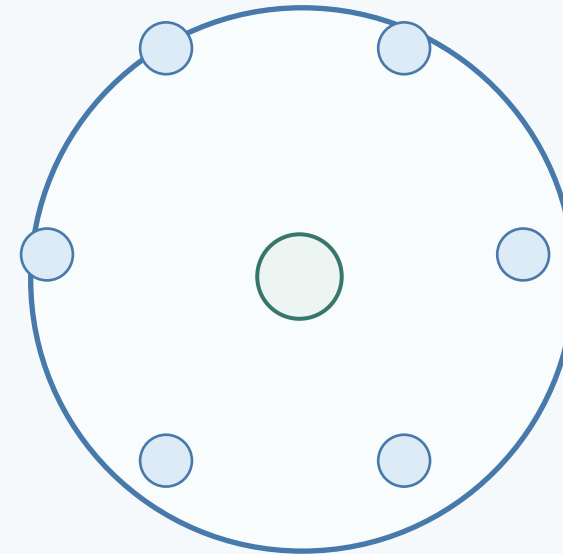
Capsular integrity lost

Life-threatening intraperitoneal bleeding

Periportal and centrilobular patterns differ

- Preeclamptic injury is described periportally with sinusoidal fibrin.
- Cardiac congestion produces centrilobular sinusoidal engorgement and hepatocyte atrophy.
- Locating injury by zone strengthens differential diagnosis.

Simplified hepatic lobule



Portal tracts: Peripheral / periportal
Central venule: Center / centrilobular

Do not confuse HELLP liver with nutmeg liver

- Interleaved Chapter 18 text describes cardiac passive congestion, not preeclampsia.
- The accompanying Fig. 18.47 is a passive congestion image, not HELLP histology.

Preeclampsia / HELLP

Periportal fibrin and hemorrhage

Coagulative necrosis

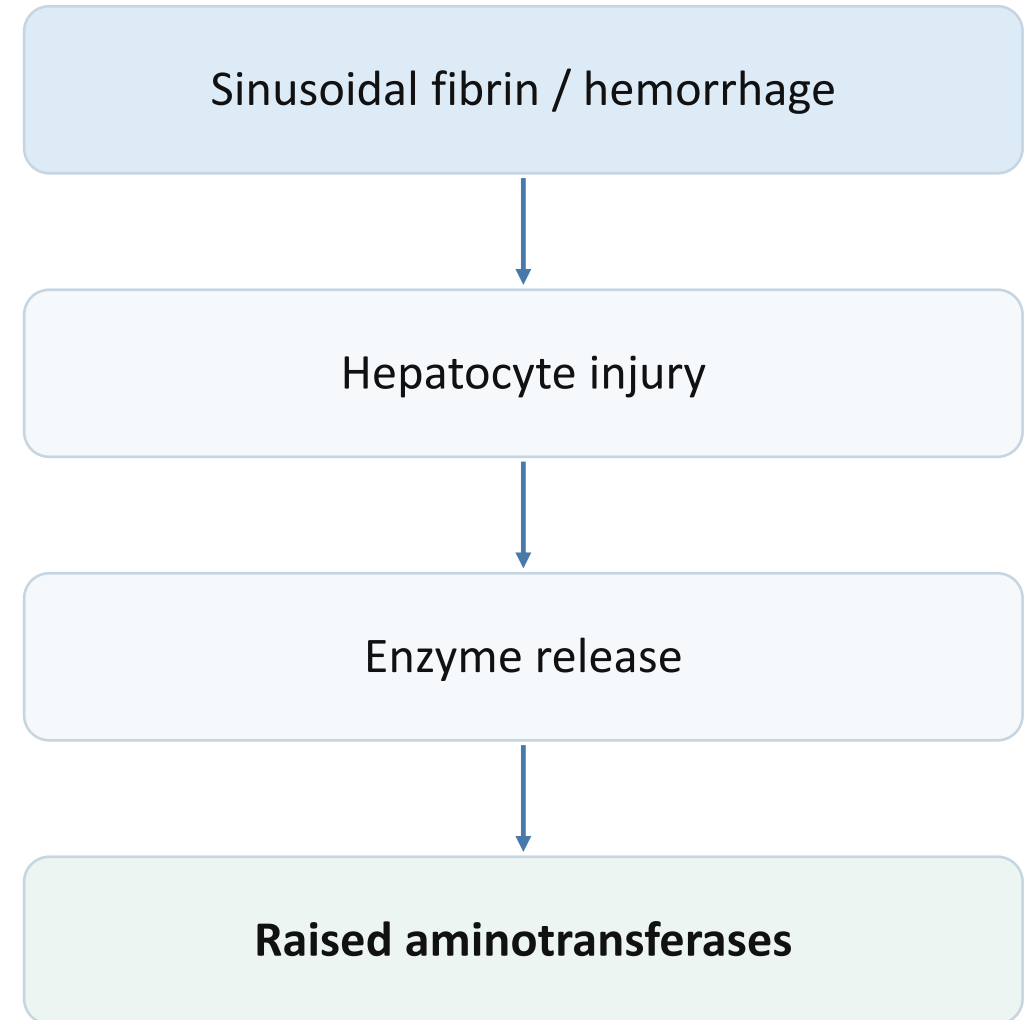
Passive hepatic congestion

Centrilobular sinusoidal congestion

Atrophy / hemorrhagic necrosis

Hepatic enzyme elevation reports cell injury

- Aminotransferase elevation may range from modest to severe.
- The biochemical finding aligns with hepatocellular injury and necrosis.
- Transaminase elevation alone does not specify the hepatic lesion.



Bilirubin abnormalities may be relatively mild

- Mild bilirubin elevation in hepatic preeclampsia.
- Marked dysfunction or additional pathology warrants broader differential consideration.

Common hepatic pattern

Aminotransferases elevated

Bilirubin sometimes mildly elevated

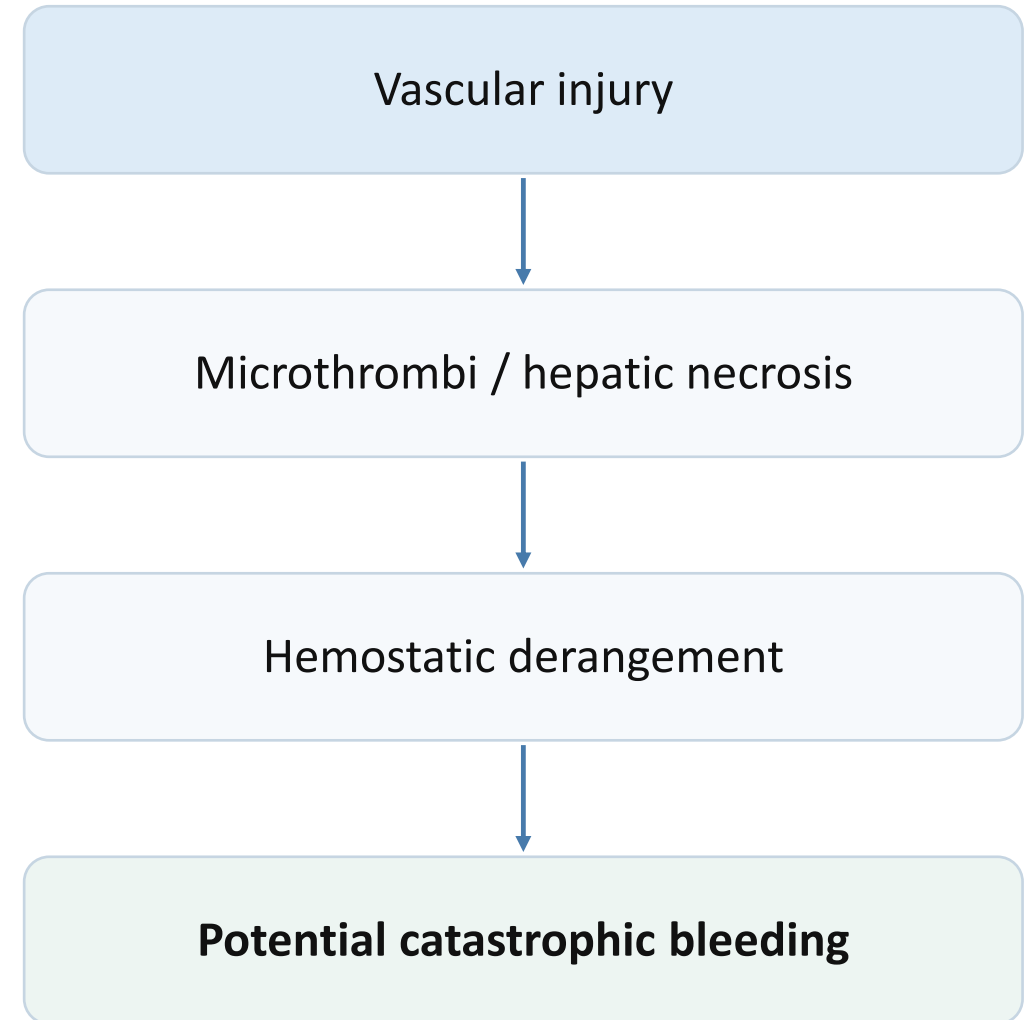
Severe systemic injury

Coagulopathy or progressive organ failure

Potentially life-threatening disease

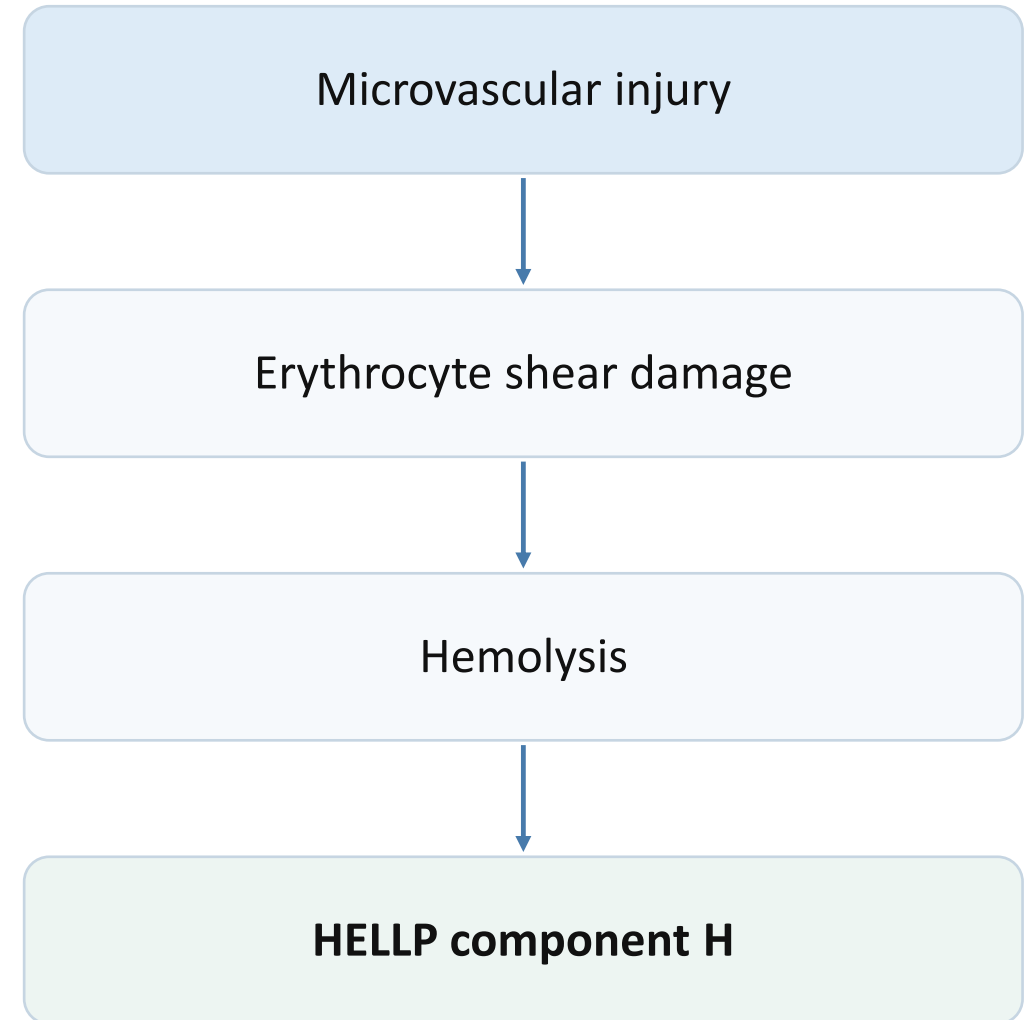
Coagulopathy is a warning of advanced disease

- Hepatic dysfunction severe enough to cause coagulopathy marks advanced disease.
- Endothelial injury and microvascular thrombosis may coexist with bleeding.
- Hemorrhagic complications require urgent clinical recognition.



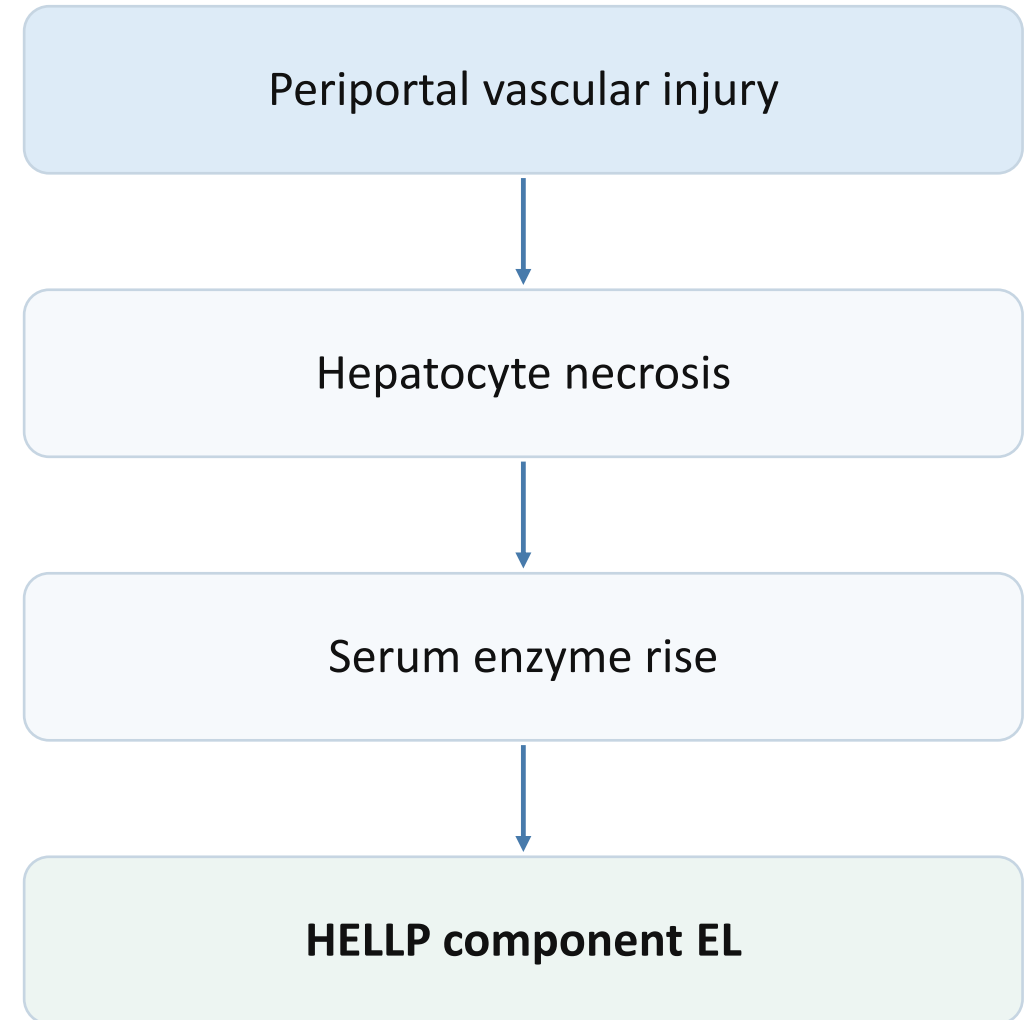
HELLP: Hemolysis reflects microangiopathy

- Endothelial injury and narrowed microvessels may damage circulating erythrocytes.
- The hemolytic component occurs alongside thrombocytopenia and liver injury.
- Hemolysis should be interpreted as systemic, not isolated hepatic, disease.



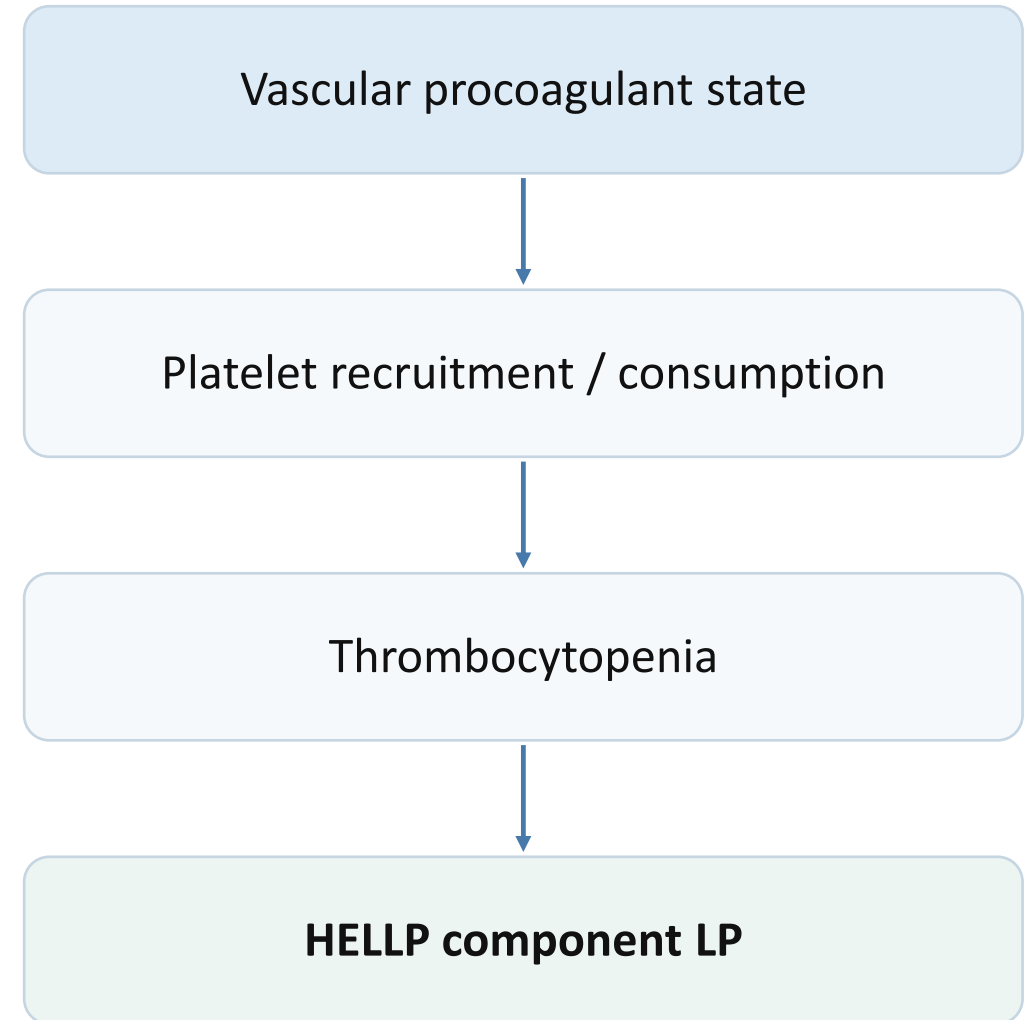
HELLP: Elevated enzymes indicate liver-cell damage

- The EL component records hepatocellular enzyme release.
- Underlying liver lesions include fibrin-associated periportal necrosis.
- The degree of biochemical elevation does not directly reveal hematoma size.



HELLP: Low platelets accompany thrombosis

- Increased platelet consumption contributes to thrombocytopenia.
- Thrombotic microangiopathy and bleeding risk can coexist.
- Low platelets complete the HELLP triad when hemolysis and enzyme elevation accompany them.



HELLP integrates three injured compartments

- Blood: Hemolysis is evidence of microangiopathic injury.
- Liver: Hepatocyte injury yields elevated aminotransferases.
- Hemostasis: Thrombocytopenia signals platelet consumption.

Microvascular red-cell injury

Hepatic parenchymal injury

Platelet depletion

The HELLP phenotype may mask preeclampsia

- Chapter 18 notes that subclinical hepatic disease may be the leading manifestation.
- A narrow hypertension-only approach may miss important systemic pathology.

Obvious preeclampsia

Maternal hypertension
/ edema

Recognizable systemic
symptoms

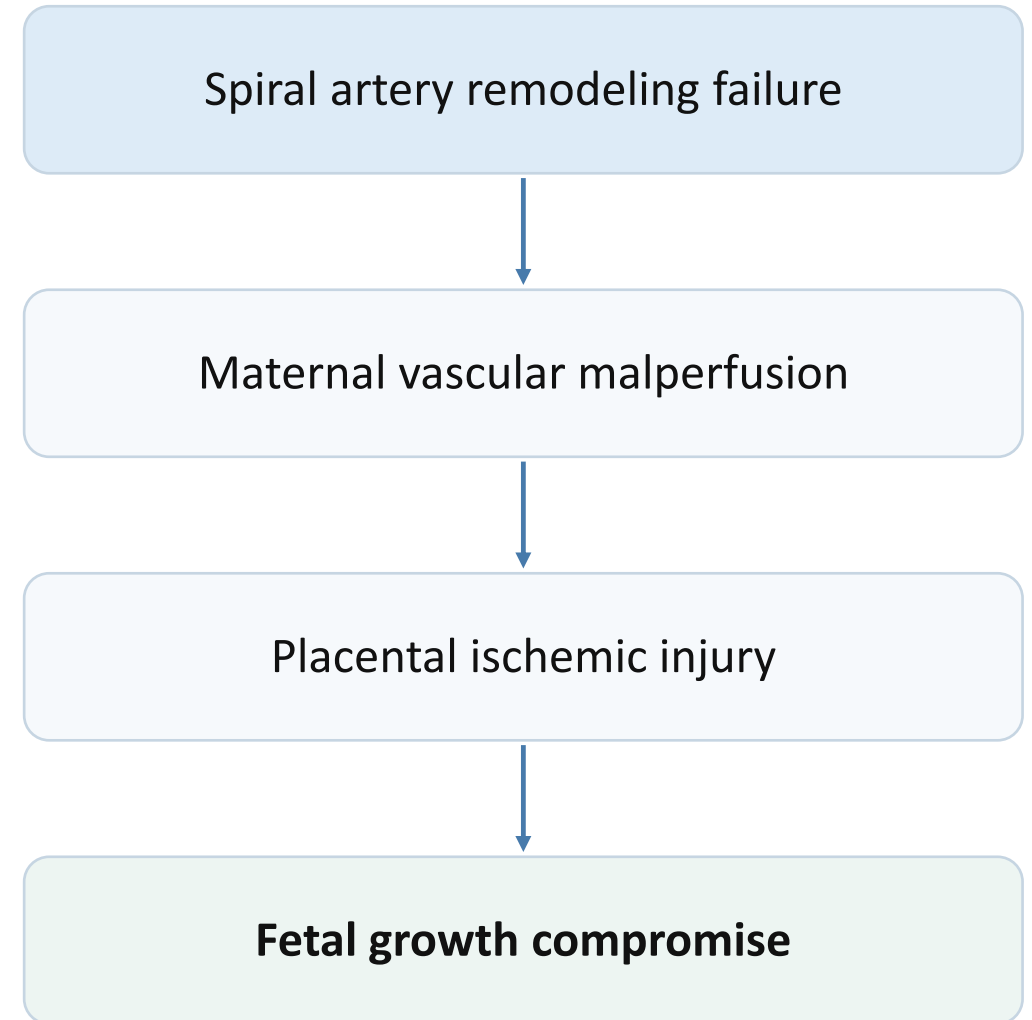
HELLP-dominant presentation

Enzyme and platelet
abnormalities

Hepatic injury may be
prominent

Placental vascular malperfusion is the upstream lesion

- The placenta may be small and show prominent infarction.
- Maternal vascular malperfusion supports a placental perfusion disorder.
- Placental morphology explains the fetal component of disease.



Placental infarcts reflect ischemic supply failure

- Placental infarcts may be extensive or numerous.
- The finding fits maternal vessel resistance and compromised perfusion.

Maternal vascular problem

High-resistance spiral arteries

Reduced placental perfusion

Placental consequence

Ischemic infarction

Reduced functional placental tissue

Distal villous hypoplasia signals chronic malperfusion

- Small, shrunken villi with increased maternal vascular space.
- Increased syncytial knotting accompanies exaggerated ischemic maturation.

Villous pattern

Small distal villi

Relatively wide
intervillous spaces

Trophoblast change

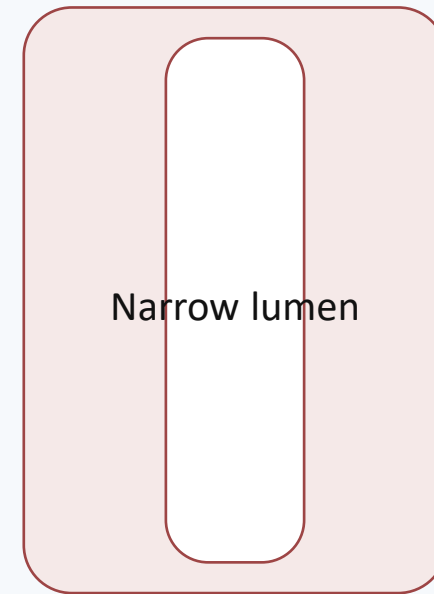
Increased syncytial
knots

Feature of chronic
perfusion stress

Decidual vessels may show acute atherosclerosis

- Abnormal decidual arteries can retain their resistance-vessel phenotype.
- Fibrinoid necrosis, lipid-laden intimal change, or thrombi may appear.
- These lesions reinforce the uteroplacental vascular origin of disease.

Abnormal decidual artery



Narrow lumen

Fibrinoid / thrombotic change possible

Schematic

Retroplacental hematoma reflects vessel instability

- Abnormal uteroplacental vessels may bleed behind the placenta.
- Retroplacental hemorrhage links placental malperfusion with acute bleeding.

Chronic component

Failed maternal vessel remodeling

Placental ischemic lesions

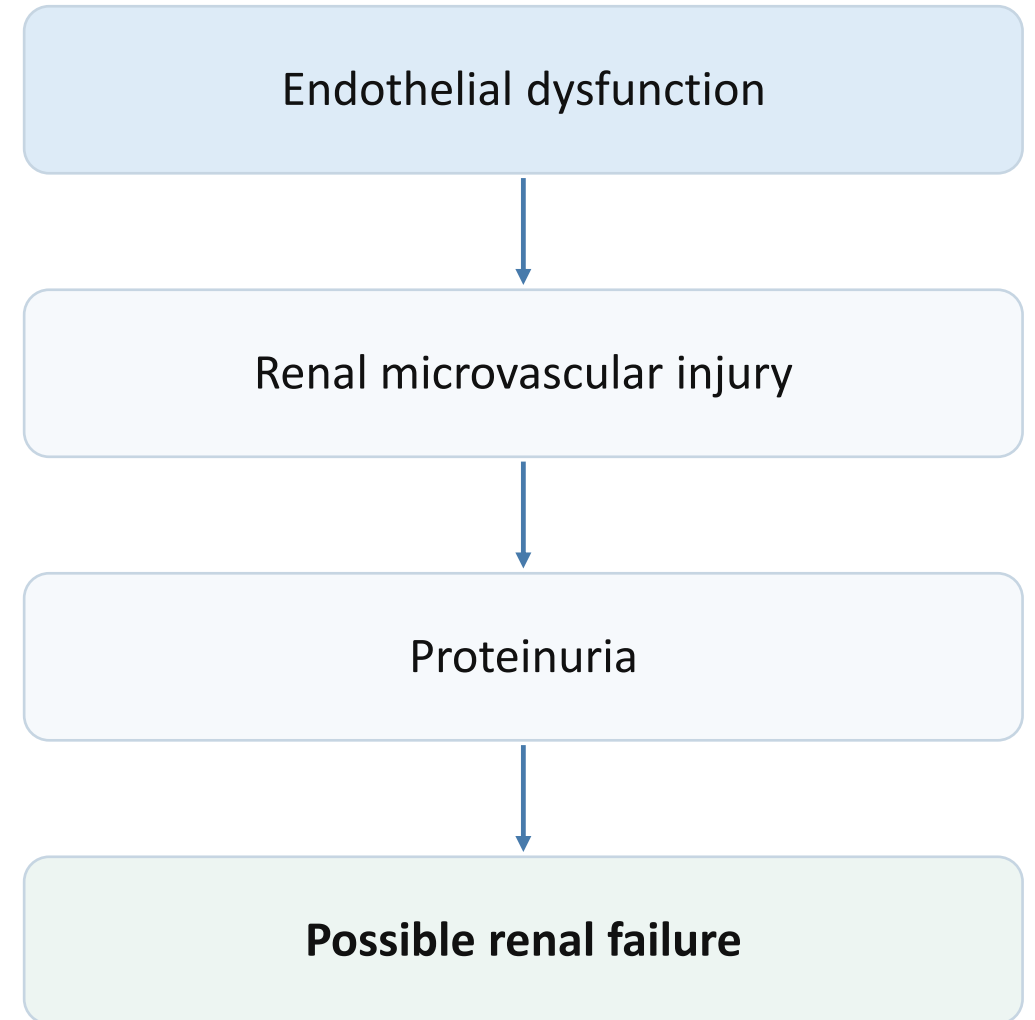
Acute component

Uteroplacental vascular instability

Retroplacental hematoma

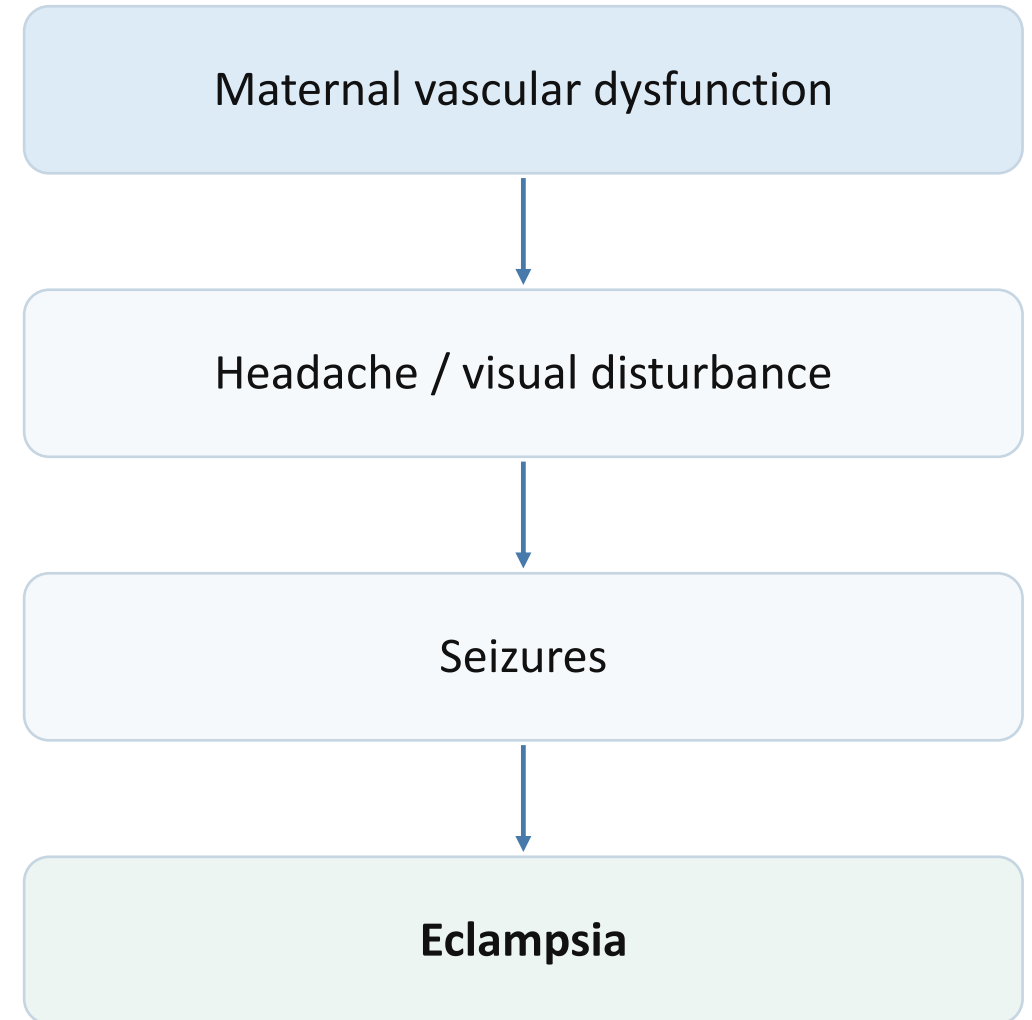
Renal involvement explains proteinuria

- The syndrome affects systemic endothelium, including renal microvessels.
- Increased permeability supports urinary protein loss.
- Severe cases can develop acute renal dysfunction.



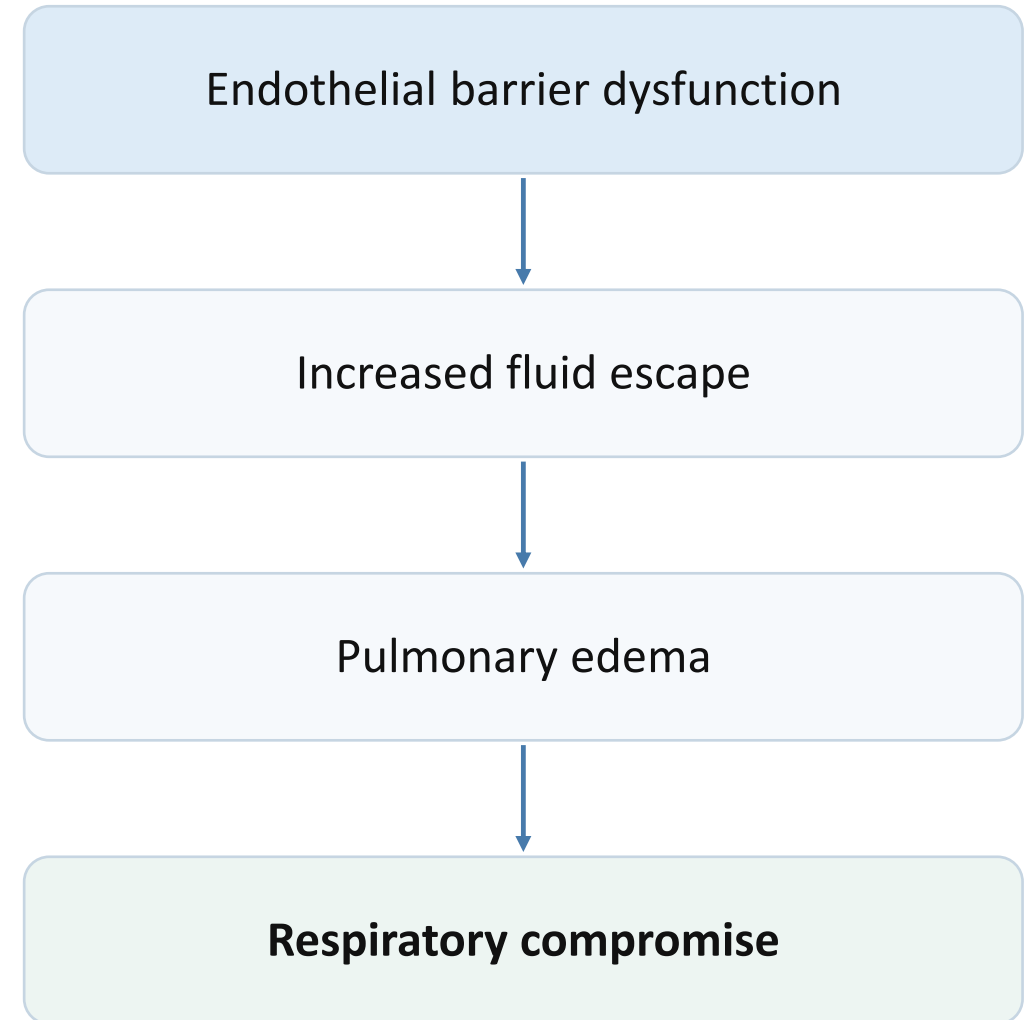
Neurologic escalation defines eclampsia

- Headache and visual disturbance may indicate severe features.
- Seizures distinguish eclampsia from preeclampsia.
- Cerebral involvement may culminate in coma and fatal complications.



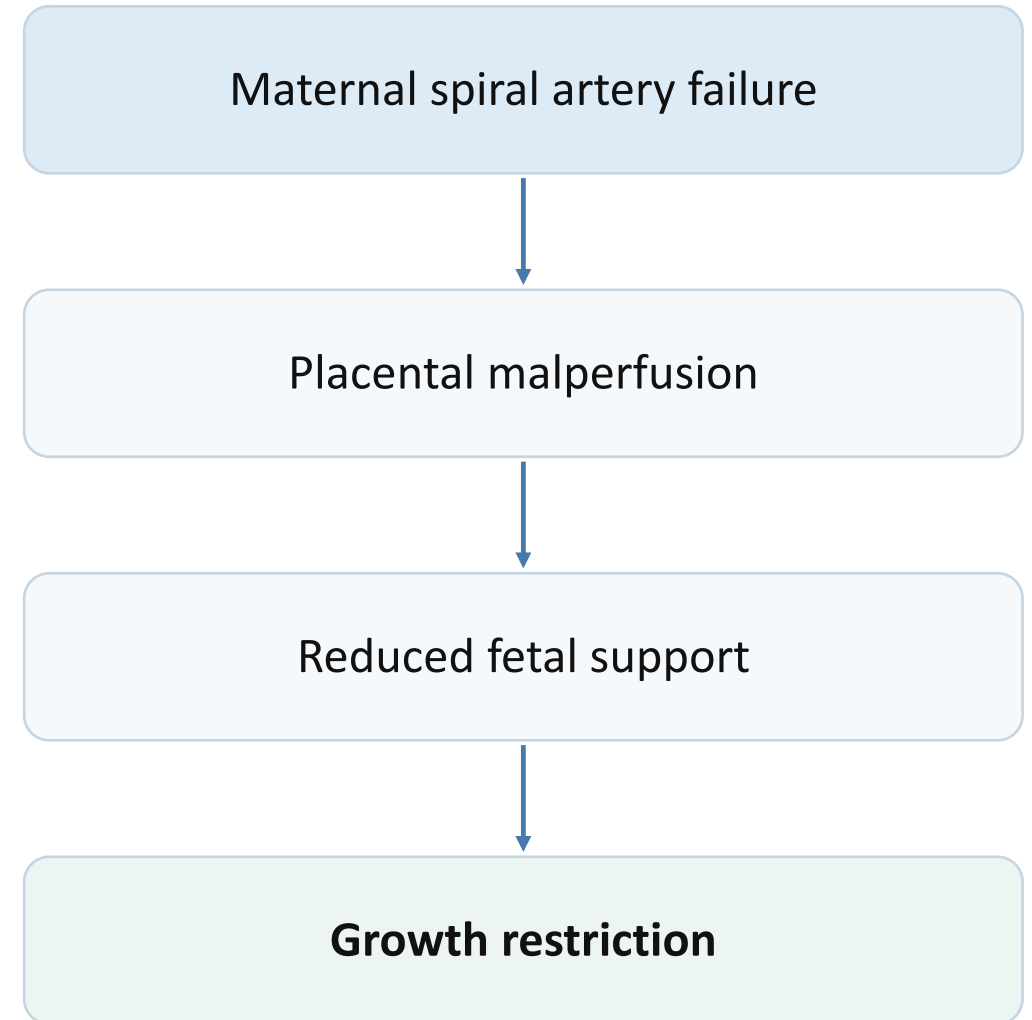
Pulmonary edema is a vascular-leak consequence

- Excess vascular permeability can shift fluid into the pulmonary interstitium.
- Preeclampsia can cause pulmonary edema and respiratory compromise.
- This is systemic endothelial disease, not a primary lung disorder.



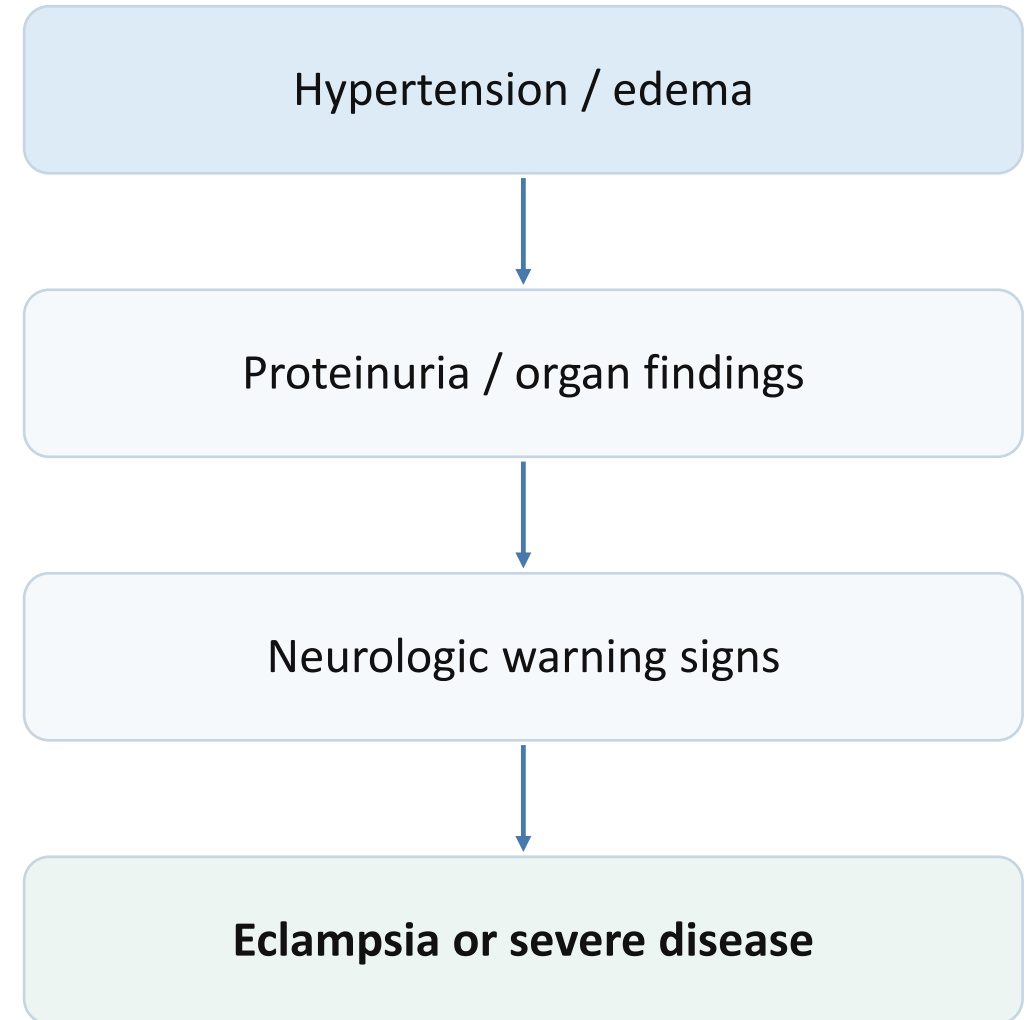
Fetal effects arise through the placenta

- Maternal malperfusion limits effective placental nutrient and oxygen delivery.
- Fetal growth restriction may accompany severe maternal disease.
- Maternal and fetal consequences share an upstream vascular mechanism.



Clinical features often evolve sequentially

- Hypertension and edema may be noticed before proteinuria.
- Headache or visual symptoms indicate neurologic progression.
- Rapid deterioration may culminate in seizures or multiorgan dysfunction.



Gestational hypertension lacks the systemic pattern

- A diagnosis based only on elevated blood pressure does not capture preeclampsia.
- Additional vascular, renal, hematologic, or hepatic findings change the syndrome classification.

Gestational hypertension

New hypertension during pregnancy

No associated preeclampsia manifestations

Preeclampsia

New hypertension after 20 weeks

Associated systemic / organ findings

HELLP versus acute fatty liver of pregnancy

- Both can present in late gestation with elevated aminotransferases.
- Their hallmark liver morphologies differ and overlap is possible clinically.

HELLP / preeclampsia

Microangiopathy and
thrombocytopenia

Periportal fibrin /
hemorrhagic necrosis

Acute fatty liver of pregnancy

Hepatic metabolic
dysfunction

Diffuse microvesicular
steatosis

HELLP versus intrahepatic cholestasis

- Pruritus and bile-salt retention characterize intrahepatic cholestasis.
- Hemolysis, low platelets, and periportal vascular injury indicate a different process.

HELLP / preeclampsia

Microvascular
thrombotic injury

Hypertension /
hemolysis / low
platelets

Pregnancy cholestasis

Pruritus in later
pregnancy

Canalicular bile-
transport dysfunction

Pregnancy liver syndromes: Three mechanisms

- Systemic endothelial injury, hepatocyte metabolic injury, and bile retention represent different mechanisms.
- Clinicopathologic integration is needed when liver tests are abnormal in pregnancy.

Entity / domain	Mechanism / test	Key interpretation
Preeclampsia / HELLP	Endothelial and microvascular injury	Periportal fibrin / hemorrhage
Acute fatty liver	Mitochondrial fatty-acid metabolism	Microvesicular steatosis
Intrahepatic cholestasis	Impaired canalicular bile handling	Cholestatic symptoms

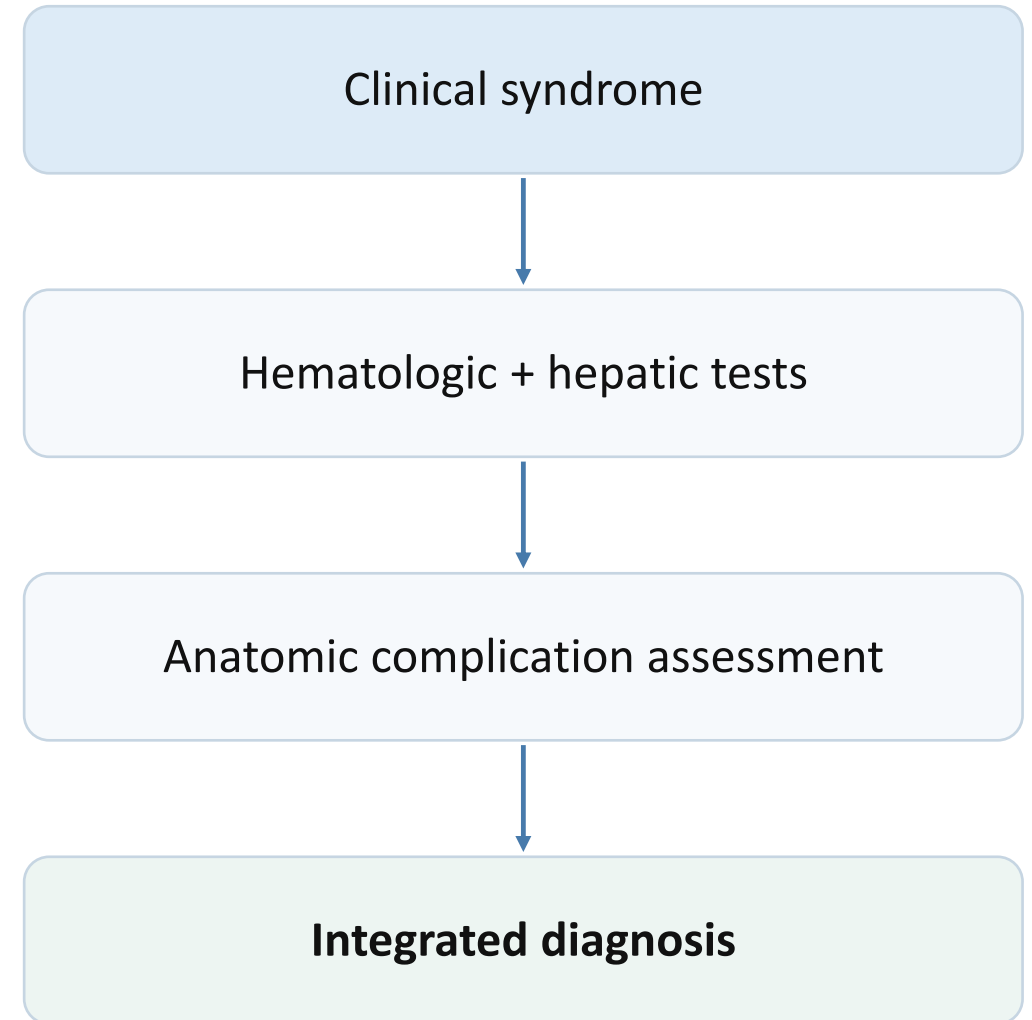
Biochemical testing follows the suspected lesion

- The pattern, not a single isolated laboratory result, guides interpretation.
- This slide states relevant test domains; No unstated diagnostic cutoffs are implied.

Entity / domain	Mechanism / test	Key interpretation
Hepatocellular injury	Serum aminotransferases	Increased in hepatic preeclampsia
Hemolysis / platelets	Evidence of hemolysis; Platelet count	HELLP pattern
Excretory / synthetic injury	Bilirubin; Coagulation profile	Severity and differential

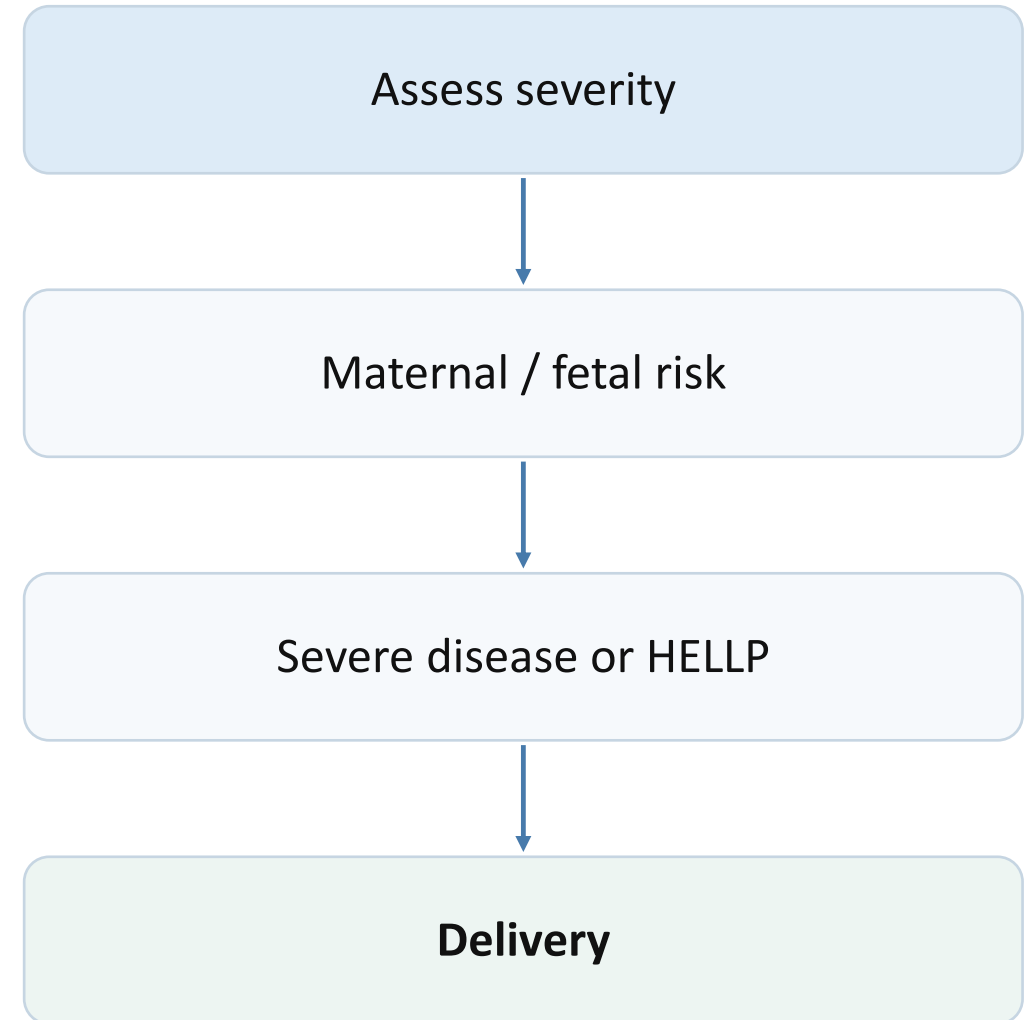
Morphology and labs must be interpreted together

- Elevated enzymes support hepatocyte injury, not a unique diagnosis.
- HELLP pattern supports systemic microangiopathy when clinically appropriate.
- Hepatic hematoma or rupture is an anatomic emergency beyond the laboratory phenotype.



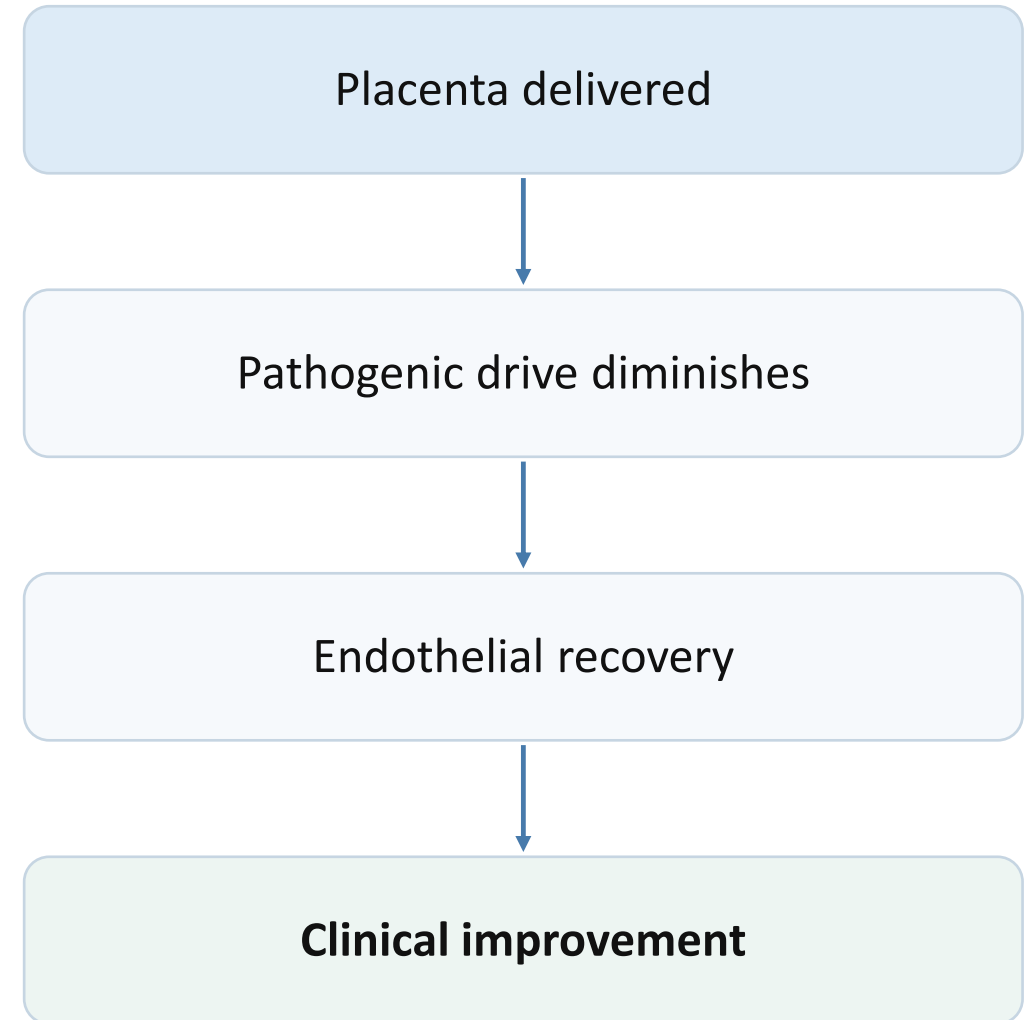
Severe features shift management toward delivery

- Management depends on gestational age and maternal–fetal condition.
- Eclampsia, HELLP, severe preeclampsia, or fetal compromise are delivery indications in the Robbins discussion.
- Delivery removes the principal source of pathogenic placental factors.



Postpartum improvement supports placental causation

- Hypertension and proteinuria usually resolve after delivery in the Robbins account.
- The maternal vascular syndrome commonly improves as placental stimuli diminish.
- Acute hepatic complications remain clinically important during recovery.



Recovery does not erase future vascular risk

- Chapter 18 emphasizes hepatic recovery in survivors.
- Chapter 22 also notes later hypertension, microalbuminuria, and cardiovascular risk after preeclampsia.
- Immediate hepatic recovery and long-term vascular susceptibility are distinct outcomes.

Short-term course

Liver injury often
resolves after
pregnancy

Monitor acute severe
complications

Long-term course

Increased future
hypertension risk

Elevated later
cardiovascular risk

Case: Enzyme elevation and low platelets

- A pregnant patient develops hypertension with elevated aminotransferases and thrombocytopenia.
- Questions: What additional hematologic component completes HELLP? What hepatic microvascular lesion is expected?

Expected reasoning

Evaluate for hemolysis.

Expect periportal sinusoidal fibrin, hemorrhage, and necrosis.

Case: Abrupt deterioration with hepatic bleeding

- A patient with eclampsia develops evidence of an expanding hepatic hemorrhagic complication.
- Questions: Which anatomic compartment may initially contain blood? Why can the lesion become catastrophic?

Expected reasoning

Blood may dissect under Glisson capsule.

Capsular rupture may cause catastrophic hemorrhage.

Case: Differentiate two hepatic lesions

- A histology description notes centrilobular sinusoidal congestion, hepatocyte atrophy, and a mottled cut surface.
- Question: Does this represent the characteristic hepatic pattern of HELLP?

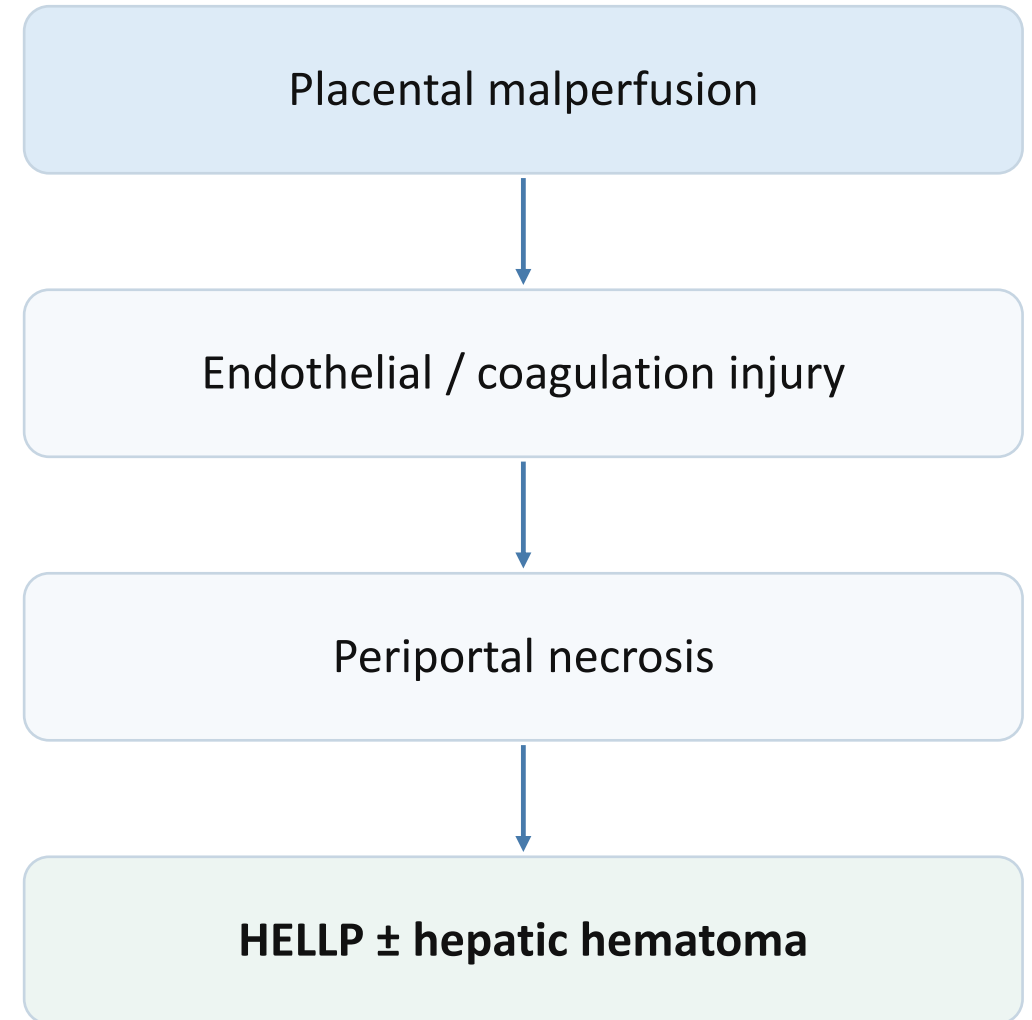
Expected reasoning

No. It matches passive hepatic congestion.

Preeclampsia favors periportal fibrin-associated hemorrhagic injury.

Hepatic pathology: An integrated map

- A placental vascular disorder drives systemic endothelial dysfunction.
- Periportal coagulation and hemorrhage are the characteristic liver lesions.
- HELLP and subcapsular hematoma represent serious clinicopathologic expressions.



Diagnostic contrasts worth retaining

- Anatomic location and dominant mechanism are more discriminating than liver enzyme elevation alone.

Entity / domain	Mechanism / test	Key interpretation
Preeclampsia / HELLP	Periportal	Fibrin, hemorrhagic injury
Passive congestion	Centrilobular	Blood pooling and atrophy
Acute fatty liver	Diffuse hepatocytic	Microvesicular steatosis

Core morphology and clinical implications

- Periportal sinusoidal fibrin with hemorrhage into the space of Disse can cause coagulative hepatocellular necrosis.
- HELLP combines hemolysis, elevated liver enzymes, and thrombocytopenia.
- Subcapsular hepatic hematoma may enlarge and rupture Glisson capsule.
- The initiating mechanism lies in failed placental remodeling and systemic endothelial injury.

Primary textbook sources

Robbins, Cotran & Kumar. Pathologic Basis of Disease. 11th edition (2026).
Chapter 18: Liver and Gallbladder, pp. 786–787.

Robbins, Cotran & Kumar. Pathologic Basis of Disease. 11th edition (2026).
Chapter 22: The Female Genital Tract, pp. 937–939.

Conceptual diagrams are original editable schematics; no synthetic images are presented as clinical or histologic specimens.