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# HYPOTHETICAL CASE STUDY

## Acute Kidney Injury in a Patient with Septic Shock

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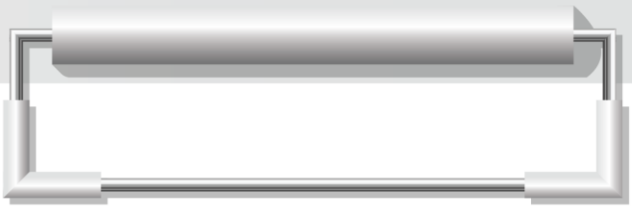
# I INITIAL PRESENTATION



## Patient presenting

- 76 year old female presents to the ED by paramedics after daughter called 911 to report that her mother confused. Not acting like herself over the past few days, not eating and sleeping most of the day.
- BP 75/42, HR 132, RR 33, Temp 101.2 F, Oxygen saturation on room air 87%
- Initial labs: Na 142, K 4.4, Cr 1.25, WBC 17.6, Hgb 12.2, Platelets 74K
- Serum lactate level=5 mmol/L
- CXR clear
- U/A positive LE positive nitrites WBC >100K
- Body weight: 62 kg

## Medical history

- Hypertension x 30 years
- History of multiple urinary tract infections (UTIs) over the past few years but never hospitalized

## Medications

- Norvasc 5 mg PO once daily
- MVI



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# I INITIAL PRESENTATION DISCUSSION

## Patient Presentation and Initial Management

A. This patient presented with septic shock secondary to a urinary tract infection (UTI).

B. Fluids (6 liters in first 24 hours) and vasopressors were administered to maintain adequate perfusion pressures.

## Sepsis is the most common cause of acute kidney injury (AKI) in critically ill patients [1,2]

AKI occurs in 40–50% of sepsis patients and is associated with a 6- to 8-fold increase in mortality [1]

Fluid therapy, combined with the oliguria associated with AKI, are likely to lead to fluid accumulation in septic shock patients [2]

In a US study of more than 5 million patients hospitalized with severe sepsis, the incidence of AKI requiring dialysis was 6%.[3]



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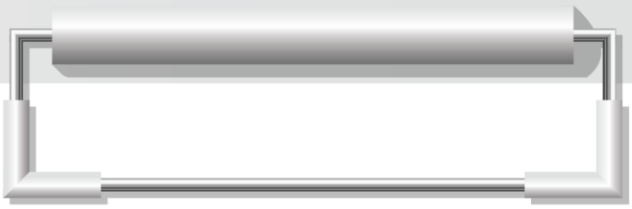
# II ICU DAY 3



## Patient status

Immediately intubated and ventilated

- Fentanyl drip 50 mcg/hr
- PRVC TV 500, RR 14, PEEP 5 cm H20, FIO2 70%

Central line inserted

IVF bolus 30 cc/kg

Blood and urine cultures

Zosyn 3.375 g every 8 hours

## Signs and symptoms

- BP: 94/60 on Norepinephrine to maintain MAP > 65 mm Hg
- HR: 120
- Temperature: 101.2 F
- Body weight: 72 kg

## Test results

- Oxygen saturation: 100%
- SCr: 2.20 mg/dL
- BUN: 60 mg/dL
- Plasma potassium: 5.6 mEq/L
- Urine output: 0 cc over the past 6 hours



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# III ICU DAY 3 DISCUSSION

## The patient meets KDIGO criteria for Stage 3 AKI [12]

| AKI Stage | SCr | Urine output |
|---|---|---|
| 1 | 1.5–1.9 times baseline<br>or ≥0.3 mg/dL (≥26.5 µmol/L) increase | <0.5 mL/kg/hr for<br>6–12 hours |
| 2 | 2.0–2.9 times baseline | <0.5 mL/kg/hr for<br>≥12 hours |
| 3 | 3.0 times baseline<br>or increase in SCr to ≥4.0 mg/dL<br>(≥353.6 µmol/L)<br>or initiation of RRT<br>or in patients <18 years, decrease in<br>eGFR to <35 mL/min per 1.73 $m^2$ | <0.3 mL/kg/hr for<br>≥24 hours<br>or anuria for<br>≥12 hours |

## What factors would influence therapy choice as you address rising SCr levels? (Choose all that apply)

A. Extent of fluid overload
B. Need for hemodynamic stability
C. Available resources in terms of dialysis machines and trained staff
D. Ability to coordinate dialysis with other therapies including antibiotic therapy


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# IV INITIATION OF DIALYSIS DISCUSSION

Septic shock is characterized by profound circulatory disturbances, making hemodynamic management of patients challenging.[4]

Appropriate and adequate antimicrobial therapy is a critical determinant of sepsis outcomes; therefore, it is important to monitor patients' antibiotic levels carefully during RRT.[2]

## What modality of RRT might you use for this patient? Why?

A. CRRT
B. SLED*
C. Intermittent hemodialysis
D. Other

*Includes sustained or slow low-efficiency dialysis, slow extended dialysis, sustained low-efficiency daily dialysis, and sustained low-efficiency daily diafiltration



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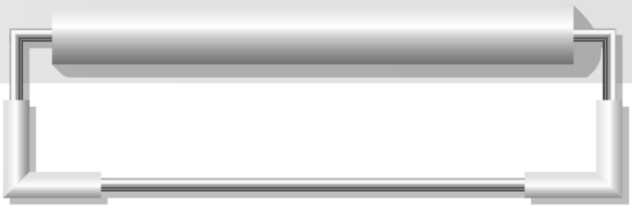
# IV INITIATION OF CRRT



## Prescription

- Body weight: 72 kg
- Dose: 35 ml/kg/hr*
- Filter:
- BFR: 180 ml/hr
- PBP: N/A
- Dialysate: PrimaSate CRRT Solution BGK4/2.5(5000 ml)
- Replacement: no replacement
- Net fluid removal: 50 cc/hour
- Anticoagulation: heparin 200 units/hour

*Dose selected in accordance with KDIGO guidelines

## Clinical Rationale for choice

- The patient was in acute renal failure, fluid overloaded and on vasopressors. Gentle fluid removal was indicated in consideration of the fragile hemodynamic picture.

## Clinical considerations

- Guideline recommendations for patients with fluid overload
- Need for hemodynamic stability



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# IV INITIATION OF CRRT DISCUSSION

## CRRT is associated with improved hemodynamic stability and more controlled fluid removal compared with intermittent RRT [6]

While intermittent RRT may cause considerable fluctuations in fluid balance, CRRT is noted for its slow and steady removal of fluid and solutes [5,6]

CRRT offers better hemodynamic tolerance and control of fluid volume in high-acuity patients with hemodynamic instability and considerable fluid accumulation [6]

## Current clinical practice guidelines recommend the use of continuous RRT in AKI patients who are hemodynamically unstable [5,7-9]

| | |
|---|---|
| SSC [7] | We suggest using CRRT to facilitate management of fluid balance in hemodynamically unstable septic patients. |
| KDIGO [8] | We suggest using CRRT, rather than standard intermittent RRT, for hemodynamically unstable patients. |
| ADQI [5,9] | We recommend the use of continuous therapies in patients with hemodynamic instability and in situations in which shifts in fluid balance are poorly tolerated. |



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# IV INITIATION OF CRRT DISCUSSION

## Selection of RRT modality requires careful consideration of patient-specific and logistical factors[5,8]

Continuous vs intermittent therapies provide different fluid flow rates and have different treatment duration limits [8,10-12]

AKI is associated with an increased risk of long-term dialysis dependence;[13] compared with IHD, use of CRRT for AKI management has been associated with lower risk of this complication [14]

While CRRT solutions are typically commercially prepared,[15] water treatment and quality testing may contribute to increased monitoring when using solutions prepared on-line for intermittent therapies [16,17]

Water treatment equipment may add to the footprint of intermittent therapy systems, potentially decreasing treatment mobility and impacting spacing considerations [18-21]

## What dialysis options are available to your septic shock patients?



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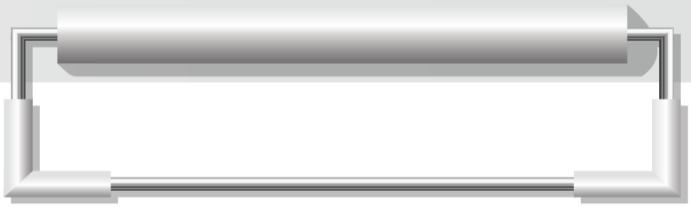
# V ICU DISCHARGE



| | Day 0 | Day 1 | Day 3 | Day 8 | Day 13 |
|---|---|---|---|---|---|
| | Presentation | ICU arrival | CRRT started | CRRT completed | ICU discharge |
| SCr (mg/dL) | 1.25 | 1.50 | 2.20 | 1.02 | 0.98 |
| BUN (mg/dL) | 35 | 40 | 60 | 28 | 22 |
| K+ (mEq/L) | 4.4 | 5.1 | 5.6 | 4.1 | 4.0 |
| Urine output (mL/hr) | 30 | 10 | 0 | 40 | 60 |
| Body weight (kg) | 62 | 68 | 72 | 64 | 62 |
| BP (mmHg) | 75/41 | 96/62 | 94/60 | 110/72 | 130/76 |



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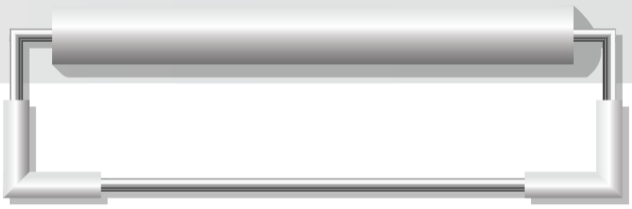

## Patient status

The patient developed septic shock from UTI. The patient required ventilatory support and CRRT as multiorgan failure was developing. The patient was successfully extubated on Day 6 and CRRT discontinued on Day 8.

## Signs and symptoms

- BP: 130/76 HR: 72
- Body temperature: 98.8 F
- Body weight: 62

## Test results

- Oxygen saturation: 100% RA
- SCr: 0.98, BUN: 22
- Plasma potassium: 4.0
- Urine output: 60 cc/hr

## Discharge

The patient was discharged from the ICU to the medical floor. After 2 days, the patient was placed in a skilled nursing facility. Follow up with PMD 2 weeks later demonstrated she had returned to her baseline.



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# V SUMMARY

## Managing AKI in Septic Shock

### RISK

Excess fluid volume is associated with increased mortality in patients with sepsis and other critical illnesses.[22,23]

### HEMODYNAMIC STABILITY

Restoration of fluid balance with minimal hemodynamic disruption is a key goal of RRT in septic shock patients.[7]

### OPTIMIZING THERAPY

- While the selection of RRT modality requires careful consideration of numerous patient-specific and logistical factors, **CRRT is a preferred RRT** by many clinicians for AKI patients who are hemodynamically unstable [5-9]
  - RRT clinical guidelines recommend CRRT over intermittent RRT in hemodynamically unstable patients.[5,8,9]
  - The 2016 International Guidelines for Management of Sepsis and Septic Shock recommend CRRT for managing fluid balance in septic patients who are hemodynamically unstable.[7]



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# ACRONYMS/ABBREVIATIONS/REFERENCES

**ADQI**, Acute Dialysis Quality Initiative; **AKI**, acute kidney injury; **BFR**, blood flow rate; **BP**, blood pressure; **BUN**, blood urea nitrogen; **CRRT**, continuous renal replacement therapy; **CXR**, chest x-ray; **HR**, heart rate, **ICU**, intensive care unit; **IHD**, intermittent hemodialysis; **K**, serum potassium level, **KDIGO**, Kidney Disease: Improving Global Outcomes; **LE**, leukocyte esterase test; **Na**, serum sodium level; **MAP**, mean arterial pressure; **MVI**, multivitamin; **RR**, respiration rate; **RRT**, renal replacement therapy; **SCr**, serum creatinine; **SLED**, sustained low-efficiency dialysis; includes sustained or slow low-efficiency dialysis, slow extended dialysis, sustained low-efficiency daily dialysis, and sustained low-efficiency daily diafiltration; **U/A**, urinalysis; **UF**, ultrafiltration; **UTI**, urinary tract infection; **WBC**, white blood cell count


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