Renal Emergencies and the Art of Kidney Recovery

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Content

- Case Scenario-1-4
- Etiologies of Acute Kidney Injury Risk Factors for Acute Kidney Injury
- Investigation- Minimum AKI Panel, In ICU
- Treatment Standard for Sepsis in AKI
- Clinical Settings
- Renal Recovery after kidney injury
- Take Home Message

Clinical Scenario-01

- A 61-year-old female, known case of T2DM, HTN was admitted CMCH with a H/O impaired consciousness for 2 days. On enquiry, her attendant gave the history of the frequency of micturition, fever and vomiting for the last 3 days. On admission-, was dehydrated, temperature 100 F, pulse was feeble and. BP: 80/60 mm Hg, GCS: 7(E2V2M3),

Clinical Scenario-01 Cont....

CBC: WBC 30,000 with 95% neutrophil. Urine R/E: plenty of pus cell, RBC 30-40/ HPF. Urine C/S: growth of E. coll. Serum creatinine 3.5 mg/dl, Urine S.Bilirubin 3.0 mg/dl, ALT: 139, S. electrolyte (Na -120, K-5, Cl-/82, HCO_3^-

12)She was diagnosed with AKI due to urosepsis and MOF with T2DM, HTN with Hyponatremia.

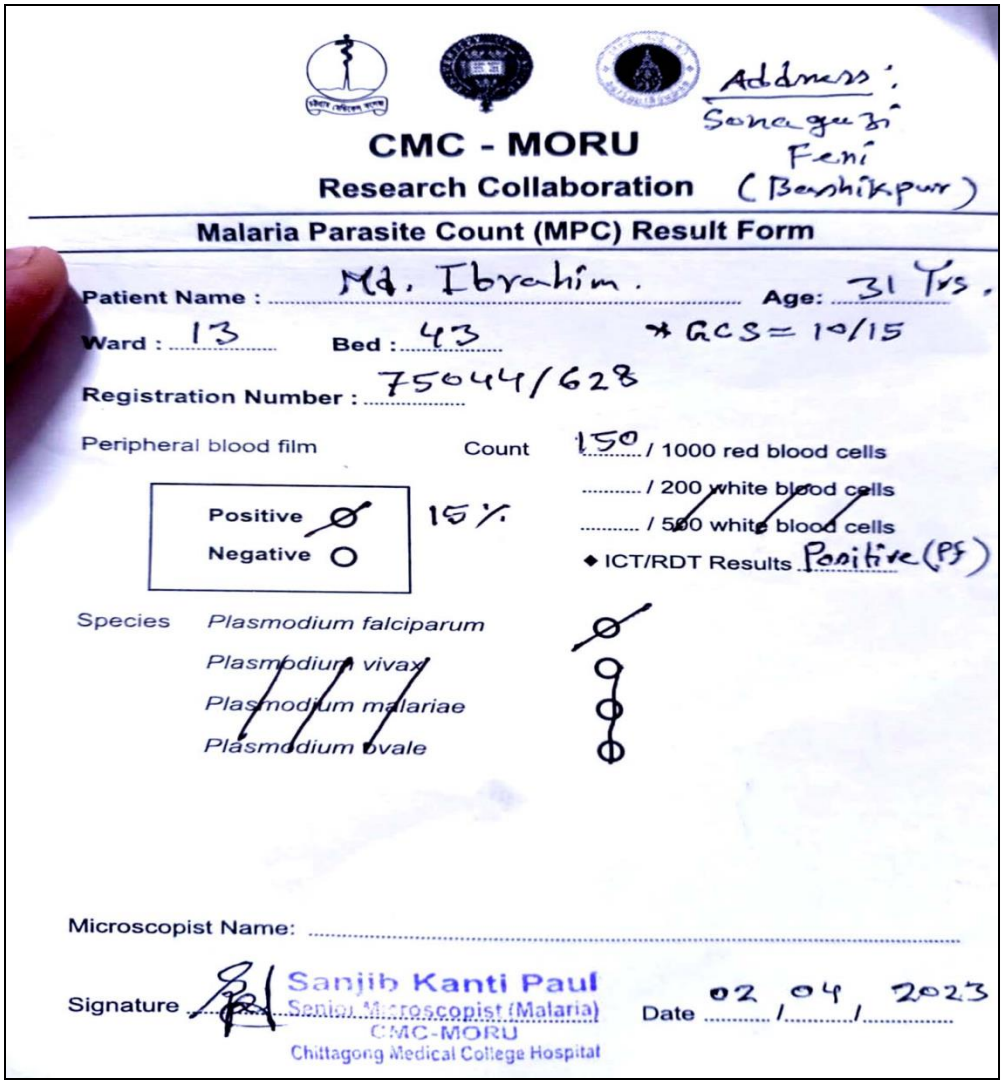
Clinical Scenario-1 Cont….

- She was treated with fluid bolus with normal saline, Initially, and Inj. Ceftriaxone 2gm BD (Switched to Meropenem according to C/S report). S. creatinine mg/dl and urine output established.Her consciousness was improved, and LFT and RFT were normal after 7 days.She was discharged from the hospital on the 8th day.

Clinical Scenario-02

1st April 2023, Mr. X 31-year-old service holder (Manager LG) of Sonagazi, Feni, (working in Congo, Africa), admitted in CMCH with H/O Fever for 15days, initially he consulted a local Physician and was given some antibiotic, later referred to district hospital with reduce conscious level and scanty micturition. He was then referred to CMCH where he was diagnosed as severe malaria with jaundice and severe anemia renal involvement. He was treated with injection artisunate, blood transfusion was given and got 3 session hemodialysis. He was recovered with renal impairment.

Clinical Scenario-02 Cont....



CMC - MORU
Research Collaboration

Address: Sonagazi Feni (Basbikpur)

Malaria Parasite Count (MPC) Result Form

Patient Name : Md. Ibrahim. Age: 31 Yrs.

Ward : 13 Bed : 43 * GCS = 10/15

Registration Number : 75044/628

Peripheral blood film Count 150 / 1000 red blood cells

..... / 200 white blood cells

..... / 500 white blood cells

Positive ✓ 15%

Negative ○

◆ ICT/RDT Results Positive (Pf)

Species *Plasmodium falciparum* ✓

Plasmodium vivax ○

Plasmodium malariae ○

Plasmodium ovale ○

Microscopist Name: .....

Signature ..... Sanjib Kanti Paul
Senior Microscopist (Malaria)
CMC-MORU
Chittagong Medical College Hospital

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Acute Kidney Injury Followed by Paraquat Poisoning with Relative Absence of Pulmonary and Renal Complaints: Story of a Survivor

Mrinal Saha* Merina Arjumand, M A Sattar, Sujat Paul.

ACUTE KIDNEY INJURY FOLLOWED BY PARAQUAT POISONING WITH RELATIVE ABSENCE OF PULMONARY AND RENAL COMPLAINTS : STORY OF A SURVIVOR

Mrinal Saha[1*] Merina Arjumand[2] M A Sattar[3] Sujat Paul[4]

Abstract

A 16 years old girl admitted in the hospital after paraquat ingestion. She had oral ulceration and difficulty in swallowing. All her vital signs were normal including clear both lung fields. After few days, her tongue found coatedwith whitish debris. Her chest X-ray was normal but creatinine was 7.45 mg/dL despite normal urine output. After 2 cycle ofhemo dialysis her creatinine became normal. She had 2 unit of blood transfusion.After 3 weeks of hospital treatments she wasdischarged from hospital with all normal routine investigations including High Resolution Computed Tomography (HRCT) of both lungs. After one month of home stay she was alright on her last follow up.

Key words

Paraquat poisoning; AKI; Lung fibrosis; Survival.

Introduction

Paraquat is classified as bipyridylcompounds[1]. Paraquat's herbicidal effects were discovered in the late 1950s and the product was first sold in 1962. It is world's second largest selling weed killer and is registered approximately 85 countries[2]. It is a fast-acting contact herbicide which is effective shortly after application and is rapidly deactivated on contact with soil, having no residual effects in the soil[1,2]. It's normal use causes no adverse effects on wildlife or the environment. It is highly toxic if ingested even in a small amount[1,2,3].

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Case Report

A previously healthy 16 years old girl was admitted to Medicine Ward, Chittagong Medical College Hospital through emergency department on 08.09.2017 after a day of ingestion of unknown quantity of a liquid poison. Following ingestion she had burning sensation on her throat with vomiting for 2 times. After 3-4 hours of sleep when she woke up she had burning in her throat with difficulty in swallowing. For this she could not take her food properly. Then she had some anti-ulcerent medications from local pharmacists but condition was static. Her situation was progressively deteriorating. The next day she got admitted to medicine ward with the complaints of burning throat, nausea, vomiting with oral ulceration. During thisperiod she did not complaints about respiratory distress, convulsion or any altered mental state. Her urine output was normal. After admission she had vomiting for 2-3 times, contents were mainly watery and not blood mixed. She had mild dry cough. During Examination she was fully consciousand co-operative. She had red ulcers on her oral cavity and lips. She was not anemic, non-icteric, and not cyanosed. Her nails and hands had no poisonous stain during examination. Her pulse was 98/min, BP -110/70 mm of Hg, RR - 20/ min, Temp-99° F with SPO_2-97% without O_2.

Fig 1 : Paraquat tongue as seen on the third day of ingestion

On query, her mother states that out of anger she took this poison in an attempt to commit suicide. She could not mention the name of the poison but

Clinical Scenario-03

- A 16-year-old girl admitted in the CMCH after Paraquat Ingestion. She Developed oral ulceration and difficulty in swallowing. All her vital signs were normal including clear both lung fields.
- Her chest X-ray was normal but creatinine was 7.45 mg/dl despite normal urine output. After 2 cycle of hemodialysis her creatinine became normal. She had 2 unit of blood transfusion.
- After 3 weeks of hospital treatments she was discharged from hospital with all normal routine investigations including HRCT of both lungs.
- After one month she was found alright on her last follow up.

Clinical Scenario-04 (Cont..)

- A 42-yr old man got admitted in the hospital with history of snake bite in the left foot while he was working in the paddy field. After bite, he felt pain and blood was oozing from the bite site. And the left leg became swollen. He also noticed that his urine volume has been reduced. 20MWBCT was positive on bed side.

Russel Viper

Clinical Scenario-04 (Cont..)

- In investigation, high TC count, low platelet, albumin and RBC was present in urine RE, **creatinine – 2mg/dl**, PT, APTT & CPK was high. This patient was taken one dose (ten vials) of polyvalent anti-venom in infusion. Later on, dialysis was done due to his AKI.

Etiologies of Acute Kidney Injury

Etiology	Examples
▪ Prerenal Increased intra-abdominal pressure	Abdominal compartment syndrome
Intravascular volume depletion	Hemorrhage, GI losses, renal losses, skin and mucous membrane losses, nephrotic syndrome, cirrhosis, capillary leak
Peripheral vasodilation	Sepsis, cirrhosis, anaphylaxis, pharmacologic adverse effects

Etiologies of Acute Kidney Injury (Cont.)

Etiology	Examples
▪ Intrinsic renal Glomerular injury	Pharmacologic adverse effects Hematologic disorders: hemolytic uremic syndrome, thrombotic thrombocytopenic purpura Inflammation: anti–glomerular basement membrane disease, antineutrophil cytoplasmic antibody disease, infection, cryoglobulinemia, membranoproliferative glomerulonephritis, immunoglobulin A nephropathy, systemic lupus erythematosus, Henoch-Schönlein purpura, polyarteritis nodosa

Etiologies of Acute Kidney Injury (Cont.)

Etiology	Examples
Renal Microvasculature	Malignant hypertension, toxemia of pregnancy, hypercalcemia, radiocontrast media, scleroderma, pharmacologic adverse effects
Tubular injury	Endogenous toxins: myoglobin, hemoglobin, paraproteinemia, uric acid Exogenous toxins: antibiotics, chemotherapy agents, radiocontrast media, phosphate preparations Ischemia due to hypoperfusion.

Etiologies of Acute Kidney Injury (Cont.)

Etiology	Examples
Tubulointerstitial injury	Acute allergic interstitial nephritis Infections: Legionella, Leptospira, Rickettsia, Hantavirus, Candida, Plasmodium, tuberculosis Infiltration
Vascular causes such as renal artery thrombosis; embolism; stenosis; and operative renal arterial clamping.	Arterial thrombosis, vasculitis, dissection, thromboembolism, venous thrombosis, compression, trauma.

Etiologies of Acute Kidney Injury (Cont.)

Etiology	Examples
Reduced cardiac output	Cardiogenic shock, pericardial diseases, congestive heart failure, valvular diseases, pulmonary diseases, sepsis
Renal vasoconstriction	Early sepsis, hepatorenal syndrome, acute hypercalcemia, pharmacologic adverse effects, iodinated contrast media

Etiologies of Acute Kidney Injury (Cont.)

Etiology	Examples
▪ Postrenal Lower urinary tract causes	Bladder: neck obstruction, calculi, carcinoma, infection (schistosomiasis) Functional: neurogenic bladder, diabetes, multiple sclerosis, stroke, pharmacologic adverse effects (anticholinergics, antidepressants) Prostate: benign prostatic hypertrophy, carcinoma, infection Urethral: posterior urethral valves, strictures, trauma, infections, tuberculosis
Upper urinary tract extrinsic causes	Retroperitoneal space tumors, pelvic or intra-abdominal tumors, retroperitoneal fibrosis, ureteral ligation or surgical trauma, granulomatous disease, hematoma
Upper urinary tract intrinsic causes	Nephrolithiasis, strictures, edema, debris, blood clots, sloughed papillae, fungal ball, malignancy

Risk Factors for Acute Kidney Injury

No modifiable AIDS	Modifiable
▪ Chronic kidney disease ▪ Chronic liver disease ▪ Congestive heart failure ▪ Diabetes mellitus ▪ Older age (65 years or older) ▪ Peripheral vascular disease ▪ Prior kidney surgery ▪ Renal artery stenosis	▪ Anemia ▪ Hypercholesterolemia ▪ Hypertension ▪ Hypoalbuminemia ▪ Hyponatremia ▪ Mechanical ventilation ▪ Nephrotoxic drug use ▪ Rhabdomyolysis ▪ Sepsis

Macedo E, Mehta RL. Clinical approach to the diagnosis of acute kidney injury. In: Gilbert SJ, Weiner DE, eds. *Primer on Kidney Diseases*. 7th ed. National Kidney Foundation; 2018:300-310.

Investigation

Minimum AKI Panel	In ICU
▪ Urine dipstick ▪ FBC, S. Creatinine, Urinary Creatinine Excretion (UCE), Ca^{2+}, Phosphate, Albumin, LFT, CK, and CRP ▪ Venous $HCO_3 - Or\ ABG$	▪ Monitor CVP, PCWP ▪ Oxygen Saturation & ABG ▪ Bed Side Echo / USG.

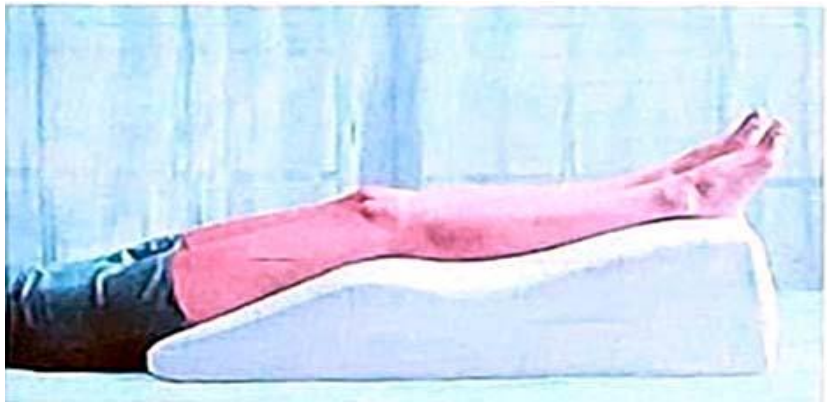
Special Investigation (Cont.)

Test For Hemodynamic Monitoring

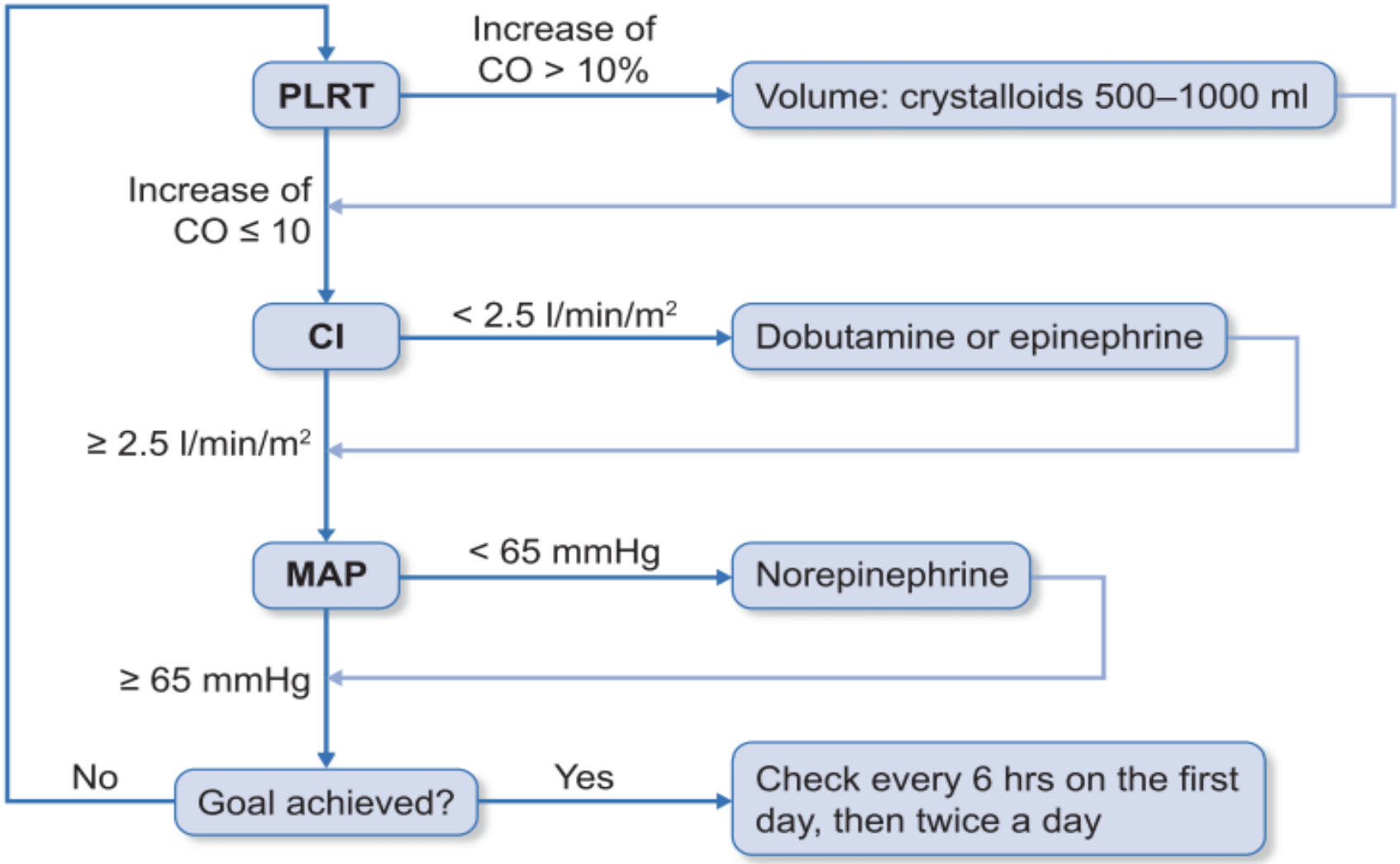
1. Static testing for fluid responsiveness
- CVP- False High in PH, RV Dysfunction, high PEEP
- PAoP- (PA occlusion pressure)- falsely high in ARDS
- LVEAD (Left ventricular end diastolic area diameter.

Note: Sepsis Recommendation 2021
For Adults with sepsis or septic shock, using Dynamic measures to guide fluid resuscitation, over physical examination or static parameters alone is recommended.

Dynamic Testing For Fluid Responsiveness (Cont.)



- Passive leg Raising (Head-of-bed Elevation at 45°) Both leg Raise to 45°)
- Improvement in hemodynamic parameters like Cardiac output, pulse pressure/ Stroke volume, MAP, PAoP suggests fluid responsiveness.



Performance of the passive leg raising test (PLRT).

TREATMENT STANDARD

OXFORD ERA ndt

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Sepsis-associated acute kidney injury—treatment standard

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ABSTRACT

Sepsis is a host's deleterious response to infection, which could lead to life-threatening organ dysfunction. Sepsis-associated acute kidney injury (SA-AKI) is the most frequent organ dysfunction and is associated with increased morbidity and mortality. Sepsis contributes to ≈50% of all AKI in critically ill adult patients. A growing body of evidence has unveiled key aspects of the clinical risk factors, pathobiology, response to treatment and elements of renal recovery that have advanced our ability to detect, prevent and treat SA-AKI. Despite these advancements, SA-AKI remains a critical clinical condition and a major health burden, and further studies are needed to diminish the short and long-term consequences of SA-AKI. We review the current treatment standards and discuss novel developments in the pathophysiology, diagnosis, outcome prediction and management of SA-AKI.

Keywords: acute kidney injury, biomarker, renal replacement therapy, sepsis

IN A NUTSHELL

1. The pathophysiology of sepsis-associated acute kidney injury (SA-AKI) is complex and incompletely understood.
2. Biomarkers can identify patients at high risk for AKI and predict short- and long-term adverse outcomes.
3. Implementing supportive measures (e.g. haemodynamic optimization and avoidance/minimizing nephrotoxins) in septic patients at high risk for AKI might prevent AKI development, but no specific therapies are available to treat sepsis-associated AKI.
4. Renal replacement therapy (RRT) should be initiated in patients with sepsis who develop medically refractory complications or persistent AKI, however, a strategy or early pre-emptive RRT is not associated with improved outcomes.
5. Preliminary data have suggested that selective subphenotypes of SA-AKI may have a better response to specific vasoactive drugs (e.g. arginine vasopressin, angiopoietin-2), however, further confirmatory data are needed.

INTRODUCTION

Sepsis is characterized by organ dysfunction as a consequence of a dysregulated response to infection. Septic shock is characterized by persistent hypotension despite adequate fluid resuscitation, the need for vasoactive drugs to maintain a mean arterial pressure (MAP) of at least 65 mmHg and a plasma lactate concentration >2 mmol/L [1].

Up to 60% of patients with sepsis develop acute kidney injury (AKI) [2]. Although the pathophysiology underlying sepsis-associated AKI (SA-AKI) remains incompletely understood, multiple mechanisms, including inflammation, complement activation, mitochondrial dysfunction and microcirculatory dysfunction, are thought to contribute to AKI development [3]. The development of AKI carries a significantly increased mortality risk compared w sepsis alone [4].

Here we discuss the most recent evidence supporting our current understanding of the pathophysiology and outcome prediction in patients with SA-AKI. Furthermore, based on the recent recommendations of the Acute Disease Quality Initiative (ADQI) group [5], we have developed a pragmatic diagnostic and treatment algorithm for SA-AKI in adults.

TREATMENT STANDARDS

From diagnosis to treatment of SA-AKI

Where sepsis is suspected, lactate should be measured, and if elevated (>2 mmol/L), measurement should be repeated, with resuscitation guided by lactate levels. Once sepsis is diagnosed, the patient should be treated according to current sepsis guidelines [1], and before administering antibiotics, blood cultures should be

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- **Sepsis-associated acute kidney injury-treatment standard.**

Implementing supportive measures (e.g. haemodynamic optimization and avoidance/minimizing nephrotoxins) in septic patients at high risk for AKI might prevent AKI development.

but no specific therapies are available to treat sepsis-associated AKI.

TREATMENT STANDARDS
From diagnosis to treatment of SA-AKI

- sepsis is suspected, lactate if elevated (>2 mmol/L), measurement repeated, with resuscitation guided by lactate levels.

- Once sepsis is diagnosed, Tx according to current sepsis guidelines, and before antibiotics, blood cultures should be obtained.

- In the sepsis-induced hypoperfusion (lactate levels ≥2 mmol/L) or septic shock.

TREATMENT STANDARDS
From diagnosis to treatment of SA-AKI (Cont.)

- crystalloid fluid administration should be initiated (dynamic parameters of fluid responsiveness), along with vasopressors to keep the MAP >65 mmHg and decrease serum lactate levels.
- The recommended first-line vasopressor in septic patients is norepinephrine, (as dopamine should not be used in this patient group!)

TREATMENT STANDARDS
From diagnosis to treatment of SA-AKI (Cont.)

- Early fluid administration is important to potentially rescue the macro- and microcirculation in sepsis.

- The guidelines recommend an initial 30 ml/kg of crystalloids without adjusting this volume to the current fluid status of the patient.

- As volume overload is associated with a worse outcome [6], fluid administration should be individualized and guided by fluid responsiveness.

Clinical Settings

- AKI occurs in about one in every five adults during the hospital stay.
- The incidence in critical care is even more alarming,
- More than half of the patients admitted to an ICU develop AKI of varying severity.

Hoste EA, Bagshaw SM, Bellomo R, Cely CM, Colman R, Cruz DN,et al. Epidemiology of acute kidney injury in critically ill patients: The multinational AKI-EPI study. *Intensive Care Med 2015;41:1411-23*.

Clinical Settings (Cont.)

- AKI is a multifactorial condition with many potential risk factors,
- While the causes of AKI are usually categorized as prerenal (including hypovolemia and obstruction of blood flow),
- Postrenal (obstruction of urinary flow) and
- Renal (including nephrotoxins, infection, and inflammation)

Hertzberg D, Rydén L, Pickering JW, Sartipy U, Holzmann MJ. Acute Kidney Injury-an Overview of Diagnostic Methods and Clinical Management. Clin Kidney J (2017) 10(3):323–31. doi: 10.1093/ckj/sfx003

Renal Recovery after kidney injury

- The Acute Disease Quality Initiative (ADQI) suggests differentiating AKI (first 7 days) from acute kidney disease (AKD, AKI persisting for 7–90 days) and CKD (after 90 days), a framework for defining recovery in terms of time after the sentinel event.

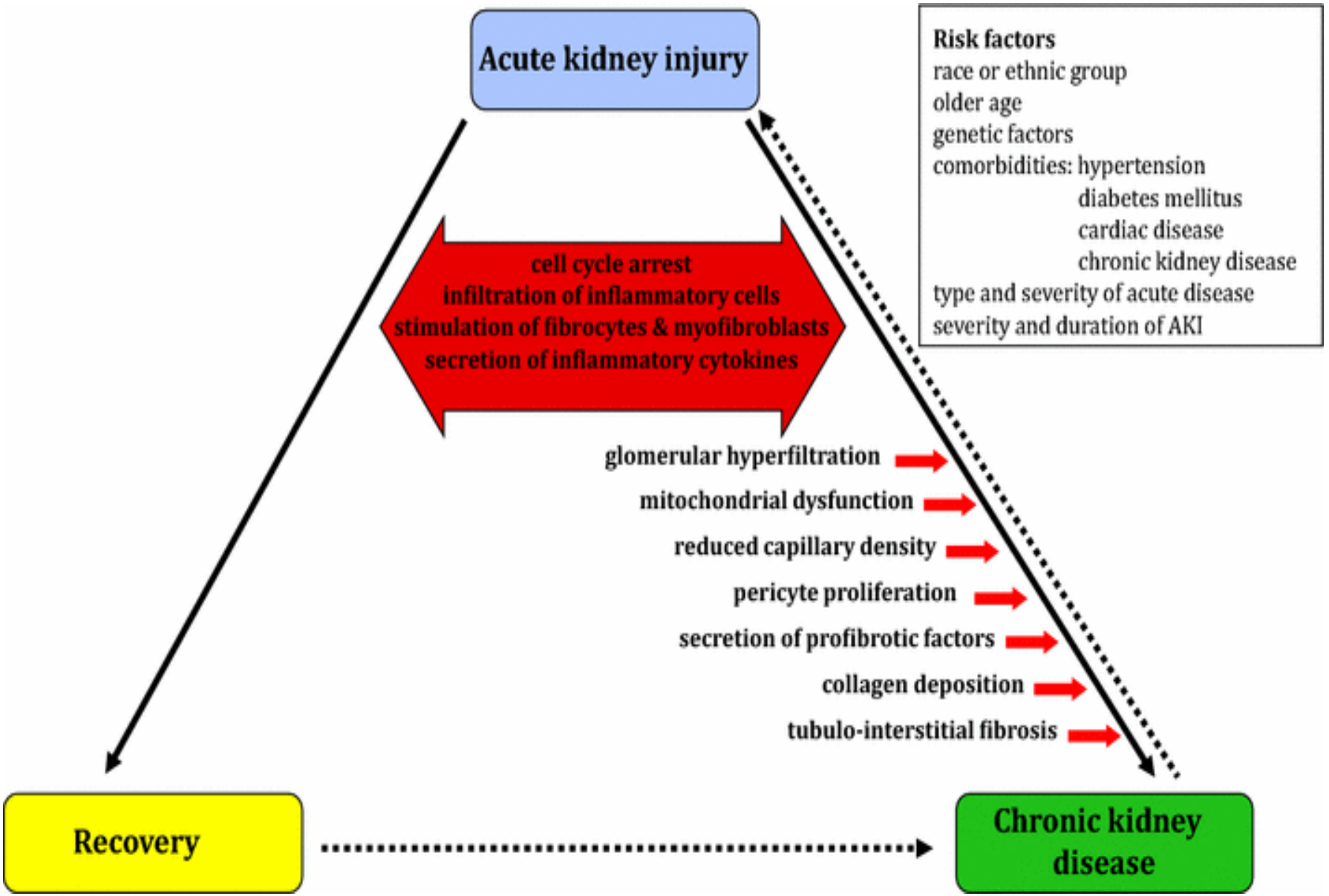
Biomarkers for (non) recovery

Biomarkers can be classified as

- Inflammatory biomarkers [e.g. neutrophil gelatinase-associated lipocalin (NGAL), interleukin (IL)-6 and IL-18]
- Cell injury biomarkers [e.g. kidney injury molecule-1 (KIM-1) and liver fatty acid binding protein (L-FABP)] and
- Markers of cell cycle arrest [e.g. insulin growth factor binding protein 7 (IGFBP7) and
- tissue inhibitor of metalloproteinase 2 (TIMP-2)

Forni, L.G., Darmon, M., Ostermann, M. *et al.* Renal recovery after acute kidney injury. *Intensive Care Med* **43**, 855–866 (2017). https://doi.org/10.1007/s00134-017-4809-

Renal Recovery after kidney injury



Take Home Message

- Renal Emergencies are common in Medical Wards and also in acute care settings
- Physicians must have skill to Identify and manage those
- Timely Basic medical care improves patients outcome
- Patient Should be followed up to assess functional kidney recovery


THANK YOU
Do you have Any Question?