Adding to the Denominator: A Case Report of Neuraxial Anesthesia for Cesarean Delivery in the Setting of Hemolysis, Elevated Liver Enzyme, Low Platelet, Thrombocytopenia, and Pulmonary Hypertension

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The acceptable platelet count for the safe provision of neuraxial anesthesia in obstetric patients is unknown. Comorbidities may sway a provider to perform neuraxial anesthesia, despite thrombocytopenia, as the putative risk of spinal–epidural hematoma may not outweigh the risks associated with general anesthesia. The case of a 22-year-old nulliparous woman undergoing a cesarean delivery with a new diagnosis of pulmonary hypertension and right heart failure, compounded with thrombocytopenia and possible Hemolysis, Elevated Liver Enzyme, and Low Platelet (HELLP) syndrome, is presented. Risks and benefits of general versus neuraxial anesthesia in this specific setting are reviewed. (A&A Practice. 2020;14:144–8.)

GLOSSARY

ALT = alanine aminotransferase; **AST** = aspartate aminotransferase; **CSE** = combined spinal–epidural; **Cr** = creatinine; **ECMO** = Extracorporeal membrane oxygenator; **HELLP** = Hemolysis, Elevated Liver Enzyme, and Low Platelet; **IV** = intravenous; **PASP** = pulmonary artery systolic pressure

The cutoff for the provision of safe neuraxial anesthesia in thrombocytopenic obstetric patients remains unknown. Risk assessment of neuraxial anesthesia in a pregnant, thrombocytopenic woman must include the timeline and severity of thrombocytopenia, coagulation status, pathophysiologic or iatrogenic etiology of the platelet or coagulation derangement, inherent hypercoagulability of pregnancy, and all coexisting maternal comorbidities. Moreover, the risks associated with general anesthesia must also be considered. We report the use of combined spinal–epidural (CSE) anesthesia for an unplanned cesarean delivery at 29 weeks' gestation in a nulliparous woman with a new diagnosis of pulmonary hypertension, right heart dysfunction, and thrombocytopenia. The patient provided written consent for the publication of the case.

CASE DESCRIPTION

A 22-year-old nulliparous woman with no prior cardiac history presented at 29 weeks' gestation with 2 days of chest pressure. She had mild shortness of breath during pregnancy. On admission, her heart rate was 90 beats per minute, blood pressure range was 118/88–134/93 mm Hg, and oxygen saturation was >95% on 2 L of oxygen. Beta-natriuretic peptide was 3933.0 (0.0–178.0 pg/mL), platelet count was 42,000/μL, coagulation tests were within normal range, creatinine was 0.82 mg/dL, and transaminases were mildly elevated (Figure A, B). She was 73 kg and 162 cm, with a Mallampati Class 1 airway, clear lungs, and no edema. Transthoracic ultrasound revealed right ventricle hypertrophy and moderately to severely reduced right heart function with septal flattening throughout the cardiac cycle. Right ventricular systolic pressure was estimated to be 58 mm Hg, and moderate tricuspid regurgitation was present. There was no thrombus on pulmonary computerized tomography scan.

The differential diagnosis was Hemolysis, Elevated Liver Enzyme, and Low Platelet (HELLP) syndrome or a pulmonary hypertensive crisis with hepatic congestion. Immediate delivery was indicated due to maternal decompensation. The decision was made to proceed with a cesarean delivery under neuraxial anesthesia in a cardiothoracic operating room. In preparation for this complex unplanned delivery, a team of specialists was consulted, including a maternal–fetal medicine specialist, obstetric and cardiothoracic anesthesiologists, pulmonary hypertension cardiologist, extracorporeal membrane oxygenator (ECMO) surgeon, perfusionists, and a critical care obstetric nurse.

On arrival in the operating room, an arterial line, central venous line, and pulmonary artery catheter were placed. The pulmonary artery systolic pressure (PASP) was 50 mm Hg. Inhaled nitric oxide was initiated through high-flow nasal

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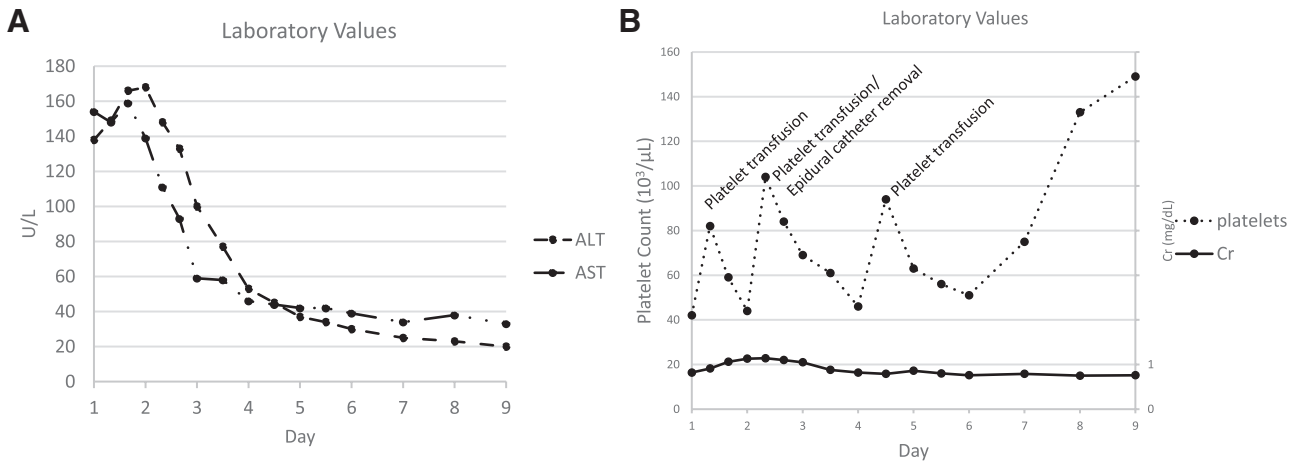

Figure. Laboratory values. A, Liver function tests over time. B, Creatinine, platelet levels and platelet transfusions over time. ALT indicates alanine aminotransferase; AST, aspartate aminotransferase; Cr, creatinine.

cannula, which resulted in a 5-mm Hg decrease in PASP. Now 5 hours after the platelet count of 42,000/μL, diphenhydramine 50 mg intravenous (IV) and furosemide 10 mg IV were administered to blunt the possibility of allergic response and volume overload with the platelet transfusion, respectively. A 1-unit dose of platelets was transfused. Then a CSE (17-gauge Tuohy and 27-gauge Whitacre needle) anesthetic technique was uneventfully performed. Intrathecal hyperbaric bupivacaine 5 mg, fentanyl 15 μg, and morphine 200 μg were administered followed by titration of epidural lidocaine 2% (15 mL) over 23 minutes to achieve our usual practice of a T4 level for cesarean delivery. During this time, the ECMO team placed wires in the left femoral artery and right femoral vein in the event that management of acute right heart decompensation was necessary. Seventeen minutes after the T4 local anesthetic block level was achieved, systemic hypotension, accompanied by vomiting and an increase in pulmonary pressure, was managed with phenylephrine 160 μg and ephedrine 10 mg intravenous. Norepinephrine (2 μg/min) was started for treatment of neuraxial-induced decrease in systemic vascular resistance.

Surgical skin incision was performed and followed 2 minutes later by neonatal delivery (Apgar 8/9). The uterus was not exteriorized to avoid air embolism and visceral pain. Intravenous oxytocin was initiated at 3 units over 3 minutes, followed by 3 units over 6 minutes, and then followed by 15 units per hour for 4 hours. There was no uterine atony or excessive bleeding at femoral wire or surgical sites. Transthoracic echocardiography was performed throughout the case. The expected postdelivery autotransfusion increased PASP to 60–70. Dobutamine 2 μg/kg/min was started for inotropic support of the right ventricle. Oxytocin-induced vasodilation was treated with norepinephrine and vasopressin. Epoprostenol 2 ng/kg/min was initiated and pulmonary pressures decreased to baseline.

The wire in the right femoral vein was removed, and the wire in the left femoral artery was changed to a 4-French catheter that was kept in place for 1 day. The patient was transferred to the intensive care unit. The epidural catheter was removed the following day after another dose of platelets, and repeat platelet count was 104,000/μL (Figure B). Pulmonary hypertension was managed with inhaled nitric oxide (1 day) and intravenous epoprostenol (4 days), then transitioned to oral sildenafil 20 mg 3 times per day and oral ambrisentan 5 mg daily. Furosemide was given daily until the third postoperative day. On the fourth postoperative day, the platelet count was 46,000/μL. A third platelet transfusion of 1 dose was given, increasing the platelet count to 94,000/μL. Dobutamine was discontinued by the fifth postoperative day. The predischarge transthoracic echocardiogram demonstrated a mildly dilated right ventricle with mildly to moderately reduced function, mild tricuspid regurgitation, and right ventricular systolic pressure 49 mm Hg. The patient was discharged home on postoperative day 8.

She had cardiology follow-up 3 times in the first 2 months since delivery. She has New York Heart Association Class I symptoms with no shortness of breath, chest pain, or edema. A right heart catheterization will be performed 3 months after resolution of acute pregnancy physiology. The patient was counseled on the need for reliable contraception and opted for an intrauterine device with condoms.

DISCUSSION

Pulmonary hypertension increases the risk of morbidity and mortality in pregnancy. Risk can be mitigated with thorough planning (Table 1) and implementation of appropriate therapy (Table 2). The etiology of the severe thrombocytopenia in this patient remains undetermined. An association between preeclampsia spectrum disorders such as HELLP and pulmonary hypertension has been proposed, but the underlying mechanism of association remains unclear. The mild elevation of transaminases could have been caused by hepatic congestion from right heart dysfunction and the thrombocytopenia from a pulmonary hypertensive crisis. However, since HELLP syndrome was suspected, delivery was recommended within 24–48 hours. The transaminases returned to normal 3 days after delivery, and the platelet count returned to 133,000/μL 7 days after delivery, suggestive of HELLP. HELLP-induced laboratory derangements usually improve by 72 hours after delivery, though more protracted resolution, especially with transaminases, can be seen up to several weeks postpartum.[2]

Table 1. Maternal Cardiac Disease Delivery Planning Algorithm/Framework for This Patient		
Who	Patient (disease, severity, risk)	HELLP syndrome Platelets 42,000/μL Mild elevation of transaminases Normal coagulation status Pulmonary hypertension and right heart strain WHO class IV: extremely high risk for severe maternal morbidity or mortality Idiopathic pulmonary arterial hypertension CARPREG II: (6 points, >40% risk of adverse event[a])[1] Ventricular dysfunction: 2 points Pulmonary hypertension: 2 points No prior cardiac intervention: 1 point Late pregnancy assessment: 1 point
	Team members	Obstetrician/maternal–fetal medicine Anesthesiologist (obstetric and cardiothoracic) Pulmonary hypertension cardiologist ECMO surgeon/perfusion team Intensivist Critical care obstetric nurse
What	Route of delivery or termination	Cesarean delivery: (preferred) HELLP syndrome requires urgent delivery Current maternal decompensation requires urgent delivery as volume increases of pregnancy are not being tolerated by maternal cardiopulmonary system Vaginal delivery: (not preferred) Preterm, nulliparous patient is likely to have a long induction, and current maternal decompensation suggests poor likelihood of success of vaginal delivery May not tolerate labor without neuraxial analgesia, which may be withheld due to thrombocytopenia
When	Target induction, delivery, or procedure date	Day of presentation HELLP: indicates urgent delivery of fetal placental unit Pulmonary hypertension and right heart strain: further decompensation possible
Where	Type of medical center, location within hospital	Cardiothoracic operating room or operating room that can accommodate cardiothoracic surgeon and ECMO team
How	Peripartum plan	Hemodynamic goals Decrease pulmonary vascular resistance (avoid pain, hypoxia, hypercarbia, acidosis) Maintain systemic blood pressure Inotropic support of right ventricle Control volume status during uterine contraction, autotransfusion, and blood loss Peripartum risks Autotransfusion and increased pulmonary vascular resistance (pulmonary hypertensive crisis) Heart failure HELLP/thrombocytopenia Medications Vasopressor: norepinephrine Inotropes: dobutamine, milrinone Pulmonary vasodilator: oxygen, inhaled nitric oxide, intravenous epoprostenol, phosphodiesterase 5 inhibitor Anesthesia/analgesia Slowly induced neuraxial anesthesia Intrathecal opioids Monitoring/Access/ECMO Telemetry Arterial line Central venous line Central venous pressure monitoring Pulmonary artery catheter Transthoracic echocardiogram Femoral venous and arterial ECMO wires Hemorrhage prevention/management Oxytocin Compression suture Blood products available Postcare Recovery location: intensive care unit Treatment goals Decrease pulmonary vascular resistance Diuresis Inotropic support of right ventricle Anticoagulation Stool softeners Sodium restriction

(Continued)

Table 1. Continued

	Analgesia
	Acetaminophen around the clock
	Epidural morphine
	Contraception
	Progesterone (implant, oral, intrauterine device)
	Copper intrauterine device
	Condoms
	Tubal ligation
	Partner sterilization

Abbreviations: CARPREG, Cardiac Disease in Pregnancy; ECMO, extracorporeal membrane oxygenator; HELLP, Hemolysis, Elevated Liver Enzyme, and Low Platelet; IV, intravenous; WHO, World Health Organization.

[a]Maternal cardiac death, maternal cardiac arrest, arrhythmias, left- or right-sided heart failure, stroke, myocardial infarction, aortic dissection, and cardiac thromboembolism.

Table 2. Hemodynamic Goals and Management Strategies in Pregnant Women With Pulmonary Hypertension

Hemodynamic Goal	Management Goal	Therapy
Decrease pulmonary vascular resistance	Pulmonary vasodilation	Oxygen
		Calcium channel blocker
		Nicardipine
		Nifedipine
		Prostanoids
		Iloprost
		Epoprostenol
		Treprostinil
		Phosphodiesterase 5 inhibitors
		Sildenafil
		Tadalafil
		Inhaled nitric oxide
		Endothelin receptor antagonists (contraindicated in pregnancy, can be used postpartum)
		Bosentan
		Ambrisentan
		Macitentan
Prevent increases in pulmonary vascular resistance	Avoid pain	Analgesia
		Intrathecal and epidural morphine
		Acetaminophen around the clock
		Transversus abdominal plane block
		Nonsteroidal anti-inflammatory (if platelets are normal)
	Avoid hypoxia	Oxygen
	Avoid hypercarbia/acidosis	Incentive spirometry
		Respiratory coaching
	Avoid air embolism	Do not perform uterine exteriorization
Support right ventricle	Inotropes	First line
		Dobutamine
		Dopamine
		Milrinone
		Second line
		Epinephrine
	Mechanical support	Venoarterial extracorporeal membrane oxygenator
Control volume status	Manage auto-transfusion	Furosemide pre delivery or at delivery and postpartum
		Dietary sodium restriction
	Prevent hemorrhage	Expert surgical technique
		Uterotonics
		Judicious oxytocin (consider 1 unit/min up to 6 units, treat expected concomitant vasodilation)
		Misoprostol
		Avoid methylergonovine (can cause hypertension) and avoid carboprost tromethamine (can cause bronchospasm)
		Avoid tranexamic acid if history of thrombosis, not enough data to make further recommendation
		Compression suture
	Prevent unsupervised valsalva	Aggressive stool softeners
		Colace
		Senna
Support coronary perfusion	Avoid hypotension, maintain appropriate systemic vascular resistance and aortic diastolic pressure	Vasopressors
		Norepinephrine
		Phenylephrine
		Vasopressin

General anesthesia is considered the safer modality in patients with severe thrombocytopenia to avoid the unquantified risk of spinal–epidural hematoma. In addition, with HELLP, there may be concomitant platelet dysfunction and coagulation abnormalities secondary to liver dysfunction. Maternal morbidity and mortality are increased with both HELLP and pulmonary hypertension. The presence of both high-risk conditions necessitated a thorough risk–benefit deliberation regarding the anesthetic technique with the least amount of risk while incorporating the patient's perspective of acceptable risks.

In this case, major risks associated with induction of general anesthesia and intubation included prolonged mechanical ventilation, pulmonary hypertensive crisis while intubated or at the time of extubation, pneumonia, stroke, cardiopulmonary decompensation, need for ECMO, arrest, and death. While it is impossible to calculate the likelihood of these events, the septal flattening throughout the cardiac cycle, combined with the symptoms that prompted the patient's presentation, was suggestive of an acutely decompensating right ventricle due to pressure and volume overload. Therefore, any further increase in pulmonary pressure or strain on the right heart during induction of general anesthesia and endotracheal intubation could lead to cardiopulmonary collapse.

The risk of spinal–epidural hematoma with neuraxial anesthesia in this patient remains difficult to quantify.[3,4] With normal coagulation parameters, a platelet transfusion was considered a reasonable approach to avoid general anesthesia and decrease the risk of spinal–epidural hematoma, although evidence supporting platelet transfusion is nonexistent.[5] Some of the considerations included whether intravenous anticoagulation would be necessary if the patient required ECMO and how to assess neurological symptoms if ECMO was required. Neurological imaging with computerized tomography is feasible while on ECMO. Therefore, if postoperatively a spinal–epidural hematoma was suspected (eg, pain, loss of motor function), the patient could be evaluated for spinal–epidural hematoma using computerized tomography.

As evidence of safely performed neuraxial anesthesia without complications of spinal–epidural hematomas in women with thrombocytopenia increases, anesthesiologists may become more willing to perform neuraxial anesthesia in thrombocytopenic pregnant patients with comorbidities, where general anesthesia is not without risk. The question of whether informed consent is ever possible in such a patient is valid. The team presented the patient with the risks and benefits of neuraxial versus general anesthesia and emphasized both options were associated with significant morbidity. She expressed understanding and stated a strong preference to be awake for the delivery.

The management of women with thrombocytopenia and severe maternal comorbidities is not straightforward, and the theoretical risk of a spinal–epidural hematoma must be weighed against the risks associated with induction of general anesthesia. Until a repository of obstetric patients with severe thrombocytopenia becomes available, we will continue to report our cases of neuraxial anesthesia in thrombocytopenic women, adding to the denominator of neuraxial cases without spinal–epidural hematomas.[6–8]

DISCLOSURES

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