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Simulation Patient Design (December 2021)
Case of Peripartum Hepatic Rupture

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Introduction

Peripartum hepatic rupture is a rare but devastating occurrence, which can result in massive blood loss. Studies have shown it is an exceedingly uncommon event with an incidence of 0.4-2.0/100,000 deliveries.[1] Due to its rare occurrence, it may be misdiagnosed and/or mismanaged which could potentially result in suboptimal outcomes.

Hemolysis, elevated liver enzymes and low platelets (HELLP) syndrome is widely accepted as the primary risk factor for hepatic rupture, it has also been reported in patients with acute fatty liver of pregnancy, connective tissue disorders, hepatic abscess, liver masses, history of cocaine use, abdominal trauma, and in uncomplicated pregnancies.[1]

Hepatic rupture typically manifests with acute abdominal pain associated with nausea and vomiting, followed by abdominal distention and hypovolemic shock, and emergent surgical and/or medical treatment is required to prevent maternal and neonatal mortality. Maternal mortality is reported as 10-30%, however neonatal mortality is reported as 60-80% because of maternal hypotension, abruptio placentae, and prematurity.[2] Recurrence in subsequent pregnancies appears to be rare.[1]

The pathologic processes that lead to hepatic rupture are poorly understood. In hypertensive disorders, the most likely sequence of events is intrahepatic or intracapsular hemorrhage with tissue disruption leading to hematoma formation, followed by distention and rupture of the capsule. The events initiating intrahepatic hemorrhage are unclear, but likely related to parenchymal ischemia resulting from fibrin thrombi or reduced blood flow caused by endothelial dysfunction.[1] Trauma literature describes hepatic rupture in terms of Grade I-V based on the extent of involvement of the hepatic capsule, the parenchyma, and vascular injury.[4] The right liver lobe has been described as the most common site of spontaneous rupture.[5]

Diagnostic tools used in assessing the presence and severity of rupture include clinical evaluation, ultrasound, CT/MRI, angiography, and in some cases it may not be diagnosed until an exploratory laparotomy has been performed.[3] Management includes eliminating the causal factor, pregnancy termination, and hemorrhage control. A hemodynamically stable patient with a stable hematoma may not require surgery, but a hemodynamically unstable patient will require a laparotomy, potentially in addition to IR embolization. A less aggressive surgical approach is preferable if possible, compared to major surgical interventions, although in extreme cases a liver transplant may be required.[6,7]

Educational Rationale: To teach team skills in managing peripartum hepatic rupture
Target Audiences: Nursing, OB, Anesthesiology, OR personnel
Learning Objectives: As per Accreditation Council for Graduate Medical Education (ACGME) Core Competencies
Upon completion of this simulation (including the debrief) learners will be able to:

- *Medical knowledge*: Recognize clinical signs and symptoms, and describe treatment options for hepatic rupture during pregnancy
- *Patient care*: Delineate risk factors for hepatic rupture to prioritize management strategies
- *Practice-based learning and improvement*: Identify the setting, equipment, and medications necessary to manage an obstetric patient who develops hepatic rupture including sequelae such as massive obstetric hemorrhage and coagulopathy
- *Interpersonal and communication skills*: Assign roles such as a team leader who will coordinate the team to provide optimal care to the patient and maintain ongoing communication about the evolution of the clinical situation among the providers
- *Professionalism*: Demonstrate mutual respect for team members
- *Systems-based practice*: Ensure all resuscitation equipment, medications, and protocols are readily identifiable and available in delivery locations including airway management, anesthesia induction/emergency medications, vascular access, massive transfusion; include identification of barriers within the hospital system such as staffing (including non-OB staff such as general/trauma surgery), equipment/protocols

Questions to ask after the scenario:

1. Was the emergency response appropriately activated?
2. Did each member of the response team have well-defined roles?
3. Were the next steps for management clearly outlined by the care team?
4. Were there any barriers or system issues identified when caring for the patient?
5. Were opportunities for improvement(s) identified during the scenario?

Assessment Instruments:

1. Learner Knowledge Assessment form (Appendix 1)
2. Simulation Activity Evaluation form (Appendix 2)

Equipment Needed and Set-up:
In-situ set-up

1. Mannequin set-up in LD room using standard admission set-up
2. 18G IV with fluids running and multiple access ports
3. Standard monitors (e.g. EKG, NIBP, SpO_2)
4. Transfer to OR where standard anesthesia setup is ready

Simulation Scenario Set-up:
The case
Ms. Hema Raaj is a 30-year-old (G6P5) at 36 weeks gestation who presented with epigastric pain and severe range blood pressure. She was diagnosed with preeclampsia with severe features and managed with antihypertensive medication and IV magnesium. A decision has been made to induce labor. Other significant history includes poorly controlled gestational diabetes (on insulin) and intra-hepatic cholestasis of pregnancy (on ursodiol).
Height = 5’4”, weight = 185 lbs, BMI = 31.8.

Simulation Pre-brief

- Read the scenario and instruct team members on their role during the simulation
- The learners take their places
- Include a confederate, if applicable

Scenario Details

Trigger	Patient Condition	Action	Done	Time	Comments
	Patient awake + responsive HR 95 bpm BP 175/110 mm Hg SpO_2 97% (air) Resp 16/min Temp 37^{o}C Reassuring FHT	1) L&D nurse performs initial patient evaluation + examination ▫ Calls the OB to assess the patient ▫ Sends labs (CBC, CMP, Coag screen) 2) OB orders IV hydralazine followed by hypertensive protocol 3) Nurse administers IV hydralazine (using closed-loop communication) 4) Continue magnesium infusion 5) OB requests an anesthesiology consult for analgesia/anesthesia options			
	HR 88 bpm BP 142/79 mm Hg SpO_2 96% (air) Resp 18/min Lab results: Hct 32% Hb 10.6 g/dL Plts 80 x10^9/L	1) Anesthesiology team discusses analgesia/anesthesia options with the patient			
2 h later: On examination found to have significant abdominal tenderness, especially in the RUQ	Patient complains of feeling weak HR 109 bpm BP 105/67 mm Hg SpO_2 95% (air) Resp 26/min FHR tracing = Category 2	1) Nurse requests OB team to reassess the patient 2) OB team re-examines the patient 3) Place 2nd IV (large bore) + send repeat labs (include serum magnesium level) 4) Administer fluid bolus			
30 min later:	Patient exhibits pallor + continued significant abdominal pain + tenderness Lab results:	1) Team discussion re differential diagnosis (e.g. abruption, other etiology of hemorrhage) 2) Decision made to proceed with emergent CD 3) Patient transported to OR 4) Anesthesiology team induce			

	Hct 24% Hb 8.0 g/dL Plts 60 x10^9/L FHR tracing = Category 3	general anesthesia + intubate the patient 5) Request MTP			
Infant delivered (Apgar scores 2 and 7) Large volume of blood identified in upper abdomen	Patient appears very pale HR 122 bpm BP 88/55 mm Hg SpO_2 96% (FiO_2 0.5) Temp 36.6^{o}C	1) Stat call to General Surgery 2) Place additional large bore IV access 3) Stop magnesium infusion 4) Resend labs + type & cross 5) Set-up rapid infuser 6) Start blood transfusion 7) OB + anesthesiology teams discuss differential 8) Administer vasopressor boluses + infusion, as indicated			
General Surgeon announces source of hemorrhage from the right hepatic lobe with capsular rupture, but no obvious source of injury	HR 138 bpm BP 70/45 mm Hg SpO_2 97% Temp 36.4^{o}C Lab results (from earlier in OR): Hct 17.4% Hb 5.8 g/dL Plts 50 x10^9/L INR 1.6 Fib 160 mg/dL EBL 7.8 L	1) Active warming 2) Stabilize coagulopathy with aggressive blood component transfusion 3) Place arterial line 4) Continue vasopressors, as indicated 5) Replete calcium, as indicated 6) Inform ICU team			
Vital signs stabilize	HR 115 bpm BP 95/48 mm Hg SpO_2 98% (intubated) Temp 36.6^{o}C	1) Surgery completed 2) Patient transferred to ICU (intubated) 3) Discuss when to restart magnesium infusion 4) Update family			

Appendix 1

Learner Knowledge Assessment
Labor and Delivery Multidisciplinary Team Simulation

Name of simulation: _____ Date: _____

OB Nursing Anes

Each item has two components. The "Before the simulation" column (left side) examines your perspective at the beginning of the simulation. The "End of Simulation" column (right side) is to evaluate your perspective at the completion of the simulation.

1. How would you rate your knowledge of risk factors for peripartum hepatic rupture?

BEFORE THE SIMULATION	END OF SIMULATION
1 2 3 4 5 6 7 Little/none Knowledgeable	1 2 3 4 5 6 7 Little/none Knowledgeable

2. How would you rate your knowledge of the differential diagnosis of peripartum hepatic rupture?

BEFORE THE SIMULATION	END OF SIMULATION
1 2 3 4 5 6 7 Little/none Knowledgeable	1 2 3 4 5 6 7 Little/none Knowledgeable

3. How would you rate your knowledge of signs and symptoms of peripartum hepatic rupture?

BEFORE THE SIMULATION	END OF SIMULATION
1 2 3 4 5 6 7 Little/none Knowledgeable	1 2 3 4 5 6 7 Little/none Knowledgeable

4. How would you rate your knowledge of delivery planning for peripartum hepatic rupture?

BEFORE THE SIMULATION	END OF SIMULATION
1 2 3 4 5 6 7 Little/none Knowledgeable	1 2 3 4 5 6 7 Little/none Knowledgeable

5. How would you rate your overall confidence when confronted with peripartum hepatic rupture and massive obstetric hemorrhage?

BEFORE THE SIMULATION	END OF SIMULATION
1 2 3 4 5 6 7 Little/none Knowledgeable	1 2 3 4 5 6 7 Little/none Knowledgeable

Appendix 2

Simulation Activity Evaluation

DATE OF SIMULATION: _____
OCCUPATION: Consultant PG Yr 1 2 3 4 STUDENT NURSE MIDWIFE OTHER
SPECIALTY:_____ YEARS IN PRACTICE: _____

Please rate the following aspects of this training program using the scale listed below:
1 = Poor 2 = Suboptimal 3 = Adequate 4 = Good 5 = Excellent
Use "N/A" if you did not experience or otherwise cannot rate an item

INTRODUCTORY MATERIALS						
Orientation to the simulator	1	2	3	4	5	N/A
PHYSICAL SPACE						
Realism of the simulator space	1	2	3	4	5	N/A
EQUIPMENT						
Satisfaction with the mannequin	1	2	3	4	5	N/A
SCENARIOS						
Realism of the scenarios	1	2	3	4	5	N/A
Ability of the scenarios to test technical skills	1	2	3	4	5	N/A
Ability of the scenarios to test behavioral skills	1	2	3	4	5	N/A
Overall quality of the debriefings	1	2	3	4	5	N/A
DID YOU FIND THIS USEFUL?						
To improve your clinical practice?	1	2	3	4	5	N/A
To improve your teamwork skills?	1	2	3	4	5	N/A
To improve your VERBAL communication?	1	2	3	4	5	N/A
To improve your NONVERBAL communication?	1	2	3	4	5	N/A
FACULTY						
Quality of instructors	1	2	3	4	5	N/A
Simulation as a teaching method	1	2	3	4	5	N/A

COMMENTS/SUGGESTIONS:

References

1) Odze RD, Goldblum JR, Editors. Odze and Goldblum Surgical Pathology of the GI Tract, Liver, Biliary Tract, and Pancreas. Third ed., Saunders/Elsevier, 2015

2) Araujo AC, Leao MD, Nobrega MH, et al. Characteristics and treatment of hepatic rupture caused by HELLP syndrome. Am J Obstet Gynecol. 2006;195:129-33

3) Poo, Jorge Luis, and Julieta Góngora. Hepatic hematoma and hepatic rupture in pregnancy: Symposium Liver & Pregnancy. Ann Hepatol. 2006;5:224-6

4) Gaillard, F., Jones, J. AAST liver injury scale. Reference article, Radiopaedia.org. (accessed on 06 Oct 2021) https://radiopaedia.org/articles/1596

5) Troja A, Abdou A, Rapp C et al. Management of spontaneous hepatic rupture on top of HELLP syndrome: case report and review of the literature. Viszeralmedizin. 2015;31:205-8

6) Moura C, Amaral L, Mendes J et al. Hepatic rupture in HELLP syndrome. J Surg Case Rep. 2019;2019:rjz277

7) Erhard J, Lange R, Niebel W et al. Acute liver necrosis in the HELLP syndrome: successful outcome after orthotopic liver transplantation. A case report. Transpl Int. 1993;6:179-81