



Time to Get Down with the Sickness

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Why is learning about sepsis important?

- You will see it often.
- Severe sepsis/septic shock mortality ~18-46% (by SIRS)
- ~10% of all pts in ICU
- Most common cause of death in ICU
- **“Sepsis and septic shock are medical emergencies and we recommend that treatment and resuscitation begin immediately.”**
 - Surviving Sepsis Campaign

Outline/Objectives

- Define and identify sepsis
- Work up sepsis
- Triage septic patients
- Treat sepsis

How do you define sepsis?_{1,8}

- Life-threatening **organ dysfunction** caused by a dysregulated host response to infection.
- Organ dysfunction
 - Cardiovascular
 - Pulmonary
 - Liver
 - Renal
 - Hematologic
 - CNS/other
- How can we identify patients with or who are at risk for sepsis?

SIRS Criteria

- Temperature
 - > 38.0 or < 36.0
- HR
 - > 90
- Respiratory status
 - RR > 20 or PaCO₂ < 32
- WBC
 - $> 12,000$ or $< 4,000$ or $> 10\%$ bands

- 2 out of 4

**** BP IS NOT A SIRS CRITERIA ****

SIRS Physiology

- Inflammatory state affecting the whole body
- Release of cytokines
 - acute phase reaction → fever, leukocytosis
 - vasodilation/vascular leak → hypotension, tachy, edema, hypoxemia, tissue hypoperfusion

SIRS

- SIRS: a continuum (the old way of thinking)
 - SIRS
 - Sepsis: 2/4 SIRS criteria + identified or suspected infection
 - Severe sepsis: Sepsis with organ dysfunction
 - Septic shock: Sepsis + hypotension despite “adequate” fluid resuscitation

Sequential Organ Failure Assessment



SOFA

- February 2016, 19 member task force of the Society of Critical Care Medicine (SCCM) and European Society of Intensive Care Medicine (ESICM) discuss identifying and classifying sepsis
- Higher SOFA score = 74% chance that pt died
- Higher SIRS = 64% likelihood chance
- -- SOFA has higher predictive value, may provide better identification of sepsis than SIRS

SOFA

Table 1. Sequential [Sepsis-Related] Organ Failure Assessment Score^a

System	Score				
	0	1	2	3	4
Respiration					
Pao ₂ /Fio ₂ , mm Hg (kPa)	≥400 (53.3)	<400 (53.3)	<300 (40)	<200 (26.7) with respiratory support	<100 (13.3) with respiratory support
Coagulation					
Platelets, ×10 ³ /μL	≥150	<150	<100	<50	<20
Liver					
Bilirubin, mg/dL (μmol/L)	<1.2 (20)	1.2-1.9 (20-32)	2.0-5.9 (33-101)	6.0-11.9 (102-204)	>12.0 (204)
Cardiovascular					
	MAP ≥70 mm Hg	MAP <70 mm Hg	Dopamine <5 or dobutamine (any dose) ^b	Dopamine 5.1-15 or epinephrine ≤0.1 or norepinephrine ≤0.1 ^b	Dopamine >15 or epinephrine >0.1 or norepinephrine >0.1 ^b
Central nervous system					
Glasgow Coma Scale score ^c	15	13-14	10-12	6-9	<6
Renal					
Creatinine, mg/dL (μmol/L)	<1.2 (110)	1.2-1.9 (110-170)	2.0-3.4 (171-299)	3.5-4.9 (300-440)	>5.0 (440)
Urine output, mL/d				<500	<200

Abbreviations: Fio₂, fraction of inspired oxygen; MAP, mean arterial pressure; Pao₂, partial pressure of oxygen.

^a Adapted from Vincent et al.²⁷

^b Catecholamine doses are given as μg/kg/min for at least 1 hour.

^c Glasgow Coma Scale scores range from 3-15; higher score indicates better neurological function.

SOFA₁

- Organ dysfunction can be identified as an acute change in total **SOFA** score ≥ 2 points consequent to the infection.
 - The baseline SOFA score can be assumed to be zero in patients not known to have preexisting organ dysfunction.
 - A SOFA score ≥ 2 reflects an overall mortality risk of approximately 10% in a general hospital population with suspected infection.

qSOFA

- Respiratory rate ≥ 22 /min
- Altered mentation
- Systolic blood pressure ≤ 100 mm Hg

- 2 or more = suggestive of sepsis, higher mortality

A new continuum₈

- Infection/infection + bacteremia
- Sepsis
- Septic Shock:
 - Sepsis with persisting hypotension requiring vasopressors to maintain MAP ≥ 65 mm Hg... despite adequate volume resuscitation.
 - With septic shock, hospital mortality is in excess of 40%₃
- Multiple organ dysfunction syndrome (MODS)
- Death

Case 1

- 38 yo F just finished running marathon, goes to medical tent because of lightheadedness
 - VS: 37.4, 130, 88/60, 24, 97% RA
 - Labs not available

- How many SIRS criteria?
2
- qSOFA?
2
- Does this patient have sepsis?
No

Case 2

- 65 yo M presents with productive cough, fever, chills.
 - VS: 38.1, 92, 120/80, 16, 90% RA
 - Labs: WBC 3.8, Hb 9, plt 180
 - RFP WNL, HFP WNL, lactate WNL, coags WNL
- How many SIRS criteria?
3
- qSOFA
0
- By SIRS:
 - Does this patient have sepsis?
Yes
 - Would it make a difference in diagnosis of sepsis if had CXR which showed LLL infiltrate?
No
 - Does this patient have severe sepsis?
No
 - Does this patient have septic shock?
No
- By qSOFA, is he septic?
 - No, has an infection... but not “septic”

Case 3

- 89 yo F sent from NH with confusion, lethargy
 - VS: 35.8, 98, 22, 85/45, 97% RA
 - Labs: WBC 10,000 with 12% bands, Hb 10, plt 160
bicarb 15, Cr 1.3 (baseline 0.7), lactate 4.1
ABG: 7.29/25/89
- How many SIRS criteria?
4
- qSOFA?
3
- Does this patient have sepsis?
Yes
- Does this patient have severe sepsis (SIRS)?
Yes
- Does this patient have septic shock?
Possibly- will need to see how her BP responds to IVFs

Outline/Objectives

- Identification of sepsis
- **Work up of sepsis**
- Triaging sepsis
- Treatment of sepsis

Work Up of Sepsis

- Source
- Severity

History/Physical

- Source
 - Respiratory
 - Cough, sore throat, rhinorrhea, sick contacts
 - Rhonchi, dullness
 - Blood
 - Fatigue, lines in place, IVDU
 - Rigors
 - Urine
 - Dysuria, hematuria
 - Flank pain, foley catheter
 - GI
 - Diarrhea, nausea, vomiting, abd pain, recent abx or hospitalization, recent travel, sick contacts
 - Other: Skin/soft tissue, bone/joint, ascites, CNS, heart
 - Skin changes, rash, joint pain, HA, confusion, back pain, neck stiffness, photophobia

History/Physical

- Severity
 - Fevers/chills, appetite, po intake
 - Onset
 - Progression
 - Vital signs

Labs

- Source
 - Lung
 - sputum cx, Legionella/Strep urine Ag, flu A+B, respiratory viral panel
 - Blood
 - Bcx: 2 peripheral + 1 from each line the pt has (central lines, HD lines, art lines, etc)
 - Urine
 - UA + Ucx
 - GI
 - C diff, fecal leuks, stool cx, diagnostic paracentesis
 - Other
 - culture of any drainage, LP, ESR, CRP



**** ALWAYS CULTURE BEFORE STARTING ANTIBIOTICS₈ ****

Labs?

- Severity
 - Does patient have evidence of any organ damage?
 - Need to evaluate organ systems to determine
 - CBC
 - RFP
 - LFTs
 - Lactate
 - Coagulation screen
 - ABG
 - ScvO₂

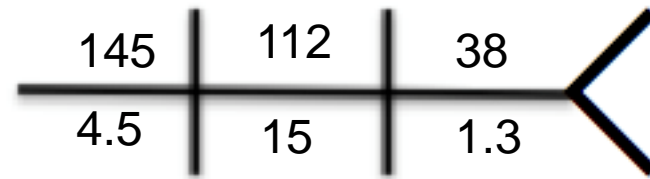
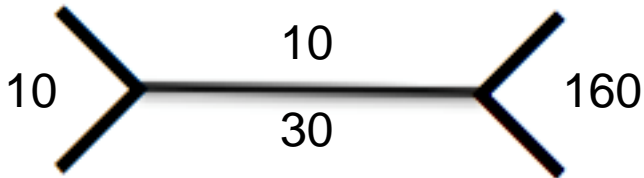
Imaging Studies?

- Lung
 - CXR, CT chest
- Blood
 - TTE
- Urine/GI
 - CT abd
- Other (CNS, Skin/Soft tissue)
 - CT head, MRI (for OM)

Back to Case 3

- 89 yo F sent from NH with confusion
 - VS: 35.8, 98, 22, 85/45, 97% RA
 - Labs: WBC 10,000 with 12% bands, Hb 10, plt 160
bicarb 15, Cr 1.3 (baseline 0.7), lactate 4.1
ABG: 7.29/25/89
- What other studies do you want?

Case 3



Lactate 4.1
ABG: 7.29/24/89

UA:
-Spec grav: 1.2
-Color: Hazy
-Blood: 1+
-Prot: Neg
-LE: 3+
-Nitrite: +
-Bacteria: Present
-Hyaline casts

Ca: 9.9
Phos: 2.4

Tbili: 1.3
Dbili: 0.3
AST: 45
ALT: 40
Alk phos: 60
Prot_{total}: 6.0
Albumin: 2.5

CXR: No acute process

Blood and urine cultures have been obtained

Outline/Objectives

- Identification of sepsis
 - Work up of sepsis
 - **Triaging sepsis**
 - Treatment of sepsis
-
- THE ED IS CALLING YOU TO ADMIT THE PATIENT TO THE FLOOR. WHAT DO YOU WANT TO DO?

When to transfer to MICU

- Sepsis
 - Usually can treat on the floor
- Severe sepsis
 - Floor or MICU depending on how severe the organ dysfunction is (or hospital policy)
 - Severe lactic acidosis → MICU
 - Respiratory distress → MICU
- Septic shock
 - MICU

Case 3

- 89 yo F sent from NH with confusion, diarrhea
 - VS: 35.8, 98, 22, 85/45, 97% RA
 - Labs: WBC 10,000 with 12% bands, Hb 10, plt 160
bicarb 15, Cr 1.3 (baseline 0.7), lactate 4.1
ABG: 7.29/25/89, UA with positive LE and nitrite
- FLUIDS
- CULTURES
- ANTIBIOTICS

Outline/Objectives

- Identification of sepsis
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The Data

- Early Goal Directed Therapy
 - Rivers et al 2001₄
- ARISE and ProCESS trials
- Surviving Sepsis Campaign
 - Last updated in 2016-2017 to incorporate new studies on sepsis
- Sepsis-3 (Feb 2016)

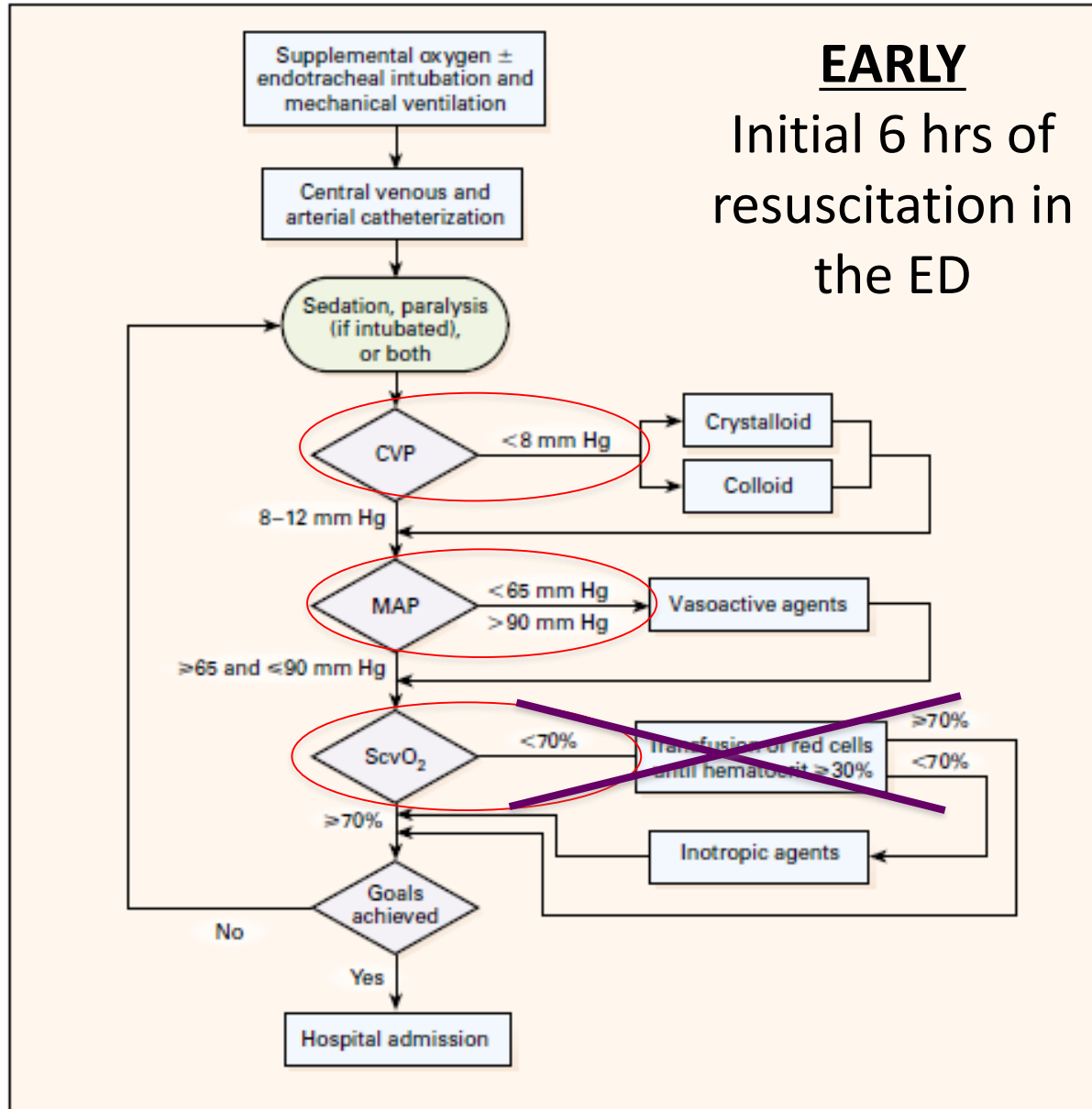
The Surviving Sepsis Campaign

- Started in 2001/2002 to spread awareness and develop guidelines for sepsis
 - ESICM and SCCM
- Guidelines published in 2004 and then updated in 2013
- Most recently updated in 2016/2017

What do they recommend?₈

- Protocolized resuscitation within the first 6 hours of patients with sepsis-induced tissue hypoperfusion
 - CVP 8-12
 - MAP \geq 65
 - UOP \geq 0.5 cc/kg/hr
 - ScvO₂ \geq 70%
 - MEASURE **LACTATE**
- So **FLUIDS**, and possibly vasoactive agents

Early Goal Directed Therapy algorithm



GOAL DIRECTED

CVP > 8

MAP > 65

ScvO₂ > 70%

Figure 2. Protocol for Early Goal-Directed Therapy.

CVP denotes central venous pressure, MAP mean arterial pressure, and ScvO₂ central venous oxygen saturation.

SURVIVING SEPSIS CAMPAIGN CARE BUNDLES

TO BE COMPLETED WITHIN 3 HOURS:

- 1) Measure lactate level
- 2) Obtain blood cultures prior to administration of antibiotics
- 3) Administer broad spectrum antibiotics
- 4) Administer 30 mL/kg crystalloid for hypotension or lactate ≥ 4 mmol/L

TO BE COMPLETED WITHIN 6 HOURS:

- 5) Apply vasopressors (for hypotension that does not respond to initial fluid resuscitation) to maintain a mean arterial pressure (MAP) ≥ 65 mm Hg
- 6) In the event of persistent arterial hypotension despite volume resuscitation (septic shock) or initial lactate ≥ 4 mmol/L (36 mg/dL):
 - Measure central venous pressure (CVP)*
 - Measure central venous oxygen saturation (ScvO₂)*
- 7) Remeasure lactate if initial lactate was elevated*

*Targets for quantitative resuscitation included in the guidelines are CVP of ≥ 8 mm Hg, ScvO₂ of $\geq 70\%$, and normalization of lactate.

FLUIDS

- How much is enough??
 - AT LEAST 30 cc/kg within first 3 hours_g
 - Additional fluids guided by hemodynamic monitoring and lactate
 - CVP, MAP, ScvO₂
 - Repeat lactate to normalization
 - Must keep in mind LVEF and renal function
- What kinds of fluids do you use??
 - Crystalloids are the fluid of choice_g
 - Can consider albumin as an adjunct when patients are requiring substantial amounts of crystalloid_g
 - Weak recommendation, low-quality evidence

CULTURES₈

- CULTURES
- Appropriate routine microbiologic cultures (including blood) **should be obtained before starting antimicrobial therapy** in patients with suspected sepsis and septic shock if doing so results in no substantial delay in the start of antimicrobials.
 - Should always include at least two sets of blood cultures (aerobic and anaerobic).

ANTIBIOTICS₈

- ANTIBIOTICS++
- Early antibiotics (within first 3 hours)
- Broad-spectrum, **double coverage?**

Back to the Case...

- 89 yo F sent from NH with confusion, diarrhea
 - VS: 35.8, 98, 22, 85/45, 97% RA
 - Labs: WBC 10,000 with 12% bands, Hb 10, plt 160
bicarb 15, Cr 1.3 (baseline 0.7), lactate 4.1
ABG: 7.29/25/89
- FLUIDS, CULTURES, ANTIBIOTICS
- After 4L of NS, her BP is 90/55. A repeat lactate is 3.7
- What now??
 - To the ICU, central line, arterial line, pressors

Vasopressors

- Which vasopressors would you use?
 - Norepinephrine (Levophed) is first choice
 - Next, add vasopressin
 - Then can consider epinephrine, phenylephrine
- Consider cardiac function. This may change your pressor choice
 - Dopamine

Other things mentioned by the new SSC Guidelines..8

- SOURCE CONTROL
- Procalcitonin can help guide de-escalation
- Consider corticosteroids (hydrocortisone) for those with inadequate hemodynamic response
- Discussed mechanical ventilation in ARDS
- Glucose control – aim for less than 180
- Early enteral nutrition
- Address goals of care and prognosis early

TAKE HOME POINTS

- Identify sepsis using qSOFA and SIRS criteria:
 - AMS, RR \geq 22, SBP \leq 100
 - T > 38.0 or < 36.0, HR > 90, RR > 20 or PaCO₂ < 32, WBC > 12,000 or < 4,000 or > 10% bands
- Initial treatment of sepsis/septic shock:
 - FLUIDS, CULTURES, ABX, PRESSORS
 - GET CULTURES BEFORE ANTIBIOTICS**
- If a patient is going in to septic shock, use levophed as first line pressor

References

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