Clinical Case Discussion

James J. Cappola, III,M.D.,FACP

Chair and Associate Professor of Medicine

CUSOM

August 28, 2025

CAMPBELL UNIVERSITY | Jerry M. Wallace School of Osteopathic Medicine

Our patient . . .

A 70-year-old man with a history of HTN and alcohol abuse presents to the emergency room unresponsive.

He lives alone and a neighbor called 911 after the patient did not answer the door for two days.

No other history is available.

On exam, he is chronically ill-appearing and incontinent of urine.

Vitals: bp 80/50 p 115 RR 30 temp 101.5F O2 sat 83% on RA
Height 5’11’ Wt 65 kg

HEENT: Pupils miotic, equal with roving eye movements;
Oropharynx: poor dentition; membranes dry

Neck: supple without lymphadenopathy

Car: r/r/r. tachycardic without murmur

Lungs: CTA with w/r/r

Extr: no edema; dp pulses trace B/L

Abd: Nondistended, soft, no focal tenderness or organomegaly with confluent erythema, excessive warmth in the lower quadrants extending to the genitalia

Neuro:
CNs: Pupils as noted; face symmetric
Motor: withdraws all four extremities to pain.

Genitourinary exam:
massive scrotal edema, erythema and induration extending across the perineum with tenderness and crepitus

Fournier’s Gangrene

Urology Case Reports 26 (2019) 100943 at sciencedirect.com

The patient is placed on a 50% Venturi oxygen mask with O2 sats improving to 94%

A peripheral IV is placed and STAT labs are sent.

A normal saline bolus is started.

A STAT ABG is sent.

Laboratory Data:

ABG: 7.20/20/70/90% on RA

Severe metabolic acidosis with respiratory compensation

wbc	33,000
hgb	10.2
hct	32%
platelets	78,000
wbc differential	92% neutrophils

Na	146
K	3.0
CL	112
CO2	8
BUN	35
Cr	2.1
Glc	90

C-reactive protein 150 mg/L (normal < 10 mg/L)

SIRS (systemic inflammatory response syndrome) definition

- Temp > 38 or < 36
- RR > 20
- HR > 90
- Wbc > 12,000 or < 4,000 or > 10% bands
- **Need 2 or more**

Sepsis definition

- SIRS plus
- Suspected source of infection

Severe sepsis: Sepsis + one of the following:

- Sepsis induced hypotension (SBP < 90, MAP < 65 or SBP drop > 40 mm Hg)
- Lactate > 2
- UOP < 0.5 ml/kg/hr for > 2 hours
- Acute lung injury (PaO2/FiO2 < 250 without pneumonia or < 200 with pneumonia
- Creatinine increase > 0.5 mg/dl above baseline
- Bilirubin > 2
- Platelets < 100,000
- Coagulopathy INR > 1.5 or PTT > 80

Septic Shock: Severe sepsis + one of the following:

- Hypotension (SBP < 90 or MAP < 65) despite adequate fluid resuscitation

- Lactate $\geq$ 4

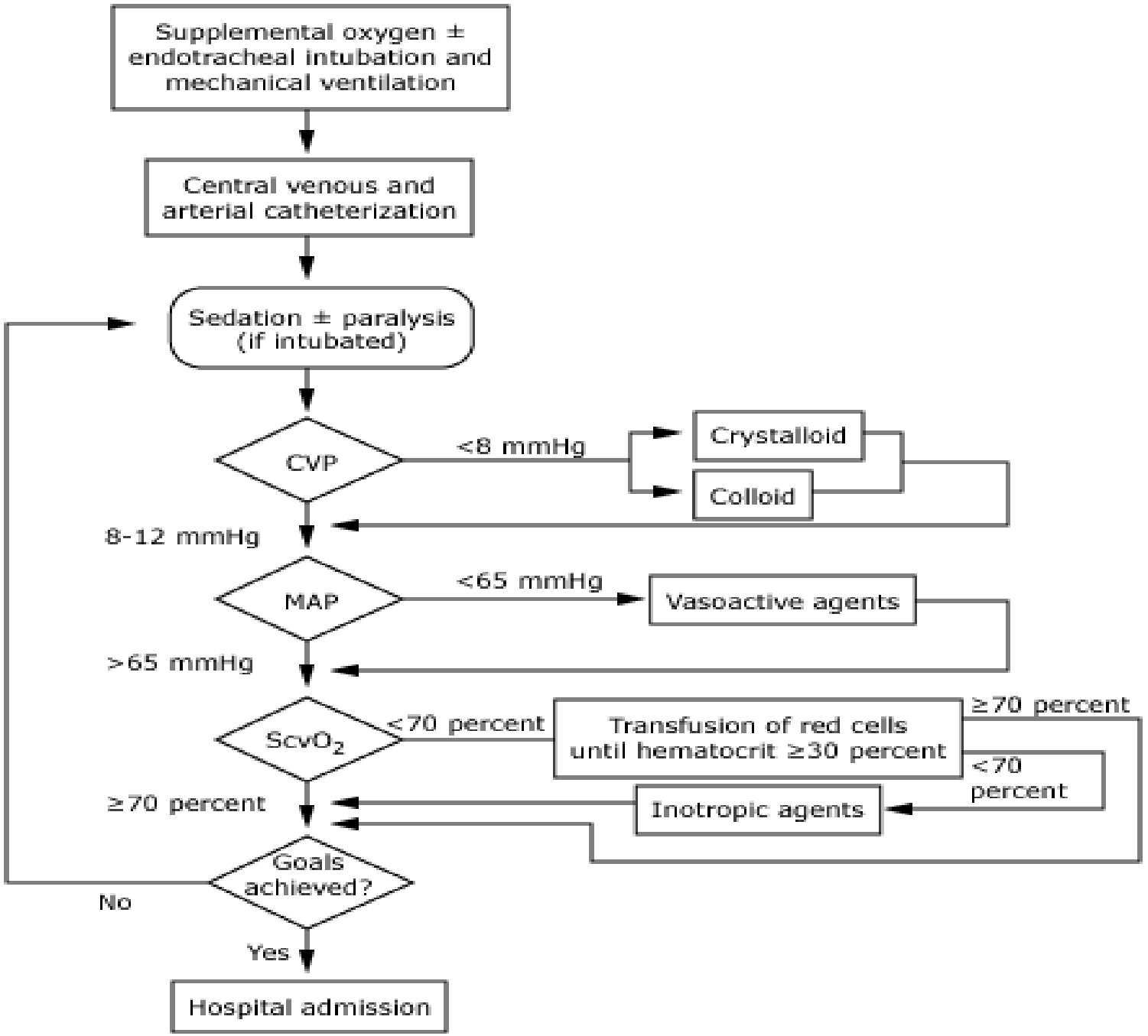
Sepsis
Early Goal-Directed Therapy

- 2001

- Single-center trial in the US

- Compared a goal-directed therapy protocol in the first six hours from presentation to the ER and usual care.

Early Goal-Directed Therapy 2001
N Engl J Med 2001;345:1368



Early goal-directed therapy for sepsis: Static measures of tissue perfusion

- Central venous pressure:
  - goal 8-12 mm Hg

- Central venous oxygen saturation:
  - goal > 70%

Why central mixed venous oxygen saturation?

- The goal in treating **all** critical illness: achieve balance between systemic oxygen delivery and oxygen demand (ie. to avoid or improve global tissue hypoxia)

- Measure successful “balance” with:
  - Mixed venous oxygen saturation
  - Arterial lactate concentration
  - Base deficit
  - Arterial pH

Management of Sepsis in Adults

- Secure airway
- Correct hypoxemia
- Vascular access
- Initial routine labs, including arterial blood gas, **serum lactate level**
- Cultures:
  - Blood
  - Urine
  - Other sites which are clinically evident sources of infection (ex: sputum, wound drainage, CSF, stool)
- Initial IVF resuscitation with isotonic fluid **30 ml/kg over first three hours**
  - Normal saline
  - Lactated Ringer's

Schmidt, G and Mandel, J UpToDate 2023

Why Measure Lactate?

- **Circulatory shock causes inadequate oxygen delivery, leading to mitochondrial hypoxia**

- Energy metabolism becomes dependent on anaerobic glycolysis
  - Cellular lactate increases, diffusing into the bloodstream

- Lactate concentration varies in proportion to ongoing deficit in tissue oxygenation
  - Marker of restoration of oxygen delivery with resuscitation

Clinical question

- Is lactate clearance a non-inferior measure compared to $ScvO_2$ monitoring for evaluating the adequacy of oxygen delivery during early quantitative resuscitation of severe sepsis and septic shock?

Study design: overview

- Randomized, prospective, parallel group, non-blinded
- Emergency Departments of 3 US urban hospitals in January 2007-2009
- Goal: compare lactate clearance as non-inferior to $ScvO_2$ as a resuscitation target in severe sepsis

JAMA 2010 Feb; 303 (8): 739-746.

ScvO2 vs lactate clearance in sepsis: In hospital mortality

Variable	Lactate Clearance Group (%)	ScvO2 Group (%)	Proportion Difference (95% CI)
In-hospital mortality	17%	23%	6% (-3 to 15)

JAMA 2010 Feb; 303 (8): 739-746.

ScvO2 vs lactate clearance in sepsis: Secondary Outcomes

Variable	Lactate Clearance Group (mean)	ScvO2 Group (mean)	P-Value
Days in ICU	5.9	5.6	.75
Days in hospital	11.4	12.1	.60
Ventilator-free days	9.3	9.9	.67

JAMA 2010 Feb; 303 (8): 739-746

Benefits and Drawbacks: measuring lactic acid in sepsis

- Benefits
  - Lactic acid levels are **a lot easier** to obtain than Scv O2 levels.
  - Managing sepsis with lactic acid levels vs ScvO2 has been shown to lead to similar outcomes
- Drawbacks
  - Lactic acid elevation does not always = sepsis
  - The target for lactic acid clearance is unclear

Elevated Lactic Acid Level does *not* always mean sepsis

- Hypovolemia
- Heart failure
- Cardiopulmonary arrest
- Metformin-induced
- Diabetic ketoacidosis
- Alcoholism
- Malignancy (ex: leukemia, lymphoma)
- HIV infection

Empiric Antibiotic Therapy in Sepsis

Management of Sepsis in Adults: Empiric Antibiotics for Necrotizing Fasciitis

Organisms to Cover	Polymicrobial: •Anaerobes *Bacteroides*, *Clostridium* *Peptostreptococcus* •Aerobes E. coli Enterobacter Klebsiella Proteus •Facultative anaerobic Streptococcus •Pseudomonas is rare
Sample antibiotic Regimen (all IV, assumes normal renal and hepatic function)	•Vancomycin 15-20 mg q 8 to 12 hrs PLUS •Meropenem 1 gram q 8hrs PLUS •Clindamycin 600-900 mg q 6 to 8 hrs for antitoxin effects on Staph and Strep

Stevens D and Baddour L, UpToDate 2023

Current Standard of Care for Sepsis in Adults: The Sepsis “Bundle”

The sepsis bundle: within 3 hours

- Lactate level
- Blood cultures then
- Broad spectrum antibiotics **within the first hour**
- If hypotensive (SBP < 90, MAP < 65 or drop in SBP > 40 mm Hg):
  - Resuscitate with crystalloid IVFs 30 ml/kg **within the first 3 hours.**
  - Ex: 70 kg patient: 2100 ml of IVF

The sepsis bundle: within 6 hours of presentation of *severe sepsis/septic shock*

- Repeat lactate level if initial lactate > 2

- If hypotension persists after IVF resuscitation or initial lactate level > 4 then

  Either

  - Physical exam to reassess tissue perfusion
  - Vital signs:
  - Cardiopulmonary exam:
    - Heart sounds
    - Lung auscultation
    - Capillary refill
    - Peripheral pluses
    - Skin color

OR . . .

The sepsis bundle: within 6 hours of septic shock

- Additional measurement responsiveness to IVFs.
- **You need 2 of the following 4:**
  - **Static measures of tissue perfusion:**
    - Central venous pressure (CVP) > 8 mm Hg
    - Central venous oxygen saturation (ScvO2) > 70%

  OR
  - **Dynamic measures of tissue perfusion:**
    - Inferior vena cava (IVC) assessed with limited echo: distensibility index > 12%
    - Passive leg raise (PLR) assessed with limited echo:

    Change in stroke volume before and after PLR > 12%

Sepsis bundle: persistent hypotension in septic shock

- IVF resuscitation with 30 ml/kg of crystalloid within 3 hours.

- Start pressors for hypotension within 6 hours of presentation.

Sepsis *recommendations*: Pressors

- Norepinephrine first-choice pressor to maintain MAP ≥ 65 mm Hg.
  - 2-12 mcg/min infusion
  - 30 mcg/min maximum infusion rate

- Use epinephrine when additional agent is needed to maintain adequate blood pressure
  - 0.1-0.5 mcg/kg/minute (7-35 mcg/minute in a 70 kg patient)
  - titrate to desired response

Sepsis *recommendations*: Pressors

- Avoid dopamine except in patients with:
  - Low risk of cardiac arrhythmia
  - Poor LV systolic function
  - Low heart rate (part of ACLS protocol for bradycardia)

- Dopamine infusion dosing:
  - 1 to 20 mcg/kg/min infusion

Sepsis *Recommendations:* Pressors

- Use dobutamine in patients with myocardial systolic dysfunction or hypoperfusion despite adequate volume resuscitation and MAP

- Often need to add dobutamine to another vasopressor to avoid hypotension

- Dosing
  - 2 to 20 mcg/kg/min
  - Maximum dosing 40 mcg/kg/min

Back to our patient . . .

A 70-year-old man with a history of HTN and alcohol abuse presents to the emergency room unresponsive.

He lives alone and a neighbor called 911 after the patient did not answer the door for two days.

No other history is available.

On exam, he is chronically ill-appearing and incontinent of urine.

Vitals: bp 80/50 p 115 RR 30 temp 101.5F O2 sat 83% on RA
Height 5’11’ Wt 65 kg

HEENT: Pupils miotic, equal with roving eye movements;
Oropharynx: poor dentition; membranes dry

Neck: supple without lymphadenopathy

Car: r/r/r. tachycardic without murmur

Lungs: CTA with w/r/r

Extr: no edema; dp pulses trace B/L

Abd: Nondistended, soft, no focal tenderness or organomegaly with confluent erythema, excessive warmth in the lower quadrants extending to the genitalia

Neuro:
CNs: Pupils as noted; face symmetric
Motor: withdraws all four extremities to pain.

Genitourinary exam:
massive scrotal edema, erythema and induration extending across the perineum with tenderness and crepitus

Fournier’s Gangrene

Urology Case Reports 26 (2019) 100943 at sciencedirect.com

The patient is placed on a 50% Venturi oxygen mask with O2 sats improving to 94%

A peripheral IV is placed and STAT labs are sent:

- CBC
- BMP
- Lactate level
- Blood cultures

A normal saline bolus is started.

A STAT ABG is sent.

Laboratory Data:

ABG: 7.20/20/70/90% on RA

Severe metabolic acidosis with respiratory compensation

wbc	33,000
hgb	10.2
hct	32%
platelets	78,000
wbc differential	92% neutrophils

Na	146
K	3.0
CL	112
CO2	8
BUN	35
Cr	2.1
Glc	90

Lactate 4.6 mmol/L

C-reactive protein 150 mg/L (normal < 10 mg/L)

The patient was intubated and mechanically ventilated for airway protection

Normal saline 2100 ml bolus continues

A R internal jugular CVP catheter was placed

Empiric Antibiotics are started Ideal body weight based on height 74 kg; Creatinine clearance 34 ml/min

- Vancomycin 1 gram IV x1 with pharmacy to dose
- Meropenem 1 gram IV q 12 hrs
- Clindamycin 600 mg IV q 6 hrs

He was admitted to the ICU and stabilized . . .

Vitals after 2100 ml of IVFs and norepinephrine drip at 10 mcg/min . . .
Bp 110/70 p 98

Vent settings: PRVC RR 18 TV 450 FiO2 60% PEEP 5

Portable CXR shows ETT 2 cm above the carina and
tip of R CVP catheter at junction of SVC and RA

Repeat ABG 7.35/38/110/98% Repeat lactic acid 2.6 mmol/L

Urology Case Reports 26 (2019) 100943 at sciencedirect.com

He underwent emergent scrotal and penile debridement.

Urology Case Reports 26 (2019) 100943 at sciencedirect.com

He underwent emergent scrotal and penile debridement.

Urology Case Reports 26 (2019) 100943 at sciencedirect.com

He needed extensive woundcare with a wound-Vac and daily dressings

Wound cultures grew

- MRSA
- Edwardsiella tarda
- Klebsiella oxytoca
- Prevotella, a gram-negative, anaerobic bacteria

Fournier Gangrene

- First described by Dr. Jean-Alfred Fournier, a French venereologist in 1883.
- Necrotizing fasciitis of the perineum and genital areas
- Can affect both sexes

Stevens, DL and Baddour LM, *UptoDate* 2023

Risk Factors for Necrotizing Skin Infections

- Major penetrating trauma
- Minor laceration or blunt trauma (muscle strain, sprain, or contusion)
- Skin breach (varicella lesion, insect bite, injection drug use)
- Mucosal breach (hemorrhoids, rectal fissures, episiotomy)
- Recent surgery (including colonic, urologic, and gynecologic procedures as well asneonatal circumcision)
- Immunosuppression (diabetes, cirrhosis, neutropenia, HIV infection)

Stevens, DL and Baddour LM, *UptoDate* 2023

Risk Factors for Necrotizing Skin Infections

- Malignancy
- Obesity
- Alcoholism
- In women: pregnancy, childbirth, pregnancy loss, gynecologic procedures

Stevens, DL and Baddour LM, *UptoDate* 2023

Fournier Gangrene

- Requires aggressive surgical debridement often over multiple surgeries.
- Requires broad-spectrum antibiotics
- Requires extensive wound-care

Stevens, DL and Baddour LM, *UptoDate* 2023

Fournier Gangrene

- Despite improved care, mortality rate is reported between 22 and 40%

- Risk factors for increased mortality in necrotizing fasciitis
  - WBC > 30,000/mm3
  - Serum creatinine > 2.0
  - Age > 60 years
  - Clostridial infection
  - Delay in surgery for more than 24 hours

Stevens, DL and Baddour LM, *UptoDate* 2023

Osteopathic Considerations in Sepsis

- Once patient is post op, consider techniques to optimize healing
  - MFR thoracic inlet
  - Dome the diaphragm
  - Thoracic pump
  - Pedal pump

Questions?

Thank you!