Managing Patients in the Transition Between Floor and ICU

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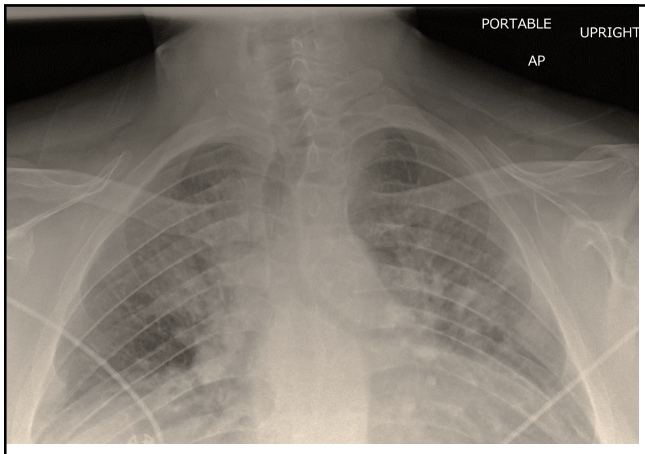
2023

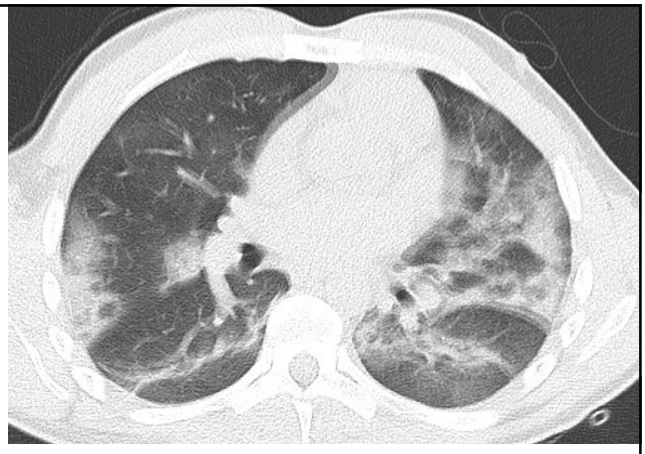
Disclosures

- None

Case 1

- 37 M mild asthma, type 2 diabetes, morbid obesity, recent new smoker
- Presents with 5 days of productive cough, fever, progressive dyspnea
- Exam: T 38.7 ^{o}C (101.7 ^{o}F), RR 20, Sat 90% on room air, bibasilar crackles, mild expiratory wheezing
- WBC 16, Na 131
- ABG on room air: pH 7.31, $PaCO_2$ 52, PaO_2 63
- CXR: bilateral infiltrates
- CT chest: ground-glass opacities, worse in bases and periphery



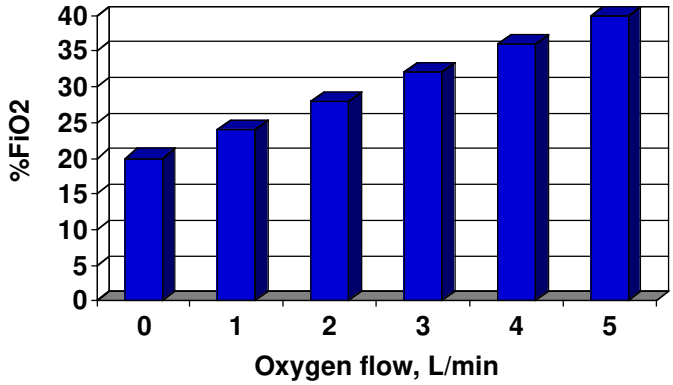


Case 1: Imaging

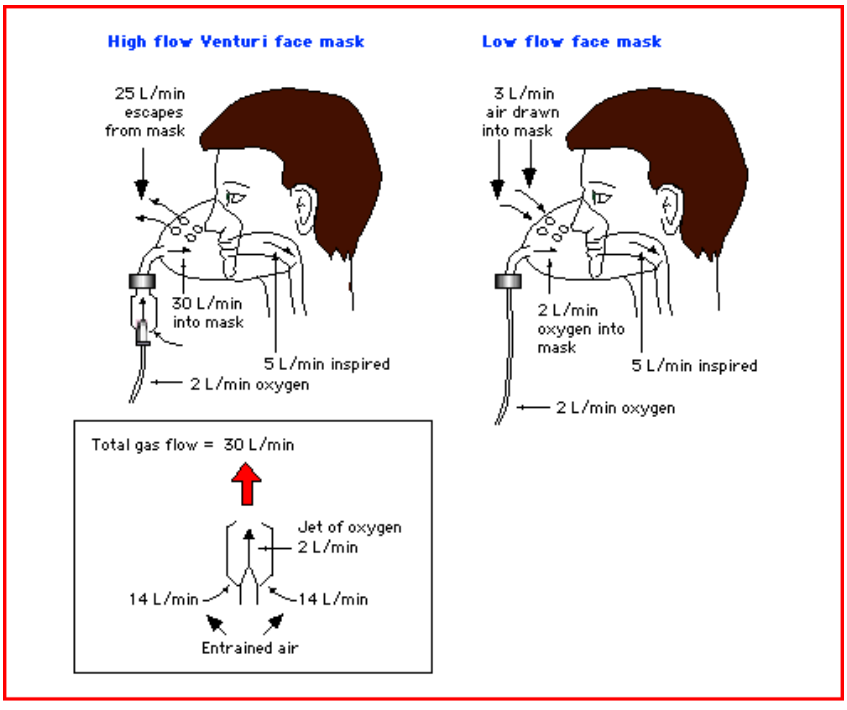
Case 1

- Started on ceftriaxone/azithro for presumed community-acquired pneumonia, bronchodilators
- On hospital day 2, respiratory status is worse
- RR 30, on 50% face mask
- ABG: pH 7.46, $PaCO_2$ 33, PaO2 66
- What options can be used to increase respiratory support on the floor?

Oxygen supplementation



Method	FiO2 (Approximate)	Flowrate (L/min)
Non rebreather Mask	60-80%	10-15
Venti Mask	24% 26% 28% 31% 35% 40% 50%	3 3 6 6 9 12 15
Simple Face Mask	35-55%	5-10 lpm
Nasal Cannula	24% 28% 32% 36% 40% 44%	1 2 3 4 5 6



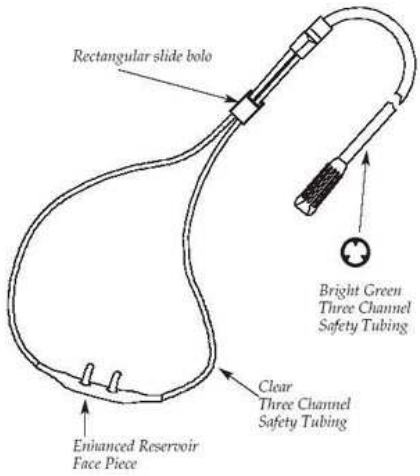
Case 1 continued

- Increasing O2 requirements to 10L
- Continued desaturations and increased work of breathing
- Next steps?
- High flow NC vs NIPPV?

High-flow nasal cannula (HFNC)

- 30 to 60 LPM oxygen heated to body temperature at 100% relative humidity
- Dramatically reduces dilution of inspired oxygen by room air
- Washes out dead space in the airways
- Can generate low-level continuous positive airway pressure (CPAP) at higher flows
- Moistens secretions, improves mucociliary transport
- Greater comfort and adherence
- Limitations: doesn't provide as much positive pressure or reduce the work of breathing as much as non-invasive ventilation; does it help prevent intubation, or "delay the inevitable"?

Fancy New Nasal Cannulas, e.g., "Salter"
Higher Flows, 6-15L and perhaps higher (e.g. 70L)



Facilitated by tubing diameters and humidification of O2 delivery.

Non-invasive ventilation: bilevel intermittent positive air pressure (BiPAP)

- Baseline positive pressure
  - Expands areas of atelectasis, and prevents other areas from becoming atelectatic
- Inspiration raises the system to a higher positive pressure, reducing the work of breathing
- May also provide supplemental oxygen
- Limitations: uncomfortable, may be poorly tolerated, unclear benefit vs. harm in ARDS

Noninvasive positive pressure ventilation (NIPPV)

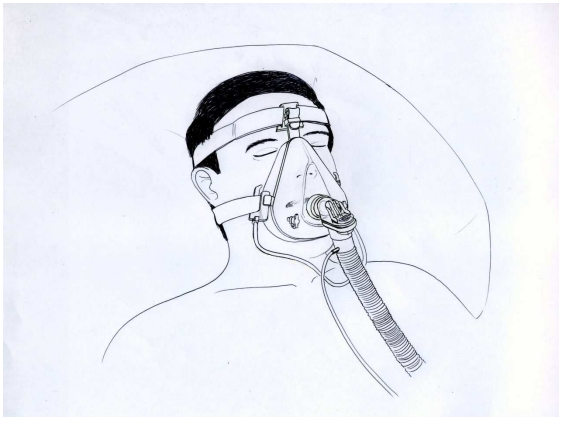
- Supportive data for:
  - Acute COPD exacerbation--greatest benefit
  - Ventilator weaning adjunct in COPD
  - Acute cardiogenic pulmonary edema
  - Hypoxemic respiratory failure, immunocompromised host in early but not later studies
- Why?
  - Improved alveolar ventilation
  - Reduced work of breathing
  - Relieving fatigued respiratory muscles
- Outcomes
  - Decreased infections
  - Fewer intubations

NIPPV, cont'd

- Facemask: better effect, less comfort
- Need "protocol-driven" initiation, with careful monitoring, esp in 1st 1-2 hours
- Contraindications:
  - Mental status, hemodynamics, facial deformity, upper airway obstruction, SECRETIONS, aspiration risk
  - Initial concern re: aerosolization in COVID; unclear benefit vs. harm in lung injury

NIV Mask Fashion Show

Most common in the ICU.



Perhaps next? The helmet.

Patel BK et al. JAMA 2016; JAMA 2021: no difference in VFD with HFNC in COVID

HFNC vs BiPAP in clinical trials

In a meta-analysis of 29 RCTs, HFNC was associated with lower need for intubation, lower mortality, and greater comfort than non-invasive ventilation

ACP guidelines lean toward HFNC as the preference over NIV for acute AHRF and over conventional oxygen for post-extubation AHRF with "low-certainty evidence"; (my own editorial: NIV has better rationale than HFNC for more significant *hypercapnic* respiratory failure)

Ann Intern Med 2021;174:952

High Flow O_2: bottom line

- HF O_2 may be as good or better than NIPPV for acute hypoxemic respiratory failure
- HF O_2 better tolerated than NIPPV
- HF O_2 may be equivalent to NIPPV at reducing post-extubation respiratory failure – *perhaps better in lower risk patients*

- *NIPPV still preferred for hypercarbic respiratory failure (or when higher "PEEP" needed)*

Case 1 continued

- Started on high flow NC
- Ongoing desaturations and escalating O2 requirement
- Anesthesia called for intubation

What is the optimal timing for intubation in the patient with deteriorating respiratory status?

As an example: 2019 AHA update: Airways

- Data isn't clear when/how to intubate during a code situation due to varying patient and provider circumstances.
- Use best judgement based on situation and provider expertise.
- It is suggested that proficiency be encouraged to acquire and maintain airway insertion skills for relevant personnel.

Case 1 evolution

- A bronchoscopy was performed with cell count/differential:
  - 685 RBC, 295 WBC (32% Neutrophils, 13% Lymphs, 8% Monos, 39% eosinophils)

Acute Eosinophilic pneumonia

- Known causes: e.g., meds, parasites, new onset smoking
- DDx: "PIE", e.g., Churg Strauss, CEP, ABPA, etc
- Idiopathic:
  - Similar presentation as CAP
  - Classically no circulating eosinophils detected, but eos seen in BAL
  - Can respond dramatically to steroids
  - One approach is to treat for 1 month after symptoms disappear and CXR normal (i.e., on the order of 4-6 weeks); inhaled steroids may be beneficial in relapse

The NEW ENGLAND JOURNAL of MEDICINE

ORIGINAL ARTICLE

Hydrocortisone in Severe Community-Acquired Pneumonia

- 795 patients, randomized phase 3 RCT
- Hydrocortisone vs. Placebo 200 mg/day for 4 or 7d based on clinical improvement (then taper, total 8 or 14 days)
- HC: Improved 28d mortality and intermediate endpoints – more insulin in the HC group
- ? Benefits in pt subgroups without a pathogen and elevated CRP (>15 mg/dL)

N Engl J Med. 2023; Mar 21. doi: 10.1056/NEJMoa2215145.

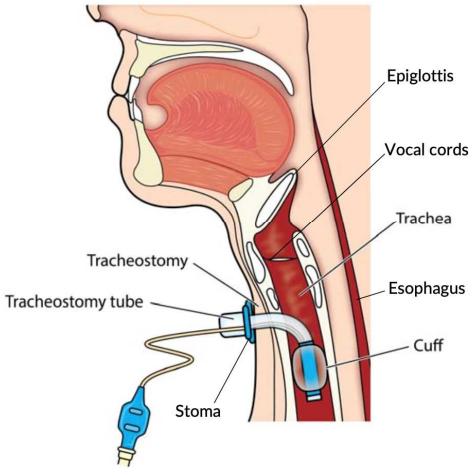
Case 1 conclusion

- Intubated for 2 weeks with slow improvement
- Required trach
- Discharged to a ventilator weaning rehab facility

Tracheostomy ICU to floor considerations

- Most often, #8 cuffed initially
- Longer term goal to regain speech, swallowing function
- Ultimately will consider down-sizing with goal to decannulate

Passey-Muir speaking valve



Case 2

- 87 F PMHx type 2 diabetes on metformin
- Brought in with confusion, hypoglycemia
- Given D50W in the field by EMS for glucose 40 mg/dl (2.2 mmol/L)
- Exam: T 92^{o}F (33.3^{o}C), P 90, BP 65/40, RR 20, Sats 97% RA

Case 2

- Laboratory workup:
- WBC 18, Na 124, K 5.2, Bicarb 11, BUN 60 mg/dl, Cr 4.0 mg/dl (354 µmol/L)
- Urinalysis >100 WBC, 4+ bacteria
- Is this sepsis? Next steps?

What is Sepsis (2001-15)?

- Systemic Inflammatory Response Syndrome (SIRS):
  - Temp >38°C or <36°C
  - Heart Rate > 90 bpm
  - Resp Rate > 20/min
  - WBC >10000, <4000, or Bandemia>10%
- Sepsis: SIRS + Infection
- Severe Sepsis: Sepsis+ Organ Dysfunction
- Septic Shock: Sepsis+Refractory Hypotension

Special Communication | CARING FOR THE CRITICALLY ILL PATIENT

The Third International Consensus Definitions for Sepsis and Septic Shock (Sepsis-3)

Mervyn Singer, MD, FRCP; Clifford S. Deutschman, MD, MS; Christopher Warren Seymour, MD, MSc; Manu Shankar-Hari, MSc, MD, FFICM; Djillali Annane, MD, PhD; Michael Bauer, MD; Rinaldo Bellomo, MD; Gordon R. Bernard, MD; Jean-Daniel Chiche, MD, PhD; Craig M. Coopersmith, MD; Richard S. Hotchkiss, MD; Mitchell M. Levy, MD; John C. Marshall, MD; Greg S. Martin, MD, MSc; Steven M. Opal, MD; Gordon D. Rubenfeld, MD, MS; Tom van der Poll, MD, PhD; Jean-Louis Vincent, MD, PhD; Derek C. Angus, MD, MPH

- SEPSIS: (>10% mortality)
  - Life-threatening organ dysfunction
  - Caused by *dysregulated response* to infection
  - Increase SOFA score of ≥2
- SHOCK: (>40% mortality)
  - Vasopressors for MAP≥65 mmg Hg
  - Lactate>2 mmol/L
  - In absence of hypovolemia

JAMA. 2016;315(8):801-810. doi:10.1001/jama.2016.0287

SOFA Score: 6 Organ Systems, 0-4 Points

Points	0	1	2	3	4
PaO2/FiO2	≥400	<400	<300	<200 + mechanical ventilation	<100 + mechanical ventilation
Platelets	≥150	<150	<100	<50	<20
Bilirubin	<1.2	1.2-1.9	2.0-5.9	6.0-11.9	>12.0
Blood Pressure	MAP ≥70	MAP <70	Dopamine <5 or Dobutamine	Dopamine 5.1-15 or Epinephrine <0.1 or Norepinephrine <0.1	Dopamine >15 or Epinephrine >0.1 or Norepinephrine >0.1
Glasgow Coma Scale	15	13-14	10-12	6-9	<6
Creatinine	<1.2	1.2-1.9	2.0-3.4	3.5-4.9 or <500cc urine/d	>5.0 or <200cc urine/d

Vincent et al, Intensive Care Med 1996

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- qSOFA
  - Out of hospital, ED, Ward settings
  - *Worse outcomes* predicted from sepsis with 2 of:
    - Respiratory Rate ≥ 22/min
    - Altered mental status (GCS ≤ 13)
    - SBP ≤ 100 mmHg
  - Ongoing inquiry as to its validation
  - *LESS SENSITIVE* but *MORE SPECIFIC* than SIRS for sepsis screening.

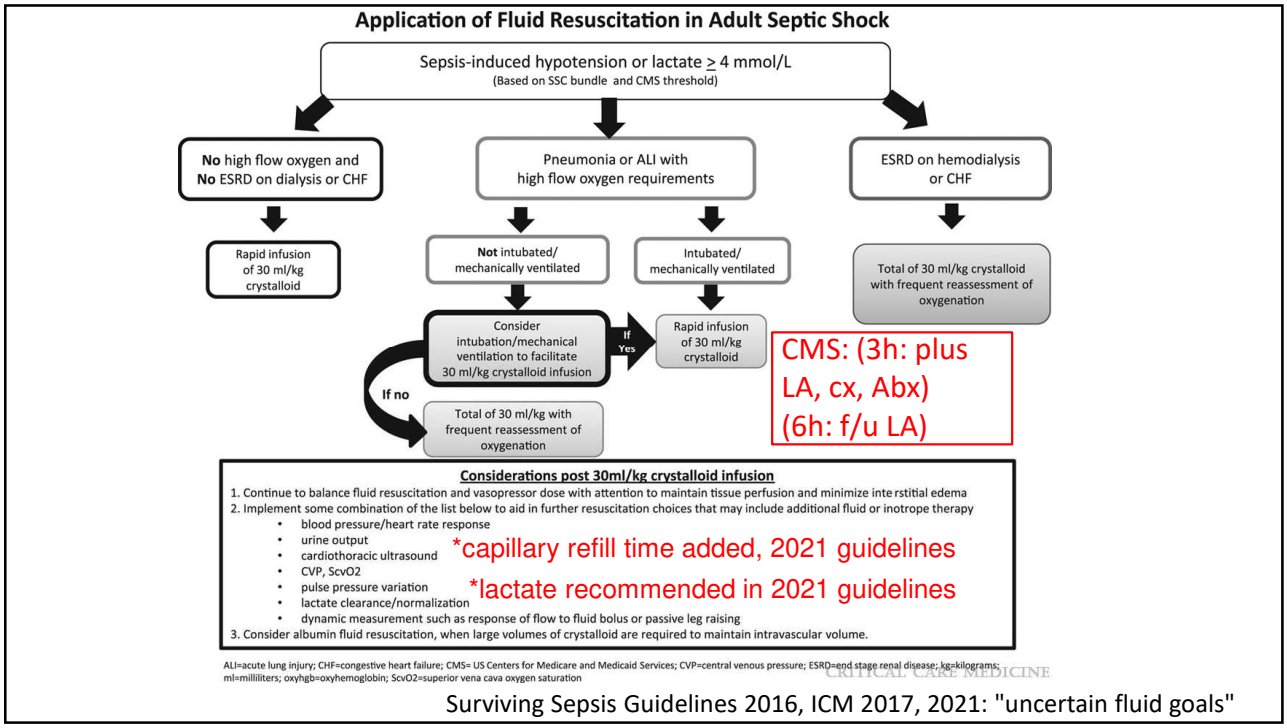
JAMA. 2016;315(8):801-810. doi:10.1001/jama.2016.0287

Case 2 continued

- After initial bedside evaluation the team received a "Sepsis Alert" from the EMR…
  - What is the evidence for sepsis alerts?

Sepsis alerts in EMR: Helpful?

- Rationale: We don't want to miss sepsis
- Reality: Mixed data on efficacy (variable effects in different systems and using different metrics, etc)...increased case detection on the good end and alert fatigue on the less good end
- Future: Better data analysis and tool creation (NIH RFA)



Surviving Sepsis Guidelines 2016, ICM 2017, 2021: "uncertain fluid goals"

The JAMA Network

From: Will This Hemodynamically Unstable Patient Respond to a Bolus of Intravenous Fluids?

JAMA. 2016;316(12):1298-1309. doi:10.1001/jama.2016.12310

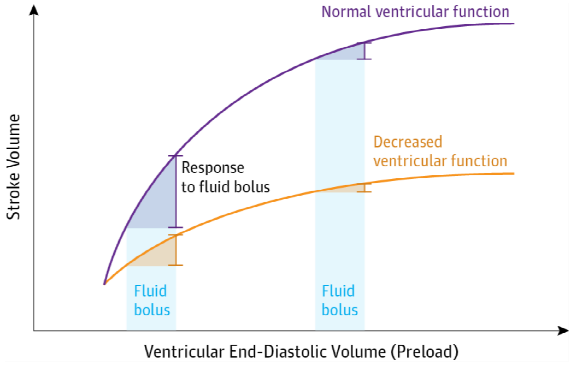


Figure Legend:

Effect of Increase in Preload on Stroke Volume of Ventricles With Normal and Decreased Contractility. Frank-Starling curves illustrate that the effect of a given increase in preload on stroke volume is dependent both on ventricular contractility and on baseline preload.

Methods for Assessing Fluid Responsiveness

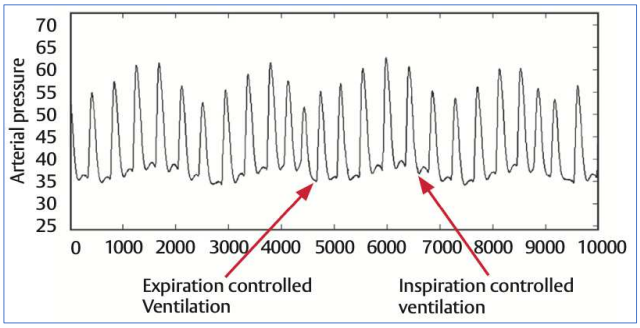
Passive leg raise (PLR) maneuver

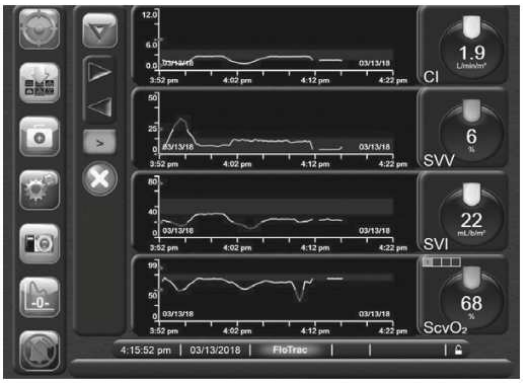
Patients who are preload responsive will:

- Usually show a maximal effect within 120 seconds

Noninvasive measures of volume responsiveness and CO (e.g., Vigileo)?

- Many use pulse pressure variability (from arterial line tracings) to estimate stroke volume variability (SVV) to predict an increase in cardiac output in response to a volume challenge.





Noninvasive measures of volume responsiveness and CO?

- As above, data suggests no optimal metric of volume responsiveness, especially in spontaneously breathing patients and those with rapidly changing pressor requirements (and patients can't be in AF, etc). Would use in conjunction with best bedside judgement.

Fluid Response Evaluation in Sepsis Hypotension and Shock

A Randomized Clinical Trial

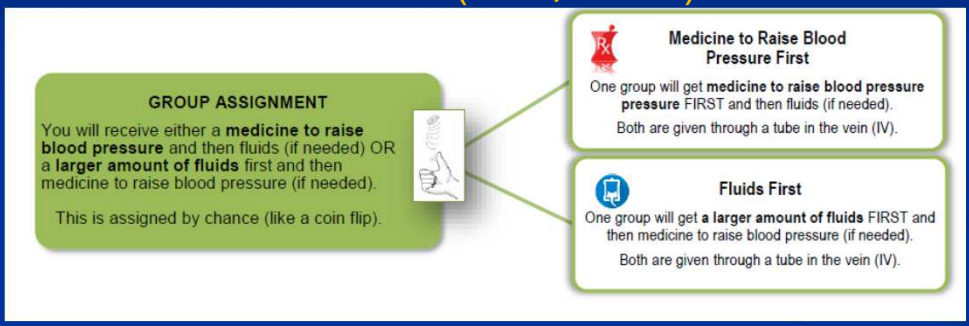
Ivor S. Douglas, MD; Philip M. Alapat, MD; Keith A. Corl, MD; Matthew C. Exline, MD, MPH; Lui G. Forni, PhD; Andre L. Holder, MD; David A. Kaufman, MD; Akram Khan, MD; Mitchell M. Levy, MD; Gregory S. Martin, MD; Jennifer A. Sahatjian, PsyD; Eric Seeley, MD; Wesley H. Self, MD; Jeremy A. Weingarten, MD; Mark Williams, MD; and Douglas M. Hansell, MD

Fluid responsiveness assessed by Passive Leg Raise to guide fluid resuscitation (n=83) vs. Usual Care (n=41). With intervention:

- Lower net positive fluid balance
- Lower risk of renal replacement and mechanical ventilation

Chest 2020

Recently completed: CLOVER trial design (PETAL Network) NEJM (Feb, 2023)



No difference in 90-day mortality with a restrictive vs. a liberal fluid strategy. Similar findings from an Denmark study (NEJM June, 2022).

What 'flavor' of fluid should we be using in sepsis?

NO: Hetastarch

Mostly NO: Albumin

Yes: Crystalloid…moving toward favoring LR over saline

The NEW ENGLAND JOURNAL of MEDICINE

ORIGINAL ARTICLE

Balanced Crystalloids versus Saline in Critically Ill Adults

Matthew W. Semler, M.D., Wesley H. Self, M.D., M.P.H., Jonathan P. Wanderer, M.D., Jesse M. Ehrenfeld, M.D., M.P.H., Li Wang, M.S., Daniel W. Byrne, M.S., Joanna L. Stollings, Pharm.D., Avinash B. Kumar, M.D., Christopher G. Hughes, M.D., Antonio Hernandez, M.D., Oscar D. Guillamondegui, M.D., M.P.H., Addison K. May, M.D., Liza Weavind, M.B., B.Ch., Jonathan D. Casey, M.D., Edward D. Siew, M.D., Andrew D. Shaw, M.B., Gordon R. Bernard, M.D., and Todd W. Rice, M.D., for the SMART Investigators and the Pragmatic Critical Care Research Group*

The NEW ENGLAND JOURNAL of MEDICINE

ORIGINAL ARTICLE

Balanced Crystalloids versus Saline in Noncritically Ill Adults

Wesley H. Self, M.D., M.P.H., Matthew W. Semler, M.D., Jonathan P. Wanderer, M.D., Li Wang, M.S., Daniel W. Byrne, M.S., Sean P. Collins, M.D., Corey M. Slovis, M.D., Christopher J. Lindsell, Ph.D., Jesse M. Ehrenfeld, M.D., M.P.H., Edward D. Siew, M.D., Andrew D. Shaw, M.B., Gordon R. Bernard, M.D., and Todd W. Rice, M.D., for the SALT-ED Investigators*

NEJM March 1, 2018

FLUIDS in SEPSIS BOTTOM LINE:

Bolus crystalloid, but don't overdo it.

Find your favorite way(s) to target resuscitation. Still no clear answers.*

*Monnet et al. Annals of Intensive Care (2022) 12:46

Other issues related to sepsis, including other 2021 guidelines points

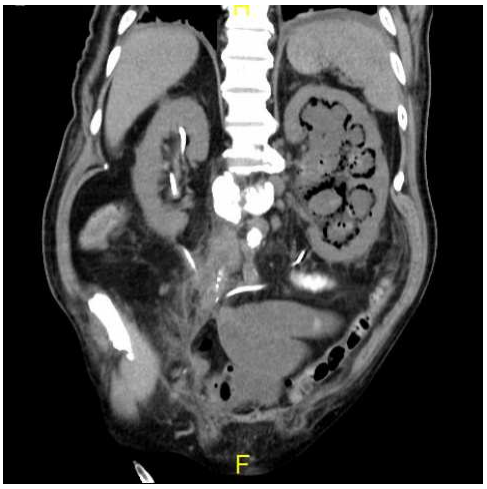
- Optimal antibiotics dosing
- Acknowledges reasonable to dose pressors peripherally while awaiting central access
- Long term follow-up needs in critical illness survivors
- Accumulating data is not supporting a role for Vitamin C in sepsis (NEJM June 2022)

Case 2 continued

- Ongoing hypotension despite adequate fluid resuscitation
- Started on norepinephrine through peripheral IV
- Transferred to ICU for further management

Case 2 continued

- Continued instability led to urgent imaging
- Emphysematous pyelonephritis
- Necrotizing soft tissue infection
- Often underlying DM
- May be associated with obstruction
- Treatment: antibiotics and/or drainage; surgery in severe cases where feasible



Case 2 continued

- Cultures grew E. coli; slowly responded to antibiotics – no obstruction on imaging and poor surgical candidate, regardless.
- Course complicated by AKI requiring HD, delirium
- Hemodynamically stable but still requiring a lot of care:
  - Delirious
  - Extremely weak
  - End of life and goals of care discussions with family have been challenging
- Transfer to floor!

Take Home Messages

- Wide spectrum of illness from floor to ICU and back
- Multiple options exist for O2 delivery and respiratory support
- Early recognition and treatment of sepsis is key
- Judicious fluid resuscitation (avoiding volume overload) is important
- Close communication between floor and ICU is critical for optimal management