Ultrasound in Shock States

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Baystate Medical Center

Case

- 70 year old male BIB ambulance
- confused, hypotensive, chest pain
- BP 70/30, P 120

Undifferentiated Hypotension

Types of Shock

<table>
<thead>
<tr>
<th>Hypovolemic</th>
<th>Cardiogenic</th>
<th>Distributive</th>
<th>Obstructive</th>
<th>Neurogenic</th>
</tr>
</thead>
<tbody>
<tr>
<td>dehydration</td>
<td>MI</td>
<td>sepsis, myocarditis</td>
<td>PE, pneumonia</td>
<td>spinal cord injury</td>
</tr>
<tr>
<td>GI bleed</td>
<td>valve insufficiency</td>
<td>anaphylaxis, toxins</td>
<td>PE, pneumothorax</td>
<td>brain injury</td>
</tr>
<tr>
<td>trauma</td>
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<tr>
<td>sepsis</td>
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<tr>
<td>tamponade</td>
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<td>pulmonary embolus</td>
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Physical Exam

- Heart
- Lungs
- Volume status

- Skin color
- Skin temperature
- Lung sounds
- Heart sounds
- JVD
- Mucus membranes
- Vital signs
Ultrasound provides direct, objective, and visual evidence of a patient’s circulatory status.

4 Problems can drop pressure

1. Congestive Heart Failure
2. Valve Disease
3. Myocardial Infarction
4. Ruptured AAA
5. Ectopic Pregnancy
Undifferentiated Hypotension

Clinical Algorithm

1. 184 patients in shock (SBP < 100 or shock index > 1), assigned to ultrasound vs no ultrasound.
2. Ultrasound group: smaller number viable diagnosis at 15 min (4 vs 2).
3. Initial diagnosis included final correct diagnosis in 80% (ultrasound) vs 50% (no ultrasound).

Jones et al. Randomized controlled trial of immediate versus delayed goal-directed ultrasound to identify the cause of non traumatic hypotension in emergency department patients. Crit Care Med 2004.

Undifferentiated Hypotension

Clinical Algorithm

- 220 patients in shock randomly assigned to standard care vs. ultrasound to guide management. Followed for 28 days.
- Significant less fluids and more dobutamine used in ultrasound group (49 vs 66ml/kg).
- Improved 28 day survival in US group (66% vs 55%), better urine output, less AKI, more days free of renal support.

Clinical Algorithm

IVC

IVC Estimates of Right Atrial Pressure

<table>
<thead>
<tr>
<th>IVC Size (cm)</th>
<th>Respiratory Changes</th>
<th>RA Pressure (cm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;1.5</td>
<td>Total collapse</td>
<td>0-5</td>
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<tr>
<td>1.5-2.5</td>
<td>&gt;50% collapse</td>
<td>5-10</td>
</tr>
<tr>
<td>1.5-2.5</td>
<td>&lt;50% collapse</td>
<td>11-15</td>
</tr>
<tr>
<td>&gt;2.5</td>
<td>&lt;50% collapse</td>
<td>16-20</td>
</tr>
<tr>
<td>&gt;2.5</td>
<td>No change</td>
<td>&gt;20</td>
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Echocardiography

LV function

- hyperdynamic
- hypovolemic
- obstructive
- distributive
- cardiogenic
**Thoracic Scan**

<table>
<thead>
<tr>
<th>B-lines</th>
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**Clinical Algorithm**

```
    IVC
   echo
  thoracic scan
  abdominal scan
```

**Thoracic Scan**

- dilated
- collapsed
- normal

**FAST**

**Aorta**

**Ultrasound Algorithm**

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**Cases**
Case #1

Chest Pain

- 58 y/o male colleague c/o chest pain during a shift
- Diaphoretic, pale
- BP 75/40, P 130
- EKG nondiagnostic
- Abdomen significantly tender
**Case #1**

**Chest Pain**

- Fluid/blood resuscitated
- CT showed splenic laceration
- IR for embolization
- History of trauma 3 days ago, forgotten

**Abdominal Pain**

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**AMS, Hypothermia**

- 45 y/o female found down in her home
- Confused, lethargic
- T91, BP 70/30, P140, O2 100%, RR 35

**Case #2**

**AMS, Hypothermia**

- IV access established, fluids bolused
- EKG
- Blood drawn
- Warming started

**Case #2**

AMS, Hypothermia
- FSBS critical high
- Lab glucose 1200, CO2 6
- Fluids, insulin gtt, antibiotics, admitted MICU
Case #3

**Weakness, Hypoxia**

- 22 y/o male, no PMHx, c/o severe weakness, DOE.
- Has been huffing “Dust-Off” for the last 3 months, 6 cans daily

**Vitals:** pulse 90, BP 90/70, O2 85% RA, afebrile
- Lungs: occasional crackles, appears mildly dyspneic
- CV: RRR

**Weakness, Hypoxia**

**Weakness, Hypoxia**

**Weakness, Hypoxia**

**Weakness, Hypoxia**
Case #3

**Weakness, Hypoxia**

- Toxic myocarditis—hydrocarbons
- EF 6%
- Eventually improved over months

### Case #3

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Case #4

**Weak**

74 y/o male, recent hip fracture, weakness and hypotension

62/34, P 86, 99% 4LNC, RR20

Patient arrested shortly after arrival to the emergency department
Empiric thrombolytics initiated IV fluids, norepinephrine, BP, pulse stabilized. Admitted to intensive care unit

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43 y/o female with metastatic breast CA (lungs, ribs), DVT on enoxaparin
3 days of worsening lethargy, vomiting, dehydration
T 97.9, P 139, BP 96/68, O2 95%
Presumed pneumonia

Pt received 2LNS, P 140, BP 95/70
Case #6

Chest Pain, Hypotension

- 72 y/o male sent from NH for CP, hypotension.
- Previous MI with stenting

- BP: 70/30, P 105, RR 24, O2 89%, T 95
- Awake but confused, tachycardic, decreased breath sounds, skin warm & dry
- EKG nondiagnostic

Moderate-large pericardial effusion

P150, BP 70/30

700cc bloody fluid aspirated
Vitals normalized post procedure
Chest Pain, Hypotension

- Fluids bolused, central access, broad antibiotics
- Troponin negative, WBC 24
- admitted to MICU
Case #7

CP, hypotension

- 72 y/o male with hypotension, acute chest discomfort
- P 160, BP 80/40, O2 95% RA
### Case #7

**Dyspnea, Hypotension, CP**

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### Case #8

**Hypotension**

- 72 y/o male with hypotension, sent from NH
- P 160, BP 80/40, O2 95% RA

![Hypotension ECG](image)

![Hypotension Thoracic](image)
**Hypotension**

- Fluids started, BP improved, converted spontaneously
- WBC 30, UA with copious bacteria

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**Cough, Fever, Hypoxia**

- 89 y/o female, h/o CHF, presented with 1 week subjective fevers, worsening SOB, productive cough.
- No CP, chronic baseline leg swelling

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**Vitals:**
- P92, BP 130/58, O2 81%, T98.2.
- Appears dyspneic, speaking in short phrases, lungs with wheezes, crackles. RRR. Trace symmetric pedal edema.
- Initial presumption pneumonia
• Started on antibiotics, admission arranged.
• Sign out: pt becoming hypotensive, bp 80/50. Unsure if fluids/no fluids.
• Pneumonia vs pulmonary edema

• Placed on bipap, inotropes
• Pressure improved, bed changed to CCU service.
### Cough, Fever, Hypoxia

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### Case #9

**Cough, Fever, Hypoxia**

- 83 y/o female, increasing weakness, dizziness x1 week
- PMHx: multiple previous MI's
- Vitals: P 90, BP 75/30, RR 25, T 98, O2 92%RA

### Case #10

**Weakness, Hypotension**

- 83 y/o female, increasing weakness, dizziness x1 week
- PMHx: multiple previous MI's
- Vitals: P 90, BP 75/30, RR 25, T 98, O2 92%RA
Dyspnea on Exertion, Hypoxia

- More NH information: large amount of diarrhea
- Guaiac positive
- Hypovolemic with pre-existing LV systolic dysfunction

Near Syncope

- 67 yo male with dizziness, near syncope, acute L testicular pain 1 hour PTA while playing cards
- BP 80/30  P115  O2 95%  T98
- Abd soft, L scrotum purple and tender
Near Syncope

- Vascular surgery paged, pt to OR
- Large ruptured retroperitoneal aneurysm
- Arrested in surgery

Case #11

82 y/o male with known CAD, with 3 hours severe CP and SOB
P130, R 35, BP 90/40, O2 78%
Dyspneic, bilateral crackles, tachy/regular

Labs: Hgb 4.9, Hct 15.9
Guaiac +
High-output failure
Eventually needed 6U PRBCs, cauterized bleeding gastric ulcer

Case #12

Summary

- Organized approach to critical patients
- Evolving field for ultrasound
- Requires a new way of thinking