ACEP Simulation Case: HCM with LVOT Obstruction

SIMULATION CASE TITLE: Crashing LVOT Obstruction
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PATIENT NAME: Charlie Thickens
PATIENT AGE: 17
CHIEF COMPLAINT: Syncope and palpitations

Brief narrative description of case *Include the presenting patient chief complaint and overall learner goals for this case*	A 17-year-old male presents to a rural ED via EMS after passing out while on a summer backpacking trip with family. He has an undiagnosed history of HCM and is severely tachycardic and hypotensive upon arrival. Bedside US demonstrates septal thickening with SAM and aliasing, concerning for severe left ventricular outflow tract (LVOT) obstruction in the setting of dehydration. The goals of this case include: 1) Demonstrate teamwork 2) Elicit subtle history and physical exam findings 3) Generate a broad differential diagnosis 4) Prioritize essential testing and interventions
Primary Learning Objectives *What should the learners gain in terms of knowledge and skill from this case? Use action verbs and utilize Bloom's Taxonomy as a conceptual guide*	1) Goal: Demonstrate teamwork - a) identify a clear team leader b) use closed-loop communication c) direct communication toward a single individual by calling their name or identifying them d) ask for drugs using name, amount, and route of administration (not just name) 2) Goal: Elicit subtle history and physical exam findings - a) elicit a thorough history in a patient with nonspecific complaints b) perform appropriate examinations based on patients chief complaint, history, and your differential diagnosis. 3) Goal: Generate a broad differential diagnosis - a) consider emergent diagnosis first and ask historical questions and perform physical exam maneuvers that would confirm/deny these diagnosis b) consider non emergent diagnoses second 4) Goal: Prioritize essential testing and interventions - a) Manage ABC's and reassess them frequently as the patient's status changes b) perform testing to rule out emergent diagnosis first

Critical Actions *List which steps the participants should take to successfully manage the simulated patient. These should be listed as concrete actions that are distinct from the overall learning objectives of the case.*	1. Place patient on monitor 2. Obtain at least 2 large bore (>18G) IVs 3. Begin fluid resuscitation early 4. Perform full cardiac/neurologic/trauma examination 5. Use POCUS to narrow differential of hypotensive patient (RUSH exam) 6. Recognize septal thickening with evidence of LVOT obstruction 7. Appropriately treat with IVF and vasopressors/beta blockers 8. Consult cardiology regarding HCM with LVOT obstruction 9. Admit to monitored SDU/ICU
Learner Preparation *What information should the learners be given prior to initiation of the case?*	1. Welcome learners, introduce yourself 2. Ask learners to be respectful, courteous, and curious. 3. Introduce goals and objectives of simulation. 4. Allow learners to orient themselves to the environment. 5. Discuss confidentiality, assessment, and learner expectations. 6. Fiction contract.
Required Equipment *What equipment is necessary for the case?*	1. Vital Signs Monitor (with telemetry leads, BP cuff, SpO2 monitor) 2. Peripheral IV supplies (angiocath, saline flushes, disinfectant, saline lock, gauze, tourniquet, sharps container, gloves) 3. Central line supplies (central line kit) 4. Arterial line supplies (arterial line, tape, sterile gloves) 5. Intubation supplies (ET tube, calorimeter, end Tidal CO2, 10 cc syringe, suction, Mac/Miller blade, stylet, bougie) 6. Ultrasound machine (with linear and abd/phased array probe, probe covers, gel)

INITIAL PRESENTATION	
Initial vital signs	HR: 142 bpm BP: 82/58 RR: 28 O_2SAT: 92% T: 37.1^{o}C W: 75kg
Overall Appearance *What do learners see when they first enter the room?*	A 17-year-old male that appears somewhat lethargic with rapid rate of breathing. He is easily arousable but speaking in short sentences.

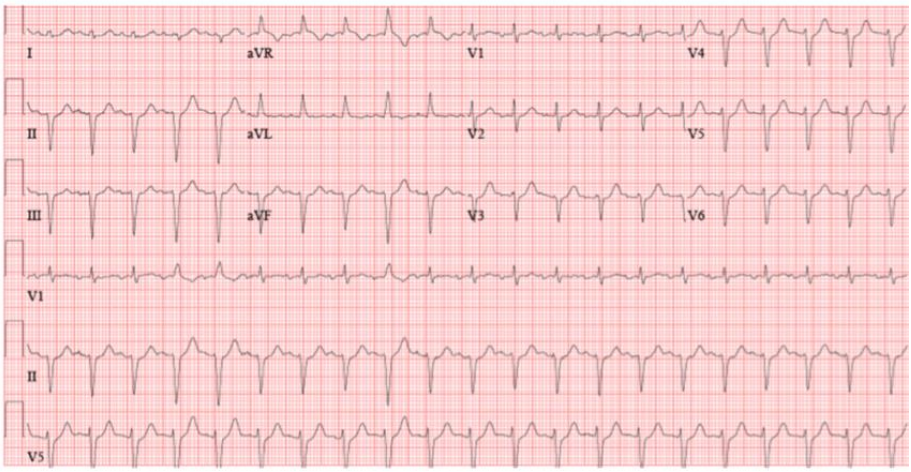
Actors and roles in the room at case start *Who is present at the beginning and what is their role? Who may play them?*	EMS and family; patient can initially provide limited information		
HPI *Please specify what info here and below must be asked vs what is volunteered by patient or other participants*	17 y/o M presents after passing out while on a summer hiking trip with his family earlier today, with 30 second LOC. No prodromal symptoms described. The patient was otherwise in his normal state of health prior to this event. Family called EMS, who was unable to obtain IV access. FSBG 107 No head trauma (asked) No illicit substance use (asked) No seizure like activity noted (asked) No known bites or stings (asked)		
Past Medical/Surg History	**Medications**	**Allergies**	**Family History**
History of home birth. No known PMH	None	Bee stings NKDA	Sudden death of paternal uncle at age 30 (asked)
Physical Examination			
General	Patient is ill-appearing. He is somnolent but arousable to verbal stimulation		
HEENT	Dry mucous membranes. No evidence of head or facial trauma. No oropharyngeal swelling. PERRL, EOMI		
Neck	Supple with normal ROM. No midline tenderness.		
Lungs	Tachypneic with good aeration throughout. Mild crackles noted at bilateral bases		
Cardiovascular	Tachycardic with harsh systolic murmur on auscultation (improved if legs are flexed on exam). Mild peripheral edema. Cap refill 3 seconds		
Abdomen	Soft, NT, ND		
Neurological	MAE x4 with normal sensation. Sluggish to respond but oriented x3		
Skin	Cool extremities without rashes or wounds noted.		
GU	Normal genitalia		
Psychiatric	Situationally appropriate		

1) **SCENARIO STATES, MODIFIERS AND TRIGGERS**
2) *This section should be a list with detailed description of each step than may happen during the case. If medications are given, what is the response? Do changes occur at certain time points? Should the nurse or other participant prompt the learners at given points? Should new actors or participants enter, and when? Are there specific things the patient will say or do at given times?*

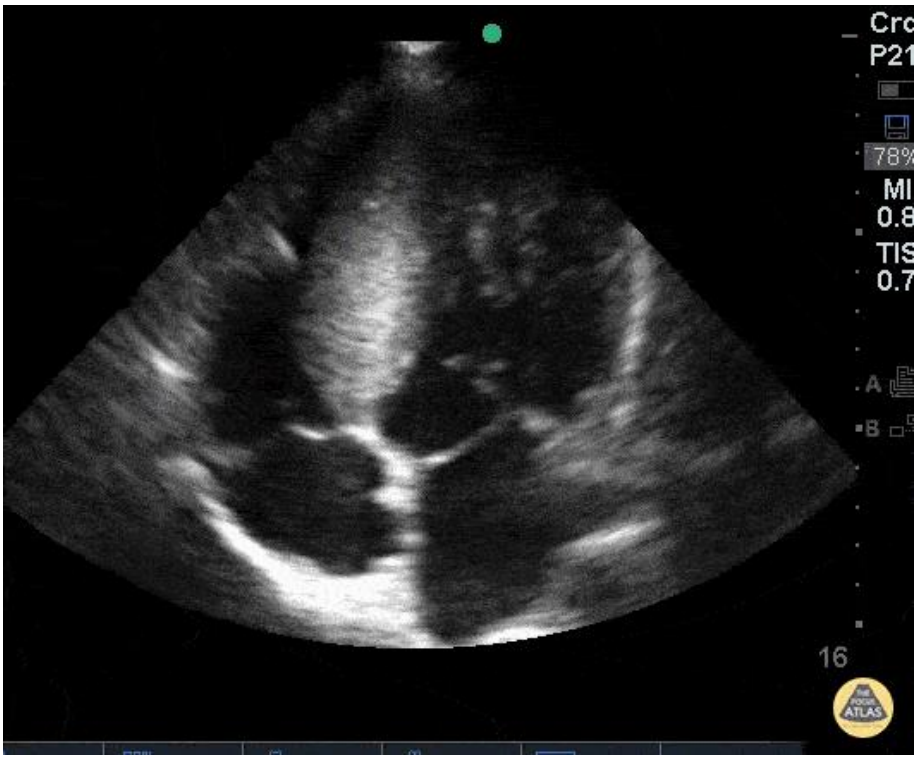
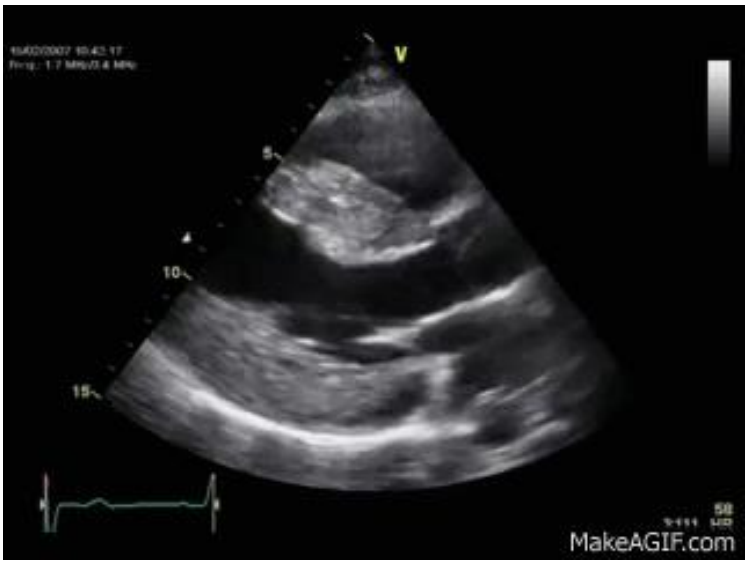
PATIENT STATUS	LEARNER ACTIONS, MODIFIERS & TRIGGERS TO MOVE TO THE NEXT STATE	
1. **Baseline State** Rhythm: ST HR: 140 BP: 80/56 RR: 28 O_2SAT: 92% T: 37.1^oC	Learner Actions ● Place patient on monitor ● Obtain IV access ● Assess ABC's ● Begin isotonic fluid resuscitation ● Full H&P	Modifiers *Changes to patient condition based on learner action* ● No fluids given/delay for workup - **Status 2** ● One bolus of fluids given - temporary response - **Status 3** ● SQ epi/chronotrope/diuretic given - **Status 5** Triggers *For progression to next state* ● IV/O2/Monitor ● Completion of H&P
2. **Delay/No fluids** Rhythm: ST HR: 145 BP: 78/52 RR: 30 O_2SAT: 90% T: 37.1^oC	Learner Actions ● Obtain CXR ● POCUS (Cardiac, RUSH) ● Obtain EKG ● Begin fluid resuscitation with LR/NS ● Administer O2	Modifiers ● If one fluid bolus given - **status 3** ● If 2+ fluid boluses given - **status 4** ● Epi/chronotrope/diuretic given OR if fluids still not given - **Status 5** Triggers ● Order POCUS ● Order CXR ● Administer O2 ○ CT unavailable
3. **One bolus of fluid** Rhythm: ST HR: 132 BP: 88/62 RR: 24 O_2SAT: 94% T: 37.1^oC	Learner Actions ● Obtain CXR ● POCUS (Cardiac, RUSH) ● Obtain EKG ● Additional fluid resuscitation	Modifiers ● If 2+ fluid boluses given - **status 4** ● Epi/chronotrope/diuretic given - **Status 5** Triggers ● Give additional fluids ● Order POCUS ● Order CXR ● Recognition of HCM and hypovolemia ○ CT/admitting service unavailable ○ bloodwork pending

4. **2+ fluid boluses** Rhythm: ST HR: 110 BP: 94/66 RR: 20 O_2SAT: 98% T: 37.1^oC	Learner Actions ● POCUS ● Cardiology/Medicine consultation ● Additional fluids ● Phenylephrine/B blockers with recognition of LVOT obstruction	Modifiers ● Appropriate fluid resuscitation/Cardiology or medicine consulted - **end case** ● Delay for more workukp/chronotrope or diuretic given - **Status 5** Triggers ● As above
5. **AMS/Shock** Rhythm: ST HR: 150 BP: 70/40 RR: 36 O_2SAT: 83% T: 37.1^oC	Learner Actions ● Intubation with appropriate preparation/meds ● Bedside POCUS/CXR	Modifiers ● No intubation - **Status 6** ● Intubation - **Status 4** Triggers ● As above
6. **Deteriorating AMS/Shock** Rhythm: ST HR: 160 BP: 64/46 RR: 36 O_2SAT: 80% T: 37.8^oC	Learner Actions ● Intubation with appropriate preparation/meds	Modifiers ● No intubation - **end case** ● Intubation - **Status 4** Triggers ● As above

SUPPORTING DOCUMENTS, LAB RESULTS AND MULTIMEDIA	
Lab Results	CBC WBC: 6.5 RBC: 5.0 Hb: 13.2 Hct: 40.1 MCV: 90 MCH: 30.1 MCHC: 34 Platelets: 320 BMP Na: 140 K: 4.5 BUN: 30 Cr: 1.4

	Glu: 98 Ca: 9.0 Cl: 97 CO2: 21 <u>Lactate</u> 2.4 <u>Troponin</u> Undetectable
EKG	

CXR imaging	Initial CXR  Repeat CXR if patient decompensates 

Ultrasound Video Files	 https://images.app.goo.gl/qR81Dn5x5R8k4GDd7  https://images.app.goo.gl/7iNNoxBXpYUzUQeN7

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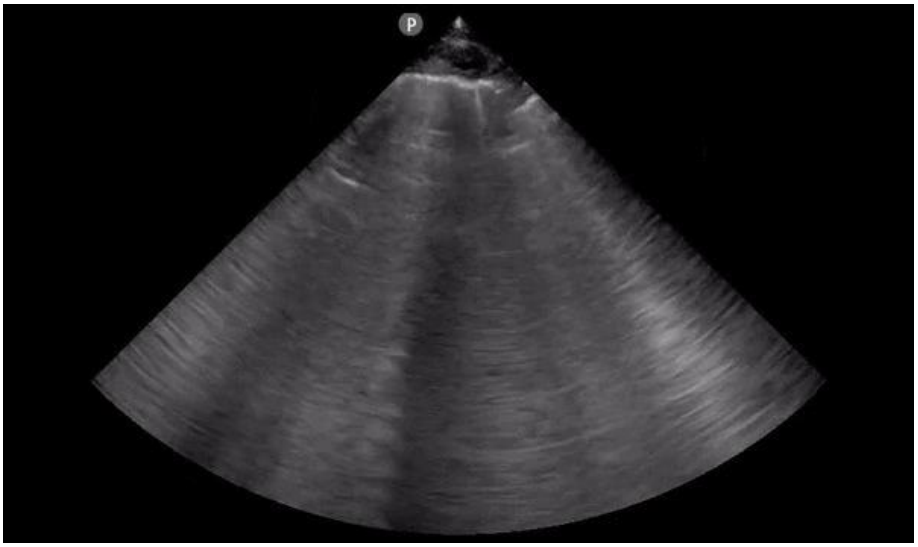

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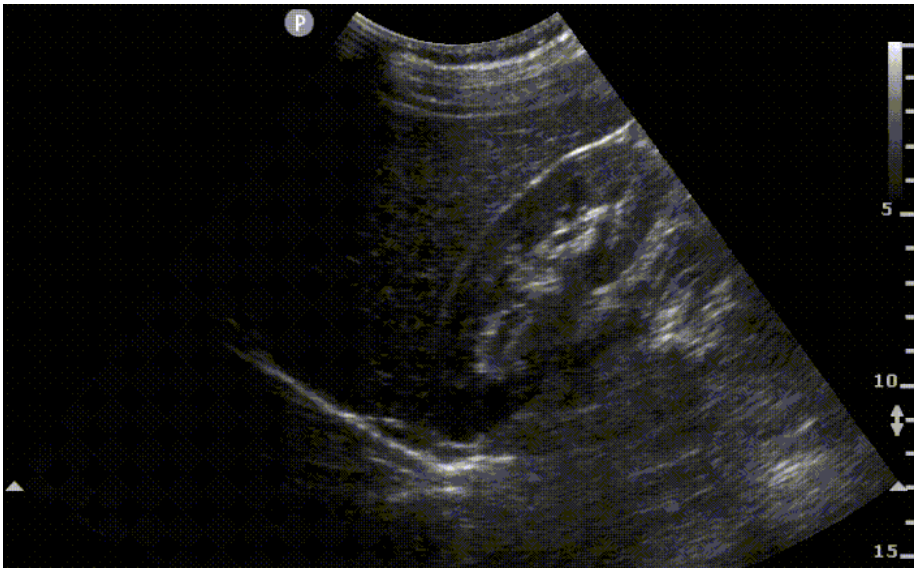

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SAMPLE QUESTIONS FOR DEBRIEFING
1. What are your thoughts on your team's communication? **2. Are there any other questions on history or maneuvers on physical exam that you would have wanted to elicit?** **3. What was on your differential?** **4. What testing did you perform and why?** **5. How is severe LVOT obstruction treated in the ER?** **6. What is the definitive treatment for Hypertrophic Cardiomyopathy?** **7. What common medications are dangerous in the setting of LVOT obstruction**

Ideal Scenario Flow

The learners enter the room and see a 17 year old male in acute distress that appears moderately toxic. They obtain vitals and perform ABCs, then quickly place large bore IVs and put the patient on a cardiac monitor with supplemental oxygen. They promptly recognize the shock state and begin resuscitation with isotonic fluids. EKG and POC glucose should be ordered with workup, which reveal sinus tachycardia and normal blood sugar. Patient hemodynamics will improve slightly with initial fluid bolus, but learners recognize the need for additional volume. CXR and POCUS will be ordered which reveal mild pulmonary edema and evidence of septal hypertrophy with systolic anterior motion. Learners will recognize the underlying etiology of HCM, causing LVOT obstruction in the setting of the patient's severe dehydration. Learners will then give additional fluids and consider adjunctive medications such as phenylephrine or beta blockers to improve obstruction; they also avoid dangerous medications such as diuretics, inotropes and nitroglycerin. Learners should recognize that lab results are consistent with mild AKI secondary to dehydration as well as mildly elevated lactate from hypoperfusion, but largely non-contributory to the patient case and management. Learners will then consult cardiology and admit to a monitored medical floor at an appropriate pediatric facility.

Anticipated Management Mistakes

1. Failure to elicit a thorough history: Learners may fail to ask about family history, which would reveal crucial information about the early sudden death of a paternal uncle, aiding diagnosis of HCM
2. Failure to provide early and appropriate fluid resuscitation: Some learners may delay to obtain more workup results, which is overall fair given complex presentation
3. Failure to expeditiously obtain and interpret Cardiac POCUS: Learners may fail to recognize septal hypertrophy and SAM on ultrasound imaging
4. Failure to recognize obstructive shock state: Learners may interpret clinical findings as cardiogenic shock requiring diuresis, which would worsen patient's clinical status
5. *Failure to avoid giving nitrates which can decrease preload, and significantly worsen the clinical picture by worsening the LVOT obstruction*
6. *Failure to realize this is not a decreased LV systolic function, and doing inotropes which can worsen LVOT obstruction*
7. *Failure to recognize that afterload reduction can be harmful and administering agents such as nitroprusside, amlodipine, and nitrates*