

Project: Ghana Emergency Medicine Collaborative

Document Title: Abdominal Compartment Syndrome

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OBJECTIVES

- Discuss two critical care cases
- Challenges in management and diagnosis
- Review emergent management of a common ED presentation
- Focused exploration of a less common disease process
- Discussion of how the health care system can contribute to individual patient morbidity and mortality

CRITICAL PATIENT IN RESUS BRAVO

- Obese elderly Asian female
- Pale, breathing heavily
- Accompanied by son

ABCs

- A
 - Speaking single words
- B
 - RR 30
 - SpO2 unable to obtain
- C
 - HR 50
 - BP unable to obtain



PULSES AND BPs

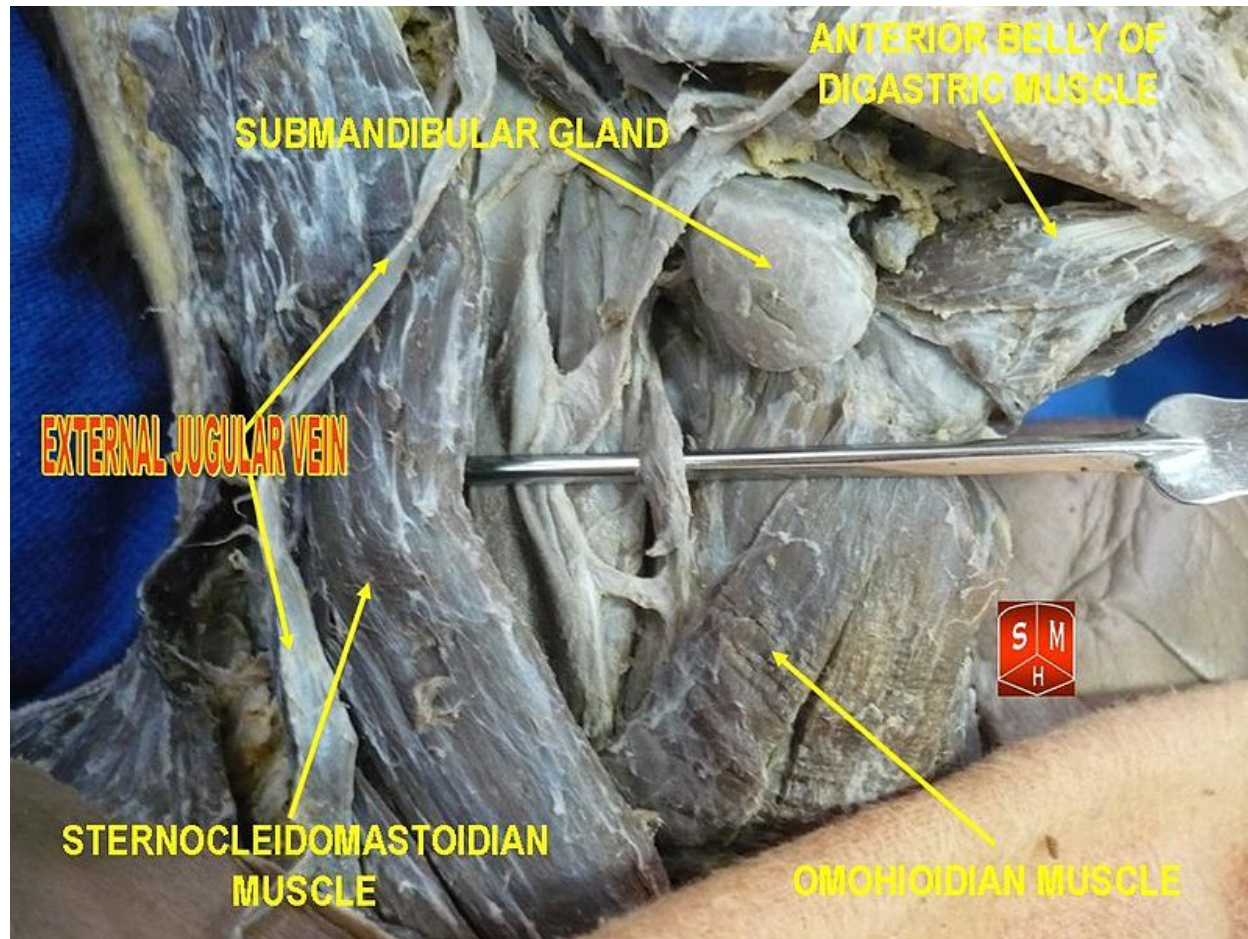
- Old ATLS teaching
 - SBP > 80 mmHg if palpable radial
 - SBP > 70 mmHg if palpable femoral
 - SBP > 60 mmHg if palpable carotid
- Not scientifically validated
- Did confirm that loss of pulses occurs in order...
 - radial
 - femoral
 - carotid

Deakin CD and Low JL. Accuracy of the advanced trauma life support guidelines for predicting systolic blood pressure using carotid, femoral, and radial pulses: observational study. BMJ 2000; 321 : 67.

NEXT STEPS

- IV
 - Multiple techs attempting
- O2
 - Supplemental O2 via NRB
- Monitor
 - Slow HR
 - No BP

NEXT STEPS



NEXT STEPS

- IV
 - 16 gauge in R EJ
- O2
 - Supplemental O2 via NRB
- Monitor
 - Slow HR (ranging 40s-50s)
 - No BP (estimate 60-70 SBP)

WHAT NOW?

Brief History

Brief Exam

Further Interventions

More Clinical Data

BRIEF HISTORY

- POD #10 from lap-to-open cholecystectomy
- Prolonged post-operative hospitalization due to “heart problems”
- Discharged home three days ago
- Increasingly weak today
- C/O severe fatigue, “chills”
- Denies measured temps, denies pain
- Taking all medications including Coumadin and blood pressure pills



BRIEF EXAM

- Pale, increased WOB
- PERRL, dry MM
- Shallow clear breath sounds
- Slow irregular heartbeat
- Obese/distended and firm abdomen
 - No focal tenderness
- Cool extremities
 - No palpable radial pulse
 - Thready femoral pulse



FURTHER INTERVENTION

- IVF bolus
 - 1L wide open
 - Attempting to obtain additional access
- Pacer pads



WHAT CLINICAL DATA?

- Labs?
- XR?
- CT Scan?
- US?
- Phone-a-friend?

RESUS SHORTCUTS

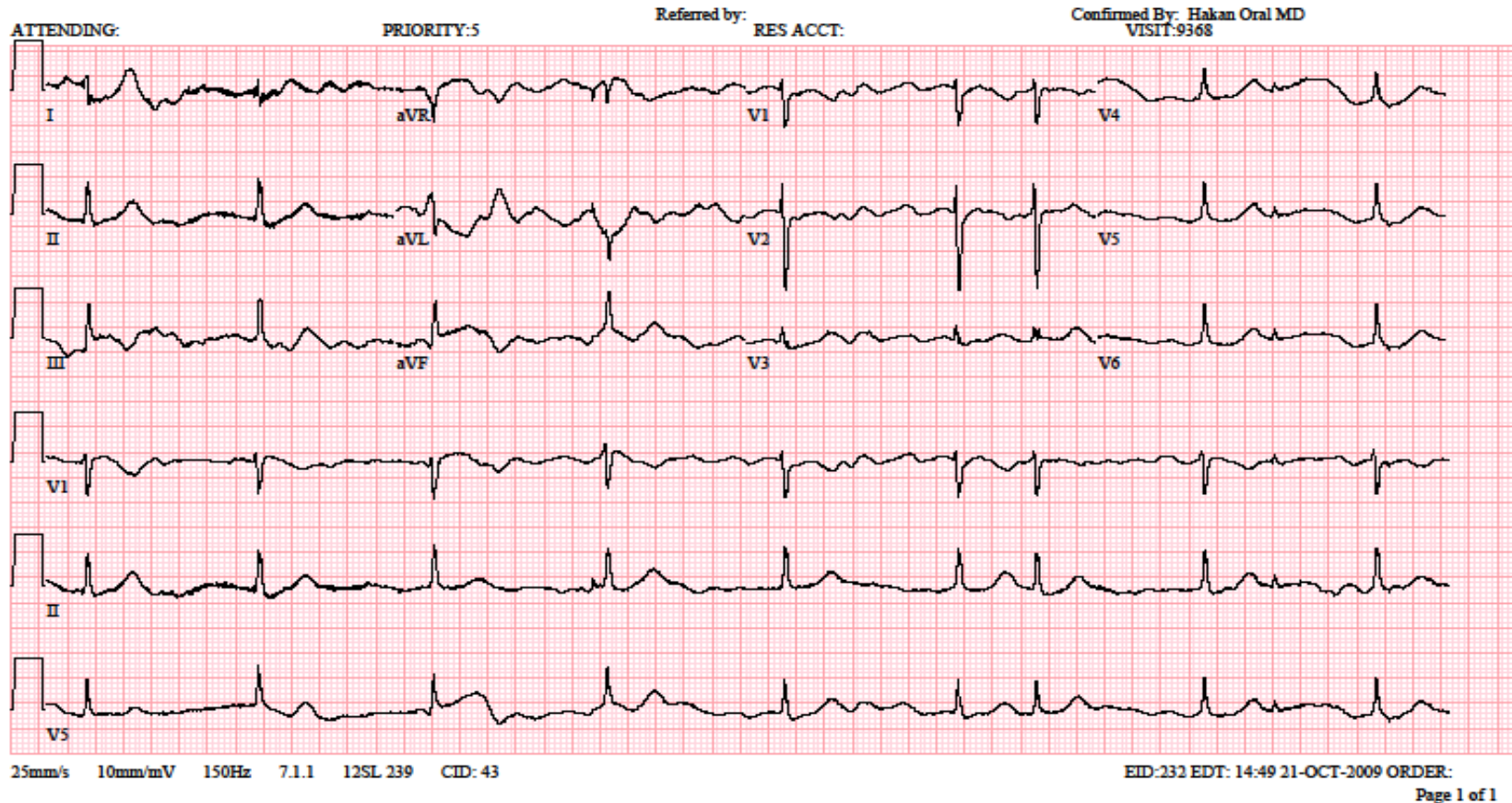
VBG

EKG

CXR

EKG

Test ind: WEAKNESS



VBG

7.23/44/164

Na 137

Glu 147

K 4.9

Lac 8.2

Ca 1.04

Hct 28

CXR

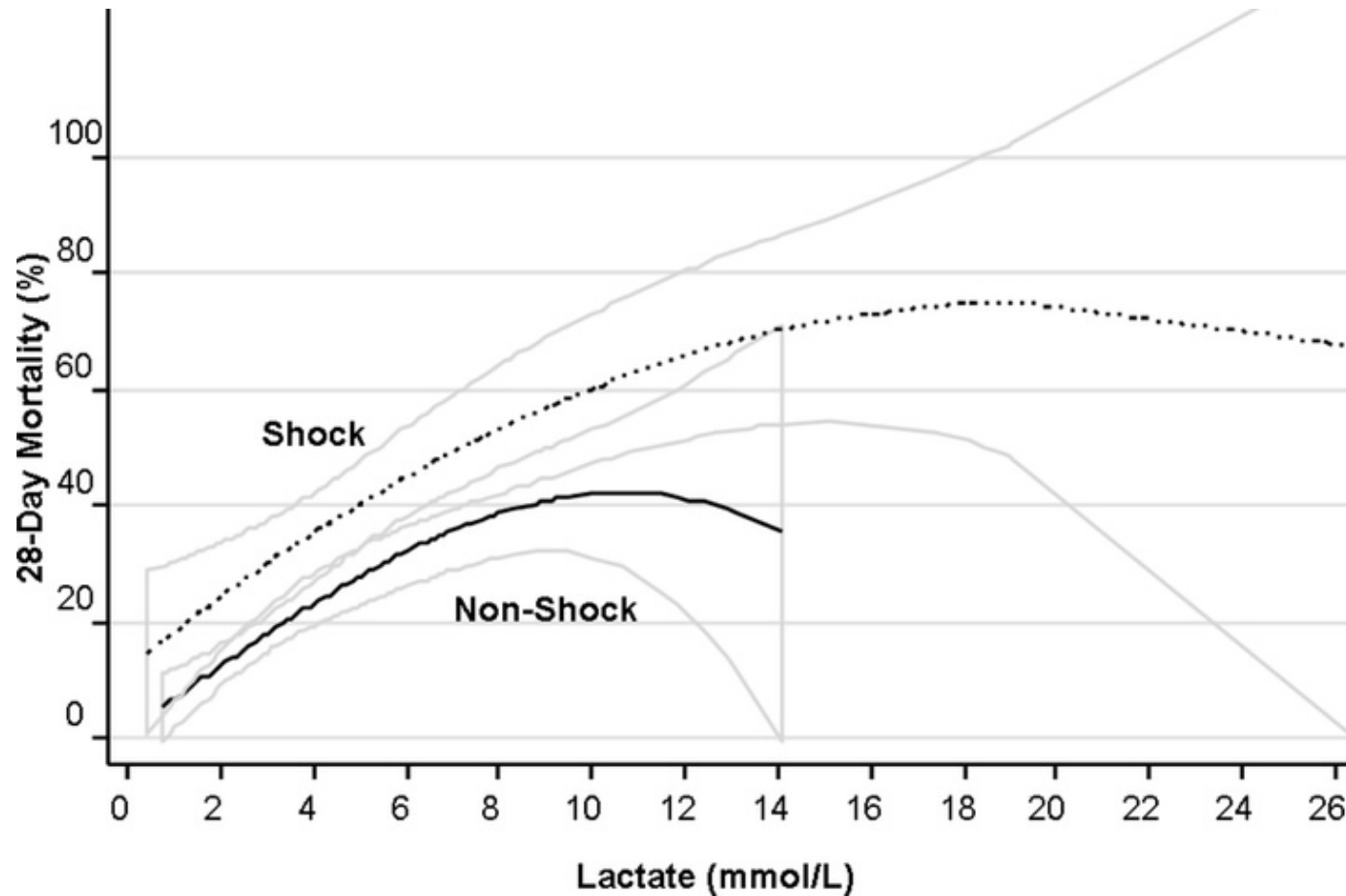


Source unknown

DIAGNOSIS?

Shock.

LACTATE & MORTALITY



Mikkelsen, M et al. Serum lactate is associated with mortality in severe sepsis independent of organ failure and shock. *Critical Care Medicine*. 2009; 37(5): 1670-1677.

TYPES OF SHOCK

- Hypovolemic
- Obstructive
- Distributive
- Cardiogenic

DIFFERENTIAL DIAGNOSIS

- Hypovolemic
 - Hemorrhagic
- Obstructive
 - No apparent evidence of PE, PTX or tamponade...
- Distributive
 - Sepsis from recent hospitalization/surgery
- Cardiogenic
 - Hx of recent cardiac problems
 - Medication toxicity?

REASSESSMENT

- Ongoing bradycardia 40s-50s
- Treatment?
 - For HR <50bpm with evidence of hypoperfusion
 - Or if high risk of progression to complete block
 - Options: atropine vs. pacing
- Atropine
 - 0.5 – 1mg IVP adult dose
 - Anticholinergic positive chronotropic effect
 - Pt has increased HR to 50s-60s without BP improvement

REASSESSMENT





- Respirations increasingly labored
- Abdomen still distended
- Now poorly responsive to son's questioning
- Back to the ABCs!



REASSESSMENT

- Airway now secure
- Still unable to obtain BP
- Access: single EJ
- Additional 14g placed by EDT in R AC
- Second L warmed NS started
- Pt started on pressors

PRESSORS (OVER)SIMPLIFIED

α	$\alpha = \beta$	β
norepinephrine 	epinephrine 	dobutamine 
	dopamine Lower dose = more β Higher dose = more α 	

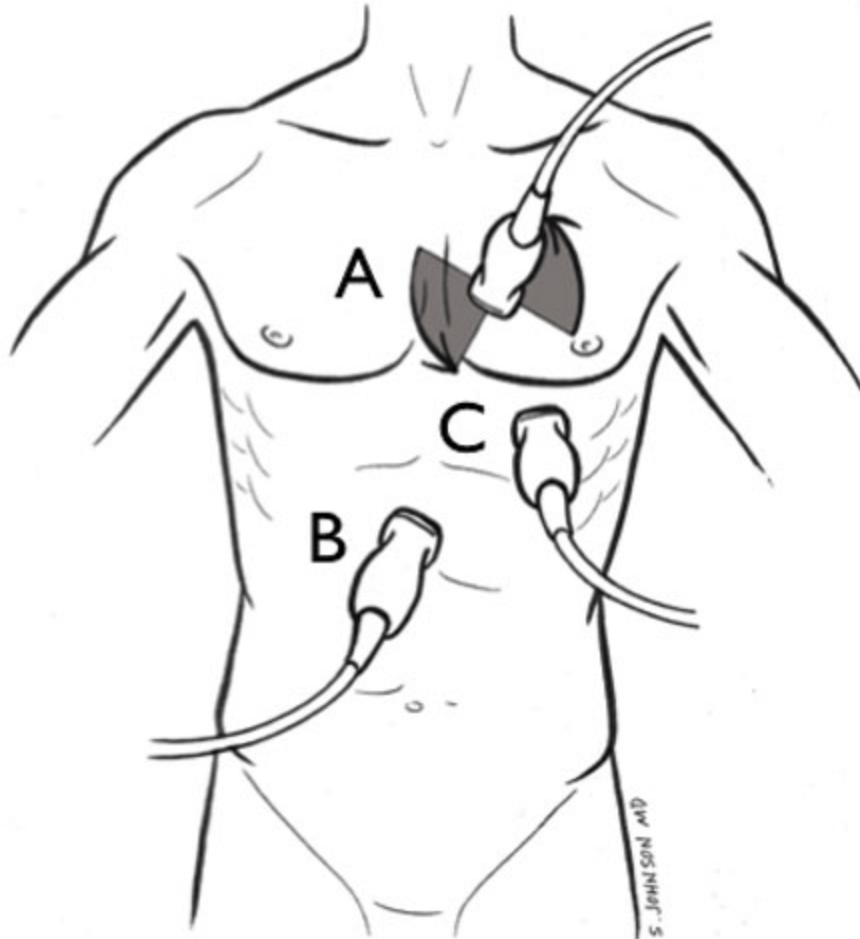
REASSESSMENT

- How can we distinguish between types of shock?

RAPID ULTRASOUND IN SHOCK (RUSH)

PUMP

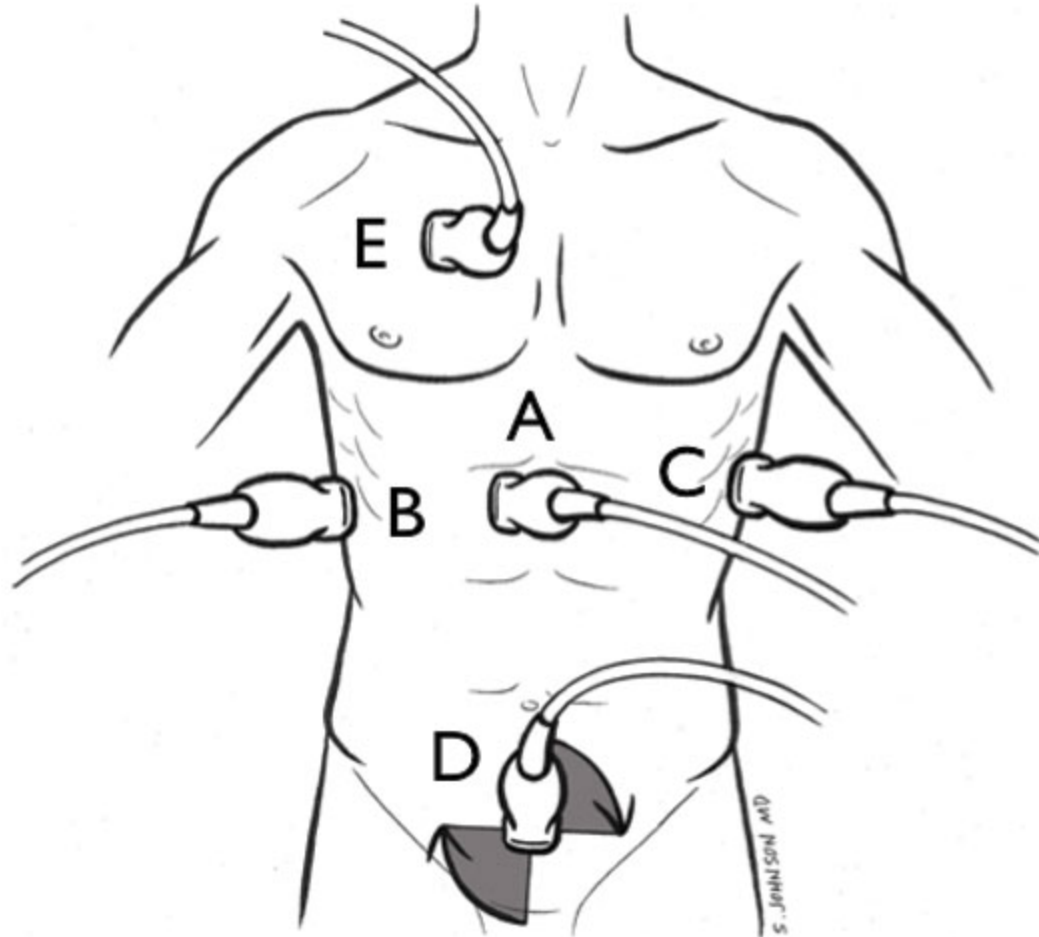
- cardiac contractility
- tamponade
- PTX
- RV strain



RAPID ULTRASOUND IN SHOCK (RUSH)

TANK

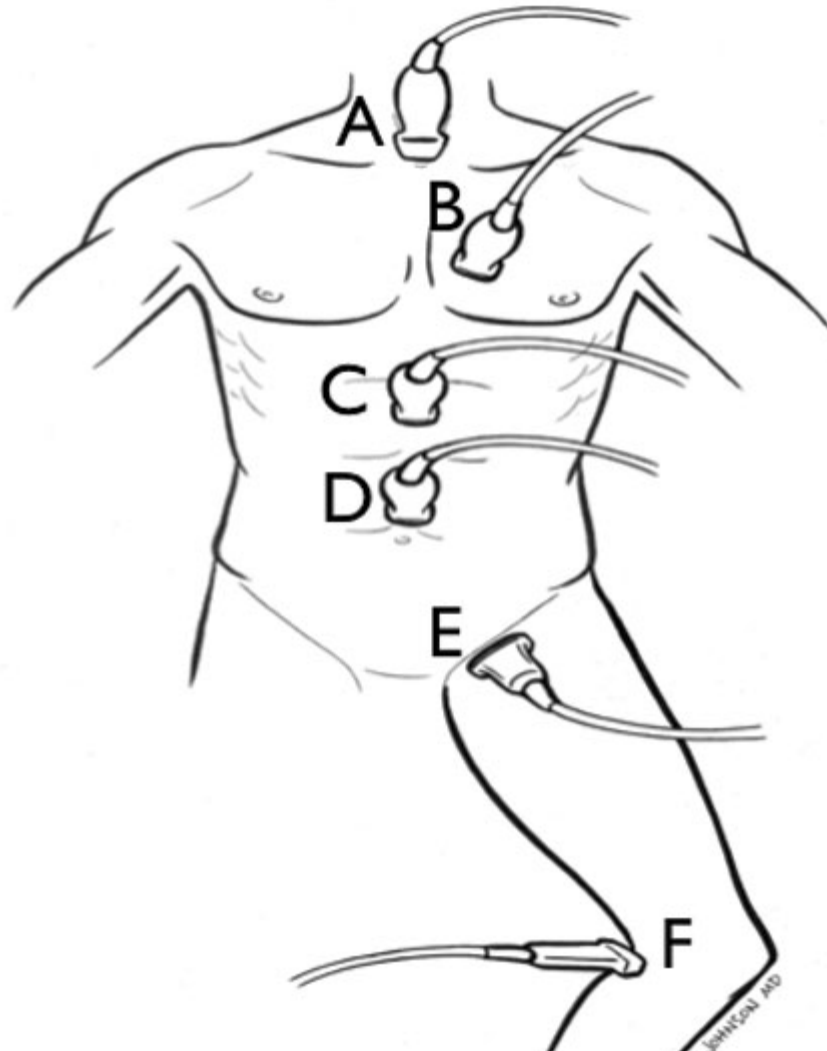
- IVC – size & resp change
- FAST



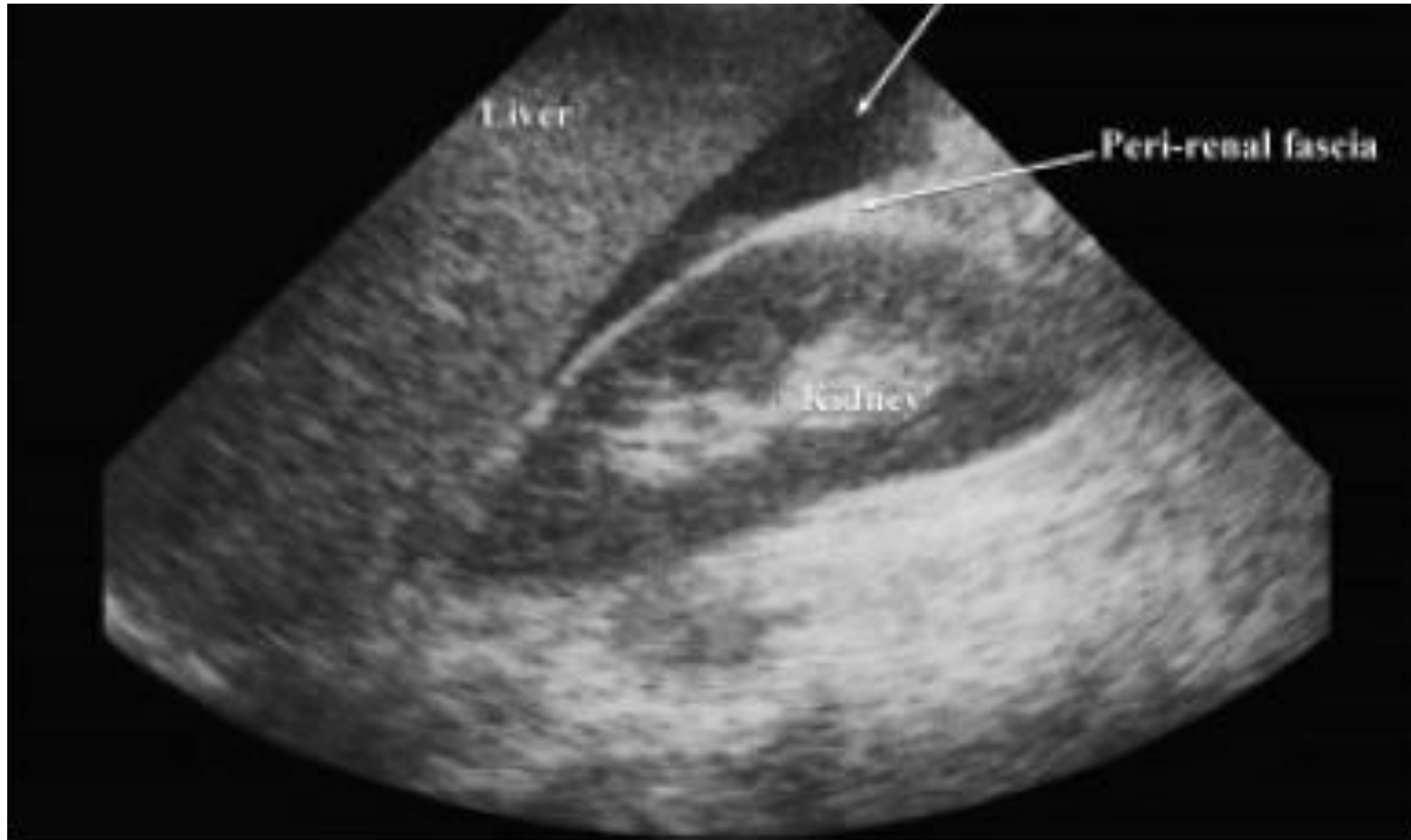
RAPID ULTRASOUND IN SHOCK (RUSH)

PIPES

- Aorta
- DVT



ULTRASOUND



REASSESSMENT

- Abdomen increasingly distended and firm
- Surgery contacted
- Treatment initiated for hemorrhagic shock
- O+ pRBCs placed on rapid transfuser
 - Massive transfusion anticipated
 - Given calcium chloride

REVERSAL OF ANTICOAGULATION: FIRST STEPS

○ FFP

- Typical adult pt requires 3-4 unites to reverse
- Contains all vitamin K dependent factors
- Does not fully reverse
 - Ex: factor IX does not rise >20% of normal post FFP (not reflected in INR)
- Requires thawing
- Risks volume overload

○ Vitamin K

- 10mg slow IV
- Starts to work in 4hrs

REVERSAL OF ANTICOAGULATION: NEXT STEPS

- Recombinant Activated Factor VII
 - Expensive, limited literature
 - UofM: “serious bleed associated with prolonged INR after significant clotting factor replacement”
 - 1200mcg x one dose
- Prothrombin Complex Concentrate
 - Plasma-derived product, no matching required
 - Virally inactivated and 20x less volume than FFP
 - Contains II, IX, and X (+ VII in UK)
 - Currently infrequently used in US
 - Expensive
 - Potentially thrombogenic

REASSESSMENT

- Rapid transfusion of 3U FFP, 4U pRBCs
- Surgery at bedside
- Still no BP on max dose dopamine (20mcg/kg/min)
- Pulse check = no carotid or femoral
- PEA
 - Compressions initiated
 - Single dose of 1mg epinephrine
 - Return of strong pulse

REASSESSMENT

- ABCs
 - Airway secured with ETT
 - Ongoing hypotension despite pressors
- Volume
 - Cordis inserted into R groin + 14G PIV + 16G PIV
 - Femoral arterial line
 - Rapid infuser for pRBCs, FFP
- Pressors
 - Max dose dopamine
 - Epinephrine and norepinephrine initiated post-arrest

LABS

Hematology:

CBCP:

10.1

26.2 >-----< 375

31.3

Diff (Automatic):

NEUT	LYMPH	MONO	EOS	BASO
------	-------	------	-----	------

%: 83.7	8.3	8.0	.0	.0
---------	-----	-----	----	----

#: 21.9	2.2	2.1	0.0	0.0
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Cardiac Enzymes (18:00):

Troponin: 0.11; CPK: 102; CKMB: 2.3;

Liver Panel:

Prot: 5.7; Alb: 3.1;

AST: 54; ALT: 23;

TBILI: 1.7;

ALK: 156;

Chemistry:

142c | 102 | 24

-----< 190

4.6 | 22 | 1.5

Cal: 9.32c AnGap: 17

BUN/Cr: 16

CalcOsm: 301

Coags:

INR: 1.8 (PT: 18.1); PTT: 24.8;

REASSESSMENT

- Mismatch between BPs
 - Femoral arterial line = SBPs in 60s
 - Cuff pressure = SBPs in 100s
- Overall poor responsiveness to pressors and fluids
- Additional diagnosis made:

ABDOMINAL COMPARTMENT SYNDROME



ABDOMINAL COMPARTMENT SYNDROME

○ Definition

- Sustained intra-abdominal pressure of >20 mmHg associated with new organ dysfunction or failure

○ Measurement of IAP

- Challenging clinical diagnosis
- Direct peritoneal cannulation, rectal, gastric, IVC
- Most popular = bladder
- Routinely tracked in MICU/SICU/TBICU settings

○ Relatively high incidence

- One study found ACS in 14% of high-risk trauma pts
- Another found 50% of ICU pts had IAH (>12 mmHg)

ABDOMINAL COMPARTMENT SYNDROME

- Primary ACS: injury/disease in abdomen
 - Abdominal trauma
 - Abdominal hemorrhage
 - Bowel obstruction
 - Intra-peritoneal sepsis
 - Ruptured AAA
 - Acute pancreatitis
 - Less acute: morbid obesity, pregnancy, massive ascites
- Secondary ACS: third-spacing in abdomen
 - Severe sepsis, burns
 - Any shock requiring massive fluid resuscitation

Box 1: Emergency department patients at risk of developing intra-abdominal hypertension (IAH) and abdominal compartment syndrome (ACS)

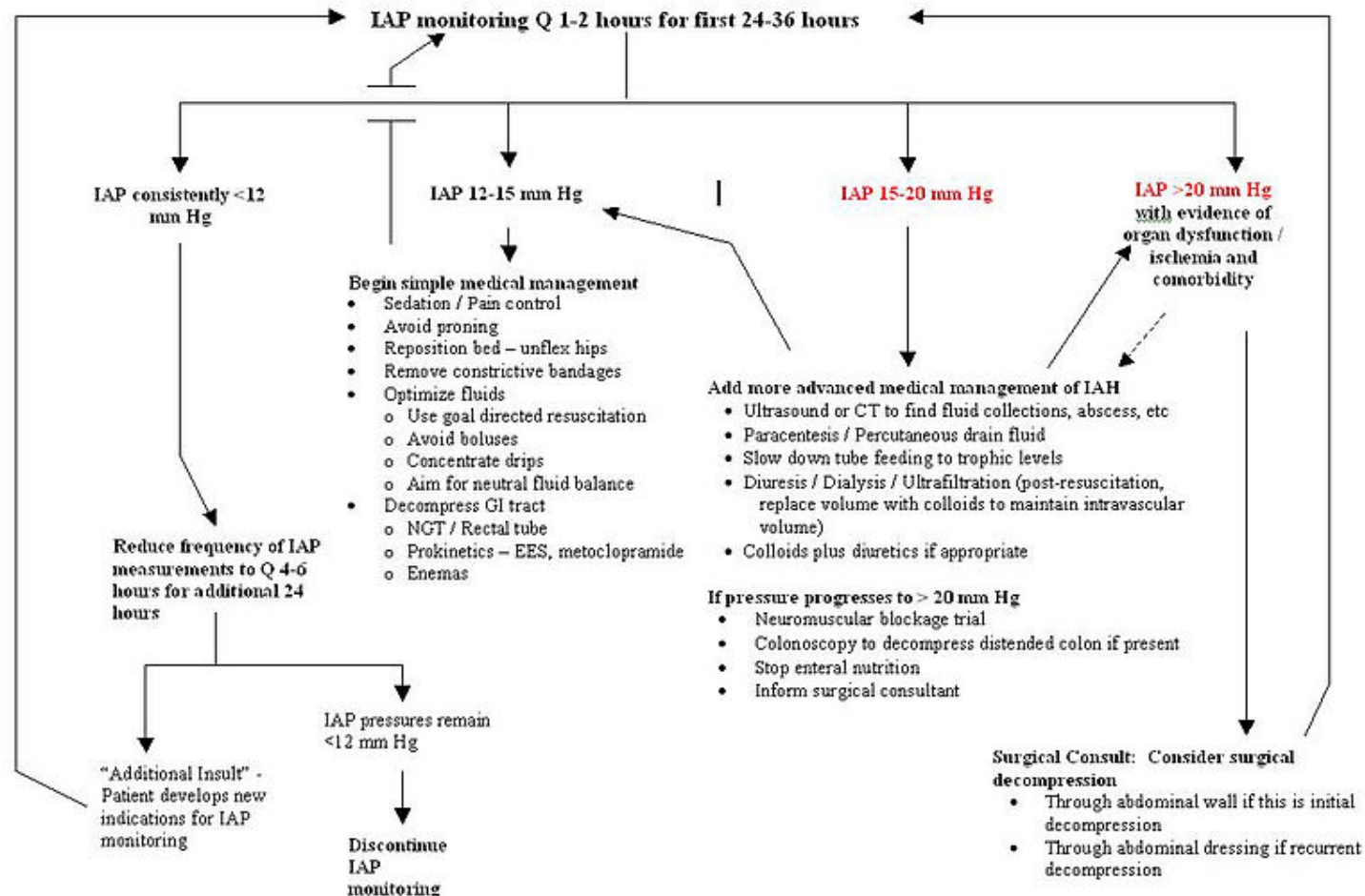
Patients who should be considered at higher risk of developing IAH and ACS:^{35 36}

- ▶ Patients with open or blunt abdominal trauma
- ▶ Patients requiring large volume fluid resuscitation (especially in the context of an underlying capillary leak problem)—for example:
 - pancreatitis
 - septic shock
 - trauma
 - severe burns
- ▶ Patients with increased intra-luminal contents
 - gastroparesis
 - ileus
- ▶ Patients with increased abdominal contents
 - haemoperitoneum or pneumoperitoneum
 - ascites or liver dysfunction

Table 40.1. Physiological consequences of intra-abdominal hypertension

	Increased	Decreased	No change
Mean blood pressure	–	–	×
Heart rate	×	–	–
Peak airway pressure	×	–	–
Thoracic/pleural pressure	×	–	–
Central venous pressure	×	–	–
Pulmonary capillary wedge pressure	×	–	–
Inferior vena cava pressure	×	–	–
Renal vein pressure	×	–	–
Systemic vascular resistance	×	–	–
Cardiac output	–	×	–
Venous return	–	×	–
Visceral blood flow	–	×	–
Gastric mucosal pH		×	
Renal blood flow	–	×	–
Glomerular filtration rate	–	×	–
Cerebrospinal fluid pressure	×		
Abdominal wall compliance	–	×	–

Intra-Abdominal Pressure Monitoring Algorithm



ABDOMINAL COMPARTMENT SYNDROME

- Definitive management: surgical decompression

Box 2: Conservative measures for treatment of abdominal compartment syndrome

- ▶ Paracentesis⁵⁹
- ▶ Gastric and rectal suctioning
- ▶ Prokinetic agents (metoclopramide, domperidone, erythromycin, prostygmine)
- ▶ Diuretic therapy
- ▶ Continuous veno-venous haemofiltration with aggressive ultrafiltration
- ▶ Sedation and paralysis⁶⁰
- ▶ Body positioning

ABDOMINAL COMPARTMENT SYNDROME

- Definitive management: surgical decompression
- In ED, pt difficult to ventilate
 - Given doses of versed and vecuronium
 - Anesthesia arrived to assist
- Covered with piperacillin/tazobactam
- OGT placed before transport to OR

OPERATIVE REPORT

INDICATIONS FOR THE PROCEDURE: Mrs. PG is an elderly woman who underwent a laparoscopic converted to open cholecystectomy 10 days ago. She presented to the ER with complaints of feeling weak and light-headed. Shortly after admission to the ER, she became hypotensive and had a PEA arrest. She was resuscitated and a FAST scan showed a large amount of fluid in her abdomen; her abdomen was also quite tense on examination. She is anti-coagulated with Coumadin and her INR at that time was 1.8. She was presumed to have an intra-abdominal bleed and was therefore taken emergently to the OR. She was requiring significant amounts of fluid resuscitation, including 4 units of PRBC's as well as pharmacologic pressure support. She was intubated in the ER.

PROCEDURE: Time out was performed, confirming correct patient. Anesthesia was induced with general endotracheal anesthesia. The patient was positioned in the supine position on the table and was prepped and draped in the usual aseptic fashion. Her abdomen was then entered through a midline incision extending from xiphoid to just above the pubis. Dissection was carried down through the subcutaneous tissues and the fascia was opened in the midline. Upon entering the peritoneal cavity, a large amount of blood and clot was encountered and evacuated. Approximately 1,500 cc's of clot and old blood was evacuated, the majority of the clot was encountered inferior to the liver. This was evacuated and there was obvious bleeding from the gallbladder fossa. This was controlled with a combination of electro cautery, fibrillar, and surgical. The area was then widely irrigated with warm normal saline and topical thrombin spray was applied and packs were then placed. Five minutes elapsed and we re-examined the area and no further bleeding was appreciated. At this point, all packs were removed. There was no further evidence of bleeding. Since the patient had undergone massive fluid resuscitation and anesthesia was already having some difficulties with ventilation, we elected to leave her abdomen open and place an abdominal VAC. Sponge and needle counts were correct at the conclusion of the case. The patient was taken to the SICU in critical condition.

Upon entering the peritoneal cavity, a large amount of blood and clot was encountered and evacuated.

Approximately 1,500 cc's of clot and old blood was evacuated, the majority of the clot was encountered inferior to the liver. This was evacuated and there was obvious bleeding from the gallbladder fossa.

we elected to leave her abdomen open and place an abdominal VAC

HOSPITAL COURSE

- Extensive ICU course
 - ARF with anuria, on CRRT
 - Resp failure requiring tracheostomy
 - Febrile with +BAL (stenotrophomonas), MDR UTI, infected rectus sheath hematoma (both E coli)
 - Intermittent A-fib with RVR
 - Multiple pulmonary emboli
- Transferred SICU to BICU to CCMU
- Discharged home two months later with PEA as primary diagnosis

SPEED CASE

- 52yo M with a hx of “liver and kidney problems”
- CC: SOB
- Arrives in Resus A in acute distress
- Gasping for breath, saying single words
- Pale, diaphoretic
- Bradycardic with palpable radial pulse
- Unable to measure BP or SpO2
- PIV placed by EDT

SPEED CASE

- Becomes unresponsive <60sec after arrival
- BVM applied
- Given atropine 1mg IV w/o change in status
- Loses pulses
- CPR initiated
- 2 rounds epinephrine/atropine
- Intubated w/o meds

SPEED CASE

- Empirically medicated given “kidney” history
 - Calcium gluconate
 - Sodium bicarbonate
- VBG returns with K of 8.0
 - Started insulin and glucose
 - Albuterol via ETT
- ROSC after <10 minutes (3 rounds)
- Spontaneous movements observed

SPEED CASE

- Gradual onset of hypotension after ROSC
- Started on dopamine
- Empiric sepsis coverage
 - Piperacillin/tazobactam
 - Vancomycin
- Accepted for admission by CCMU
- Sedated with propofol

- Cooling?

SPEED CASE

- 2 week admission to CCMU requiring dialysis
- Normal neurologic status post-extubation
- Discharged home with outpt dialysis, otherwise doing well

THANK YOU!

