Καρδιοχειρουργικές επεμβάσεις και οξεία νεφρική βλάβη

Ιωάννης Γ. Γριβέας, MD,PhD

athens-NEPHROLOGY

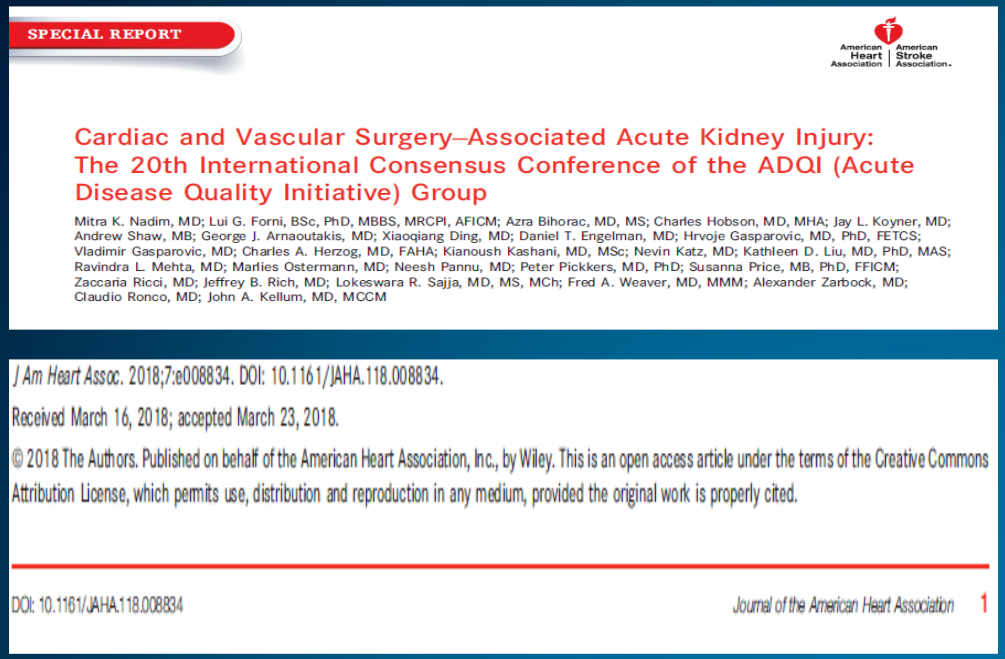
Incidence of AKI

- Estimates depend entirely on definition, population being studied
  - 5 to 7% of hospital admissions (0.5, 1.0, or 1.5 mg/dL increase in SCr depending on baseline)
  - 1% of admissions from community-acquired AKI
  - Following CABG:
    - 15% of patients have a ≥ 25% increase in SCr
    - 1-2% require renal replacement therapy
  - Sepsis:
    - Doubling of SCr in 9% with SIRS, 51% with shock


HEART
KIDNEY

Risk factors for AKI

- Best studied in cardiac catheterization and CABG
- Cardiac catheterization:
  - Age, higher SCr, CHF, diabetes
  - contrast volume, intra-aortic balloon pump
- CABG:
  - Age, higher SCr, CHF, diabetes, concomitant valve surgery
  - urgency of operation, bypass time



SPECIAL REPORT

American Heart Association | American Stroke Association

Cardiac and Vascular Surgery–Associated Acute Kidney Injury: The 20th International Consensus Conference of the ADQI (Acute Disease Quality Initiative) Group

Mitra K. Nadim, MD; Lui G. Forni, BSc, PhD, MBBS, MRCPI, AFICM; Azra Bihorac, MD, MS; Charles Hobson, MD, MHA; Jay L. Koyner, MD; Andrew Shaw, MB; George J. Arnaoutakis, MD; Xiaoqiang Ding, MD; Daniel T. Engelman, MD; Hrvoje Gasparovic, MD, PhD, FETCS; Vladimir Gasparovic, MD; Charles A. Herzog, MD, FAHA; Kianoush Kashani, MD, MSc; Nevin Katz, MD; Kathleen D. Liu, MD, PhD, MAS; Ravindra L. Mehta, MD; Marlies Ostermann, MD; Neesh Pannu, MD; Peter Pickkers, MD, PhD; Susanna Price, MB, PhD, FFICM; Zaccaria Ricci, MD; Jeffrey B. Rich, MD; Lokeswara R. Sajja, MD, MS, MCh; Fred A. Weaver, MD, MMM; Alexander Zarbock, MD; Claudio Ronco, MD; John A. Kellum, MD, MCCM

J Am Heart Assoc. 2018;7:e008834. DOI: 10.1161/JAHA.118.008834.

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Millions of patients undergo cardiac and vascular surgery (CVS) every year in developed countries alone.

Acute Kidney Injury (AKI) is a common perioperative complication occurring in 20% to 70% of cases depending on the type of surgery and the
definition of AKI used.

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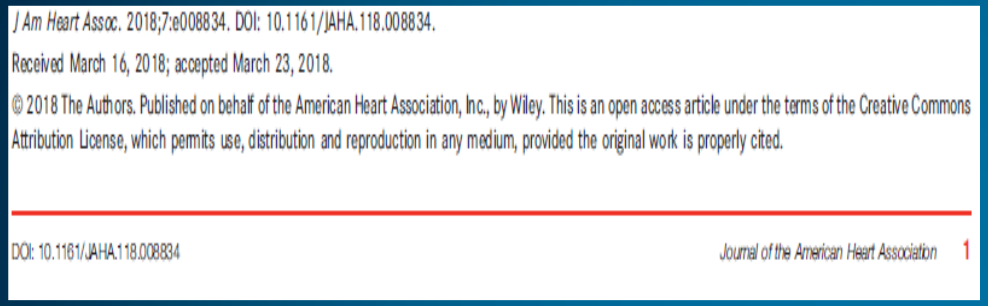

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More and more of these patients who receive complex CVS are elderly with multiple comorbidities, which predispose to the development of AKI and potentially hasten progression to ESRD.

Mortality rates among cardiovascular patients undergoing RRT are between 40% and 70%, and mortality is associated with both the severity of the initial insult and the number of episodes of AKI occurring during the hospital admission.

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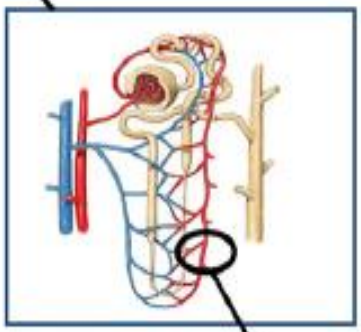
Effect of CPB Circuit
Low Cardiac Output
Blood Pressure
Venous Pressure
Preload/Volume
Anemia/Hemolysis
Ischemia/Reperfusion

Hemodynamic Pertubations

Emboli
Arterial Obstruction
Venous Congestion
Perfusion Pressure
Abdominal Hypertension

Mechanical Factors

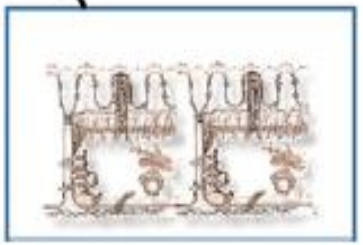


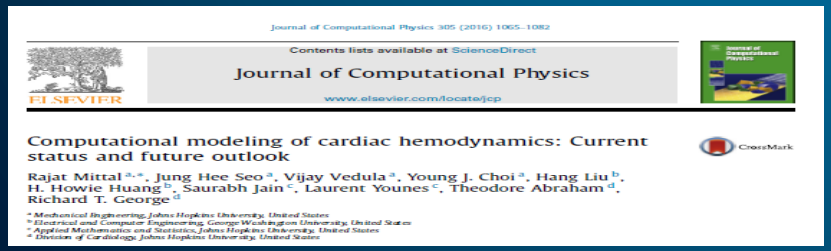
Other Mechanisms

Neurohormonal
Vasoconstriction
Venous Congestion
Tubular Toxicity

Inflammation/Immunity

Inflammation
Oxidant Stress
Complement Activation
Toxins / Drugs
Contrast Media





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Computational modeling of cardiac hemodynamics: Current status and future outlook

Rajat Mittal [a,*], Jung Hee Seo [a], Vijay Vedula [a], Young J. Choi [a], Hang Liu [b], H. Howie Huang [b], Saurabh Jain [c], Laurent Younes [c], Theodore Abraham [d], Richard T. George [d]

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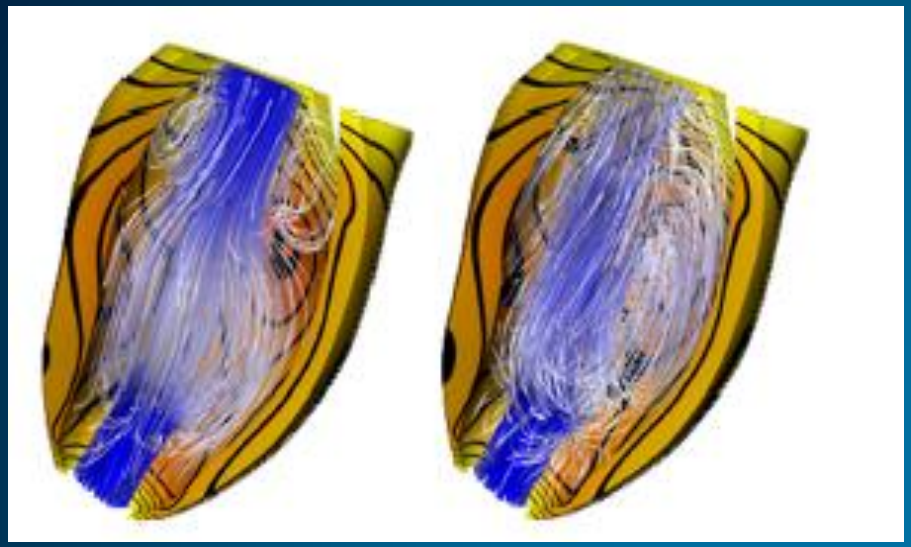
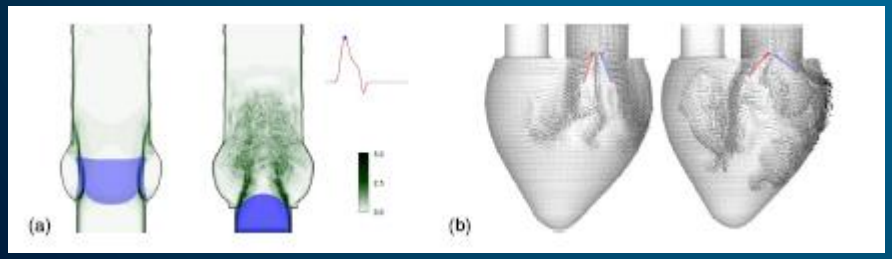
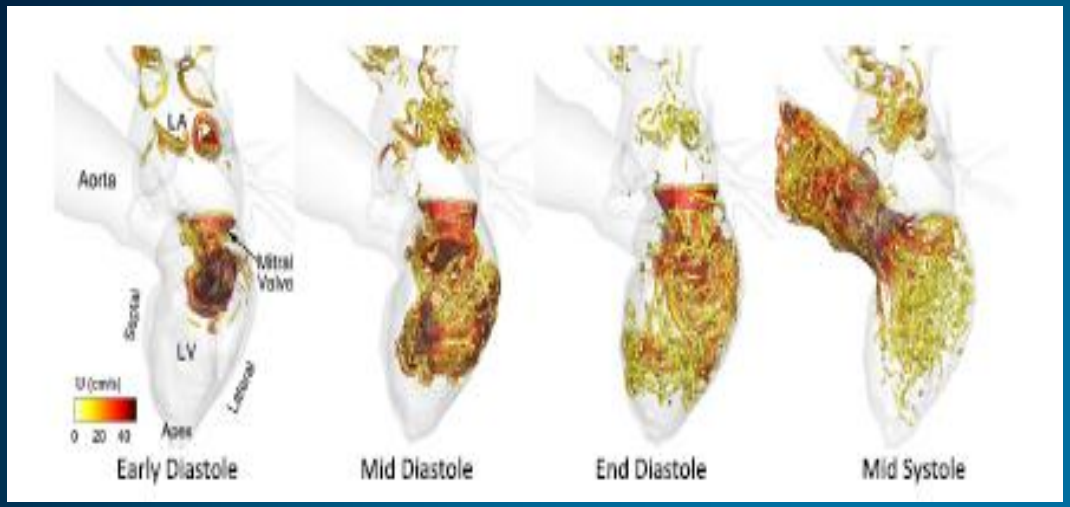
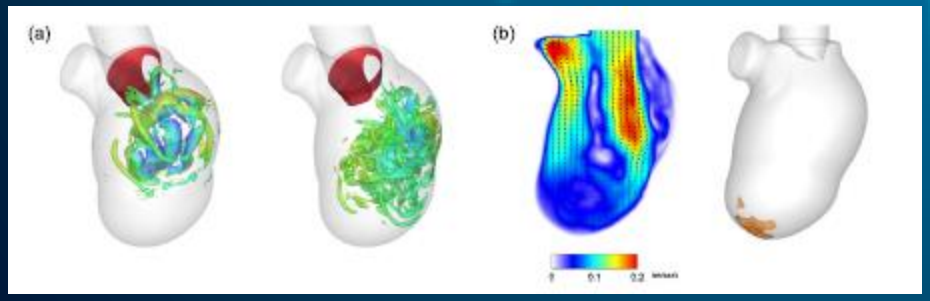



(a)
(b)


LA
Aorta
Mitral Valve
Septal
LV
Lateral
Apex
U (cm/s)
0 20 40
Early Diastole
Mid Diastole
End Diastole
Mid Systole


(a)
(b)

Intraoperative hypotension - a neglected causative factor in hospital-acquired acute kidney injury; a Mayo Clinic Health System experience revisited

Macaulay Amechi Chukwukadibia Onuigbo[1,2*], Nneoma Agbasi[3]

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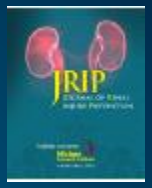
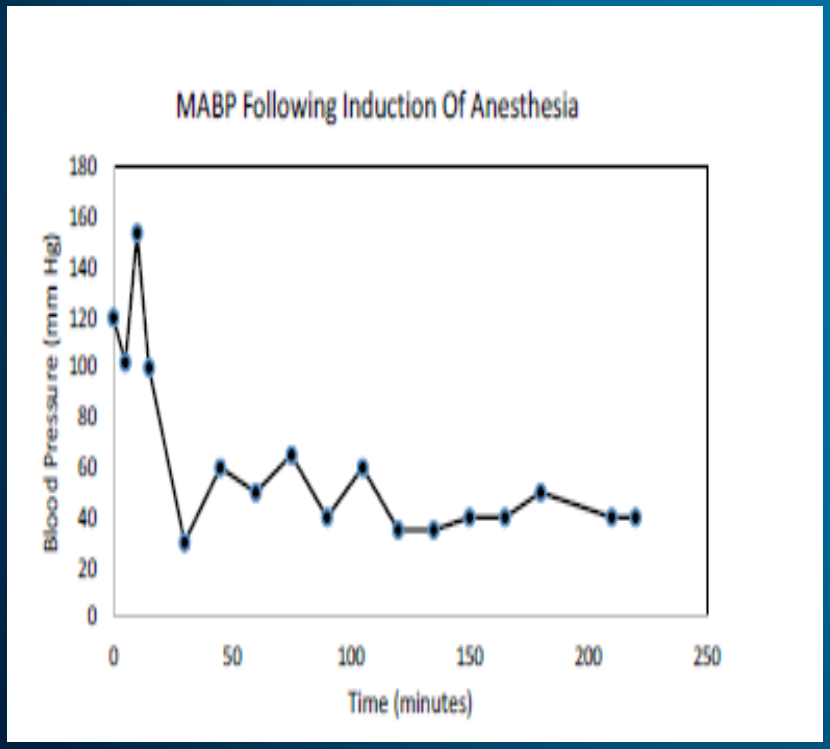
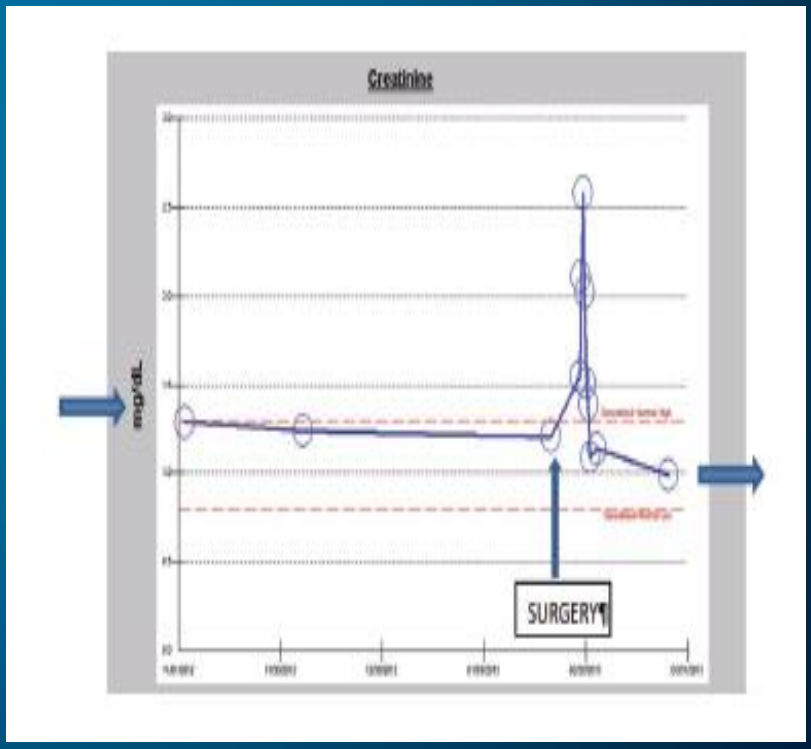
[3]North East London NHS Foundation Trust, UK



DOI: 10.12861/jrip.2015.13





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Ischemia and reperfusion—from mechanism to translation

Holger K Eltzschig and **Tobias Eckle**
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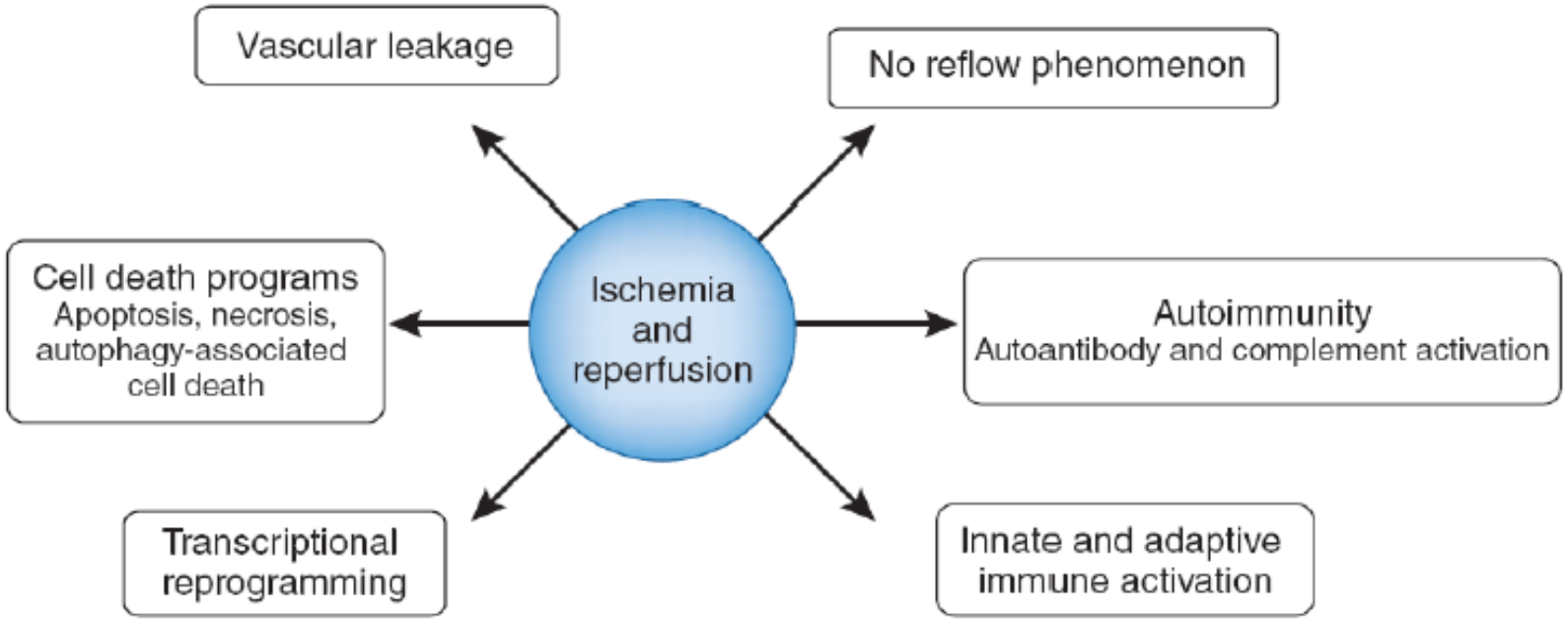


Figure 1.
Biological processes implicated in ischemia and reperfusion.

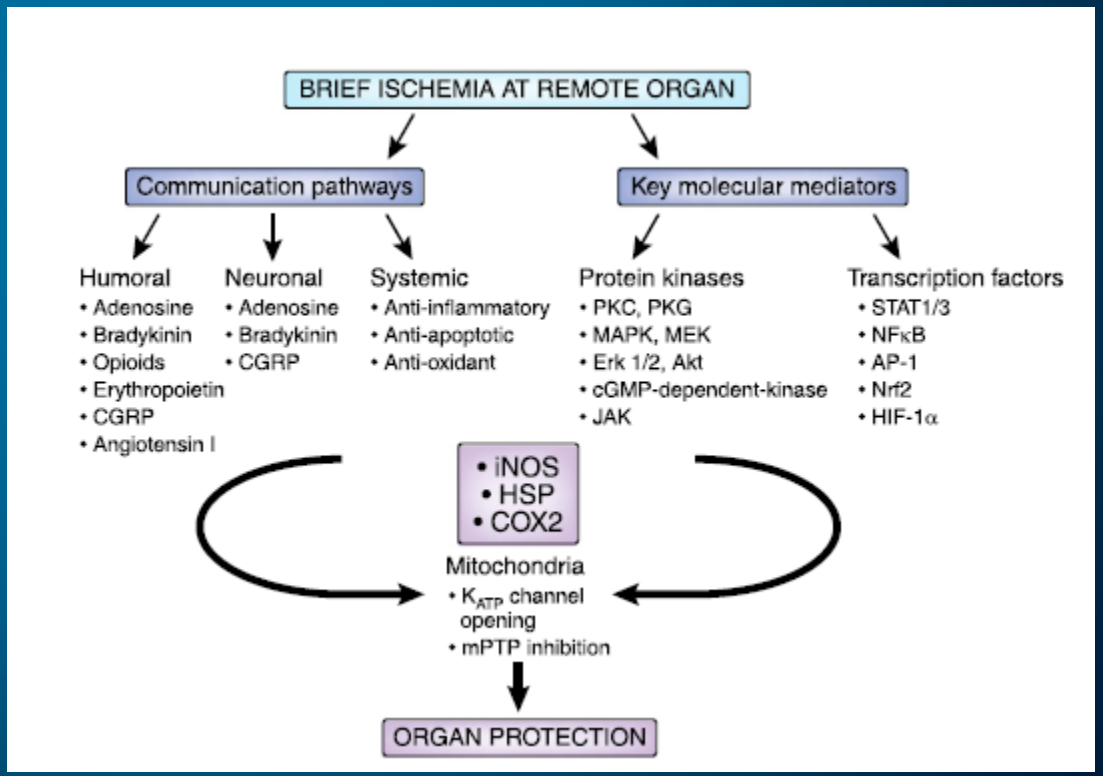
BRIEF REVIEW www.jasn.org

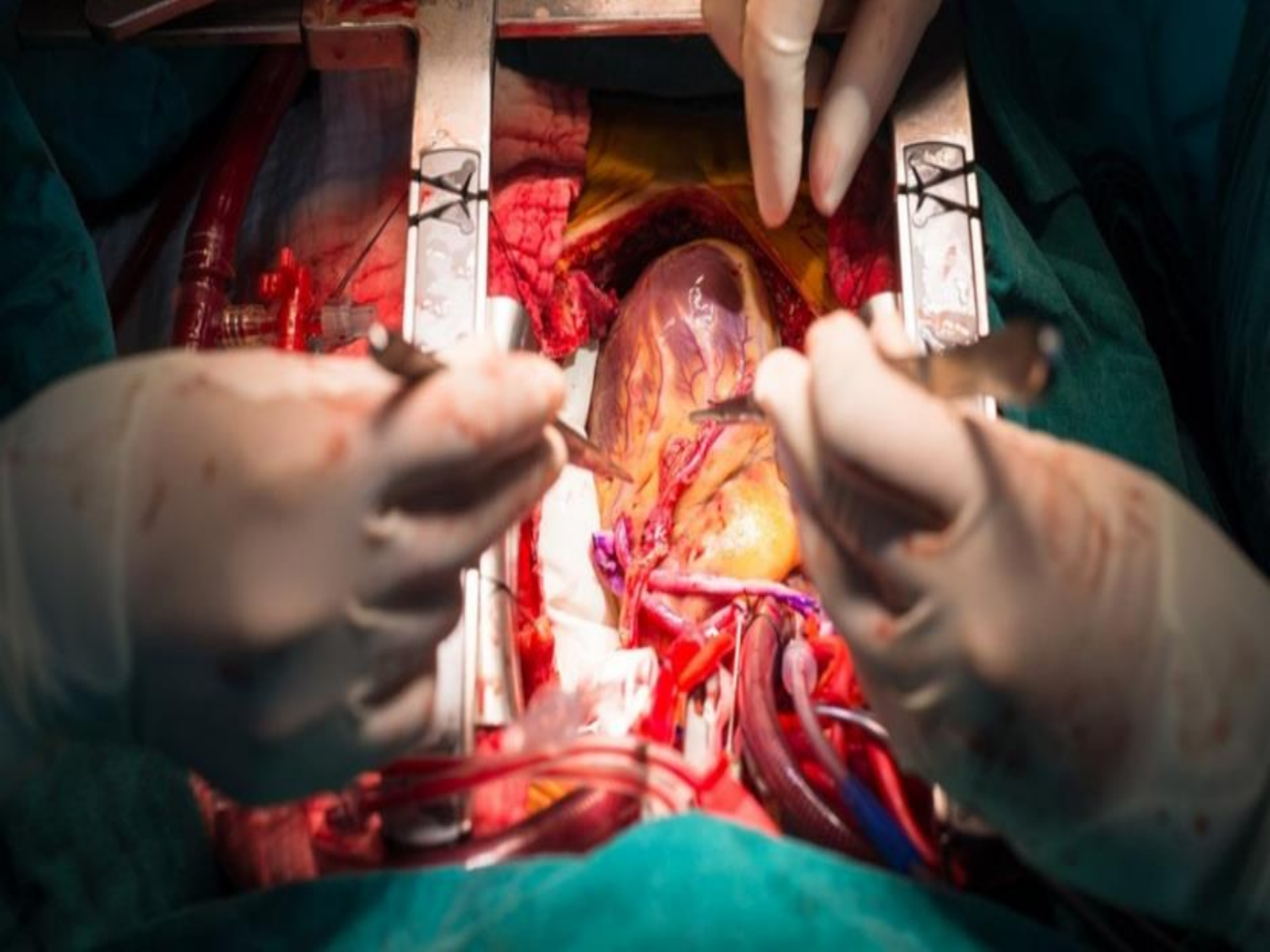
Remote Ischemic Preconditioning and Renoprotection: From Myth to a Novel Therapeutic Option?

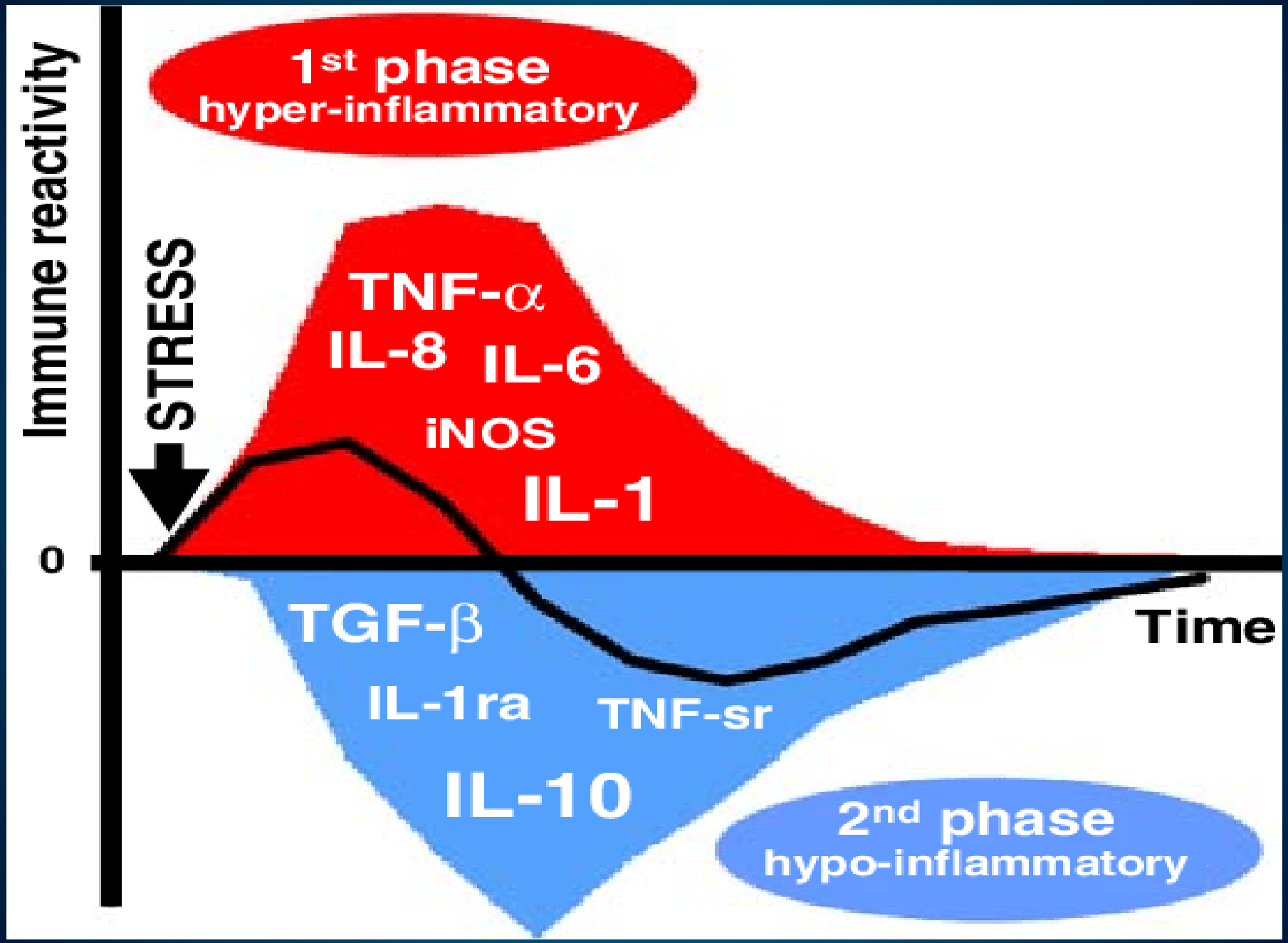
Natig Gassanov,* Amir M. Nia,† Evren Caglayan,* and Fikret Er*‡

Department of Internal Medicine III, University of Cologne, Cologne, Germany; †Department of Internal Medicine III, University Hospital of Saarland, Homburg, Germany; and ‡Department of Internal Medicine I, Klinikum Gütersloh, Gütersloh, Germany

J Am Soc Nephrol 25: 216–224, 2014. doi: 10.1681/ASN.2013070708






1st phase
hyper-inflammatory
Immune reactivity
STRESS
TNF-α
IL-8
IL-6
iNOS
IL-1
0
TGF-β
IL-1ra
TNF-sr
IL-10
Time
2nd phase
hypo-inflammatory

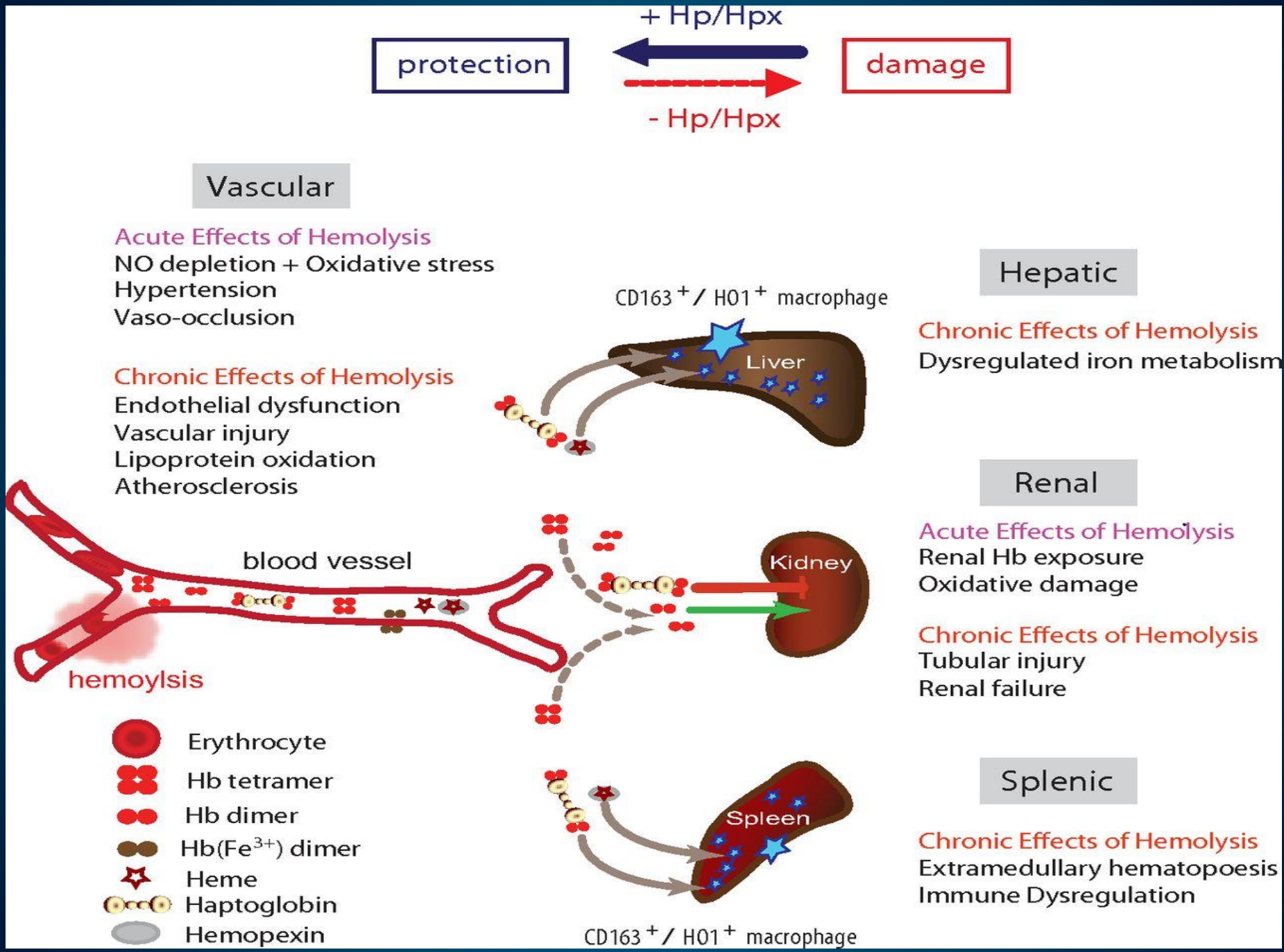
Clinical Implications of the Inflammatory Response to Cardiac Surgery

- Beneficial? :

Immune system priming may help prevent perioperative infection and promote wound healing.

However…….

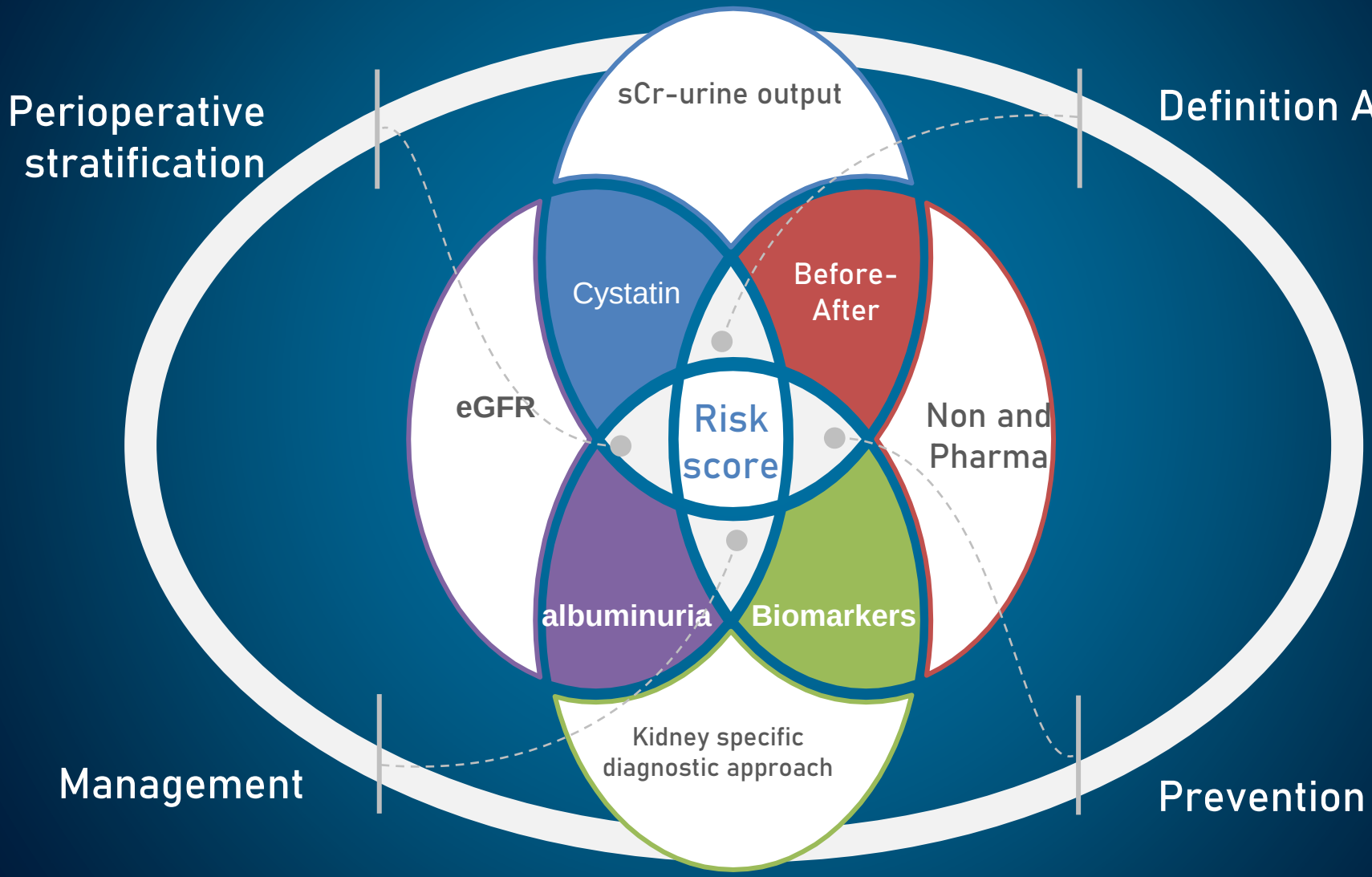
- An uncontrolled inflammatory response contributes to the pathogenesis of:
    * Acute pulmonary dysfunction
    * Cardiovascular dysfunction
    * Neurologic dysfunction
    * Renal dysfunction
    * Splanchnic dysfunction
    * Hematologic dysfunction

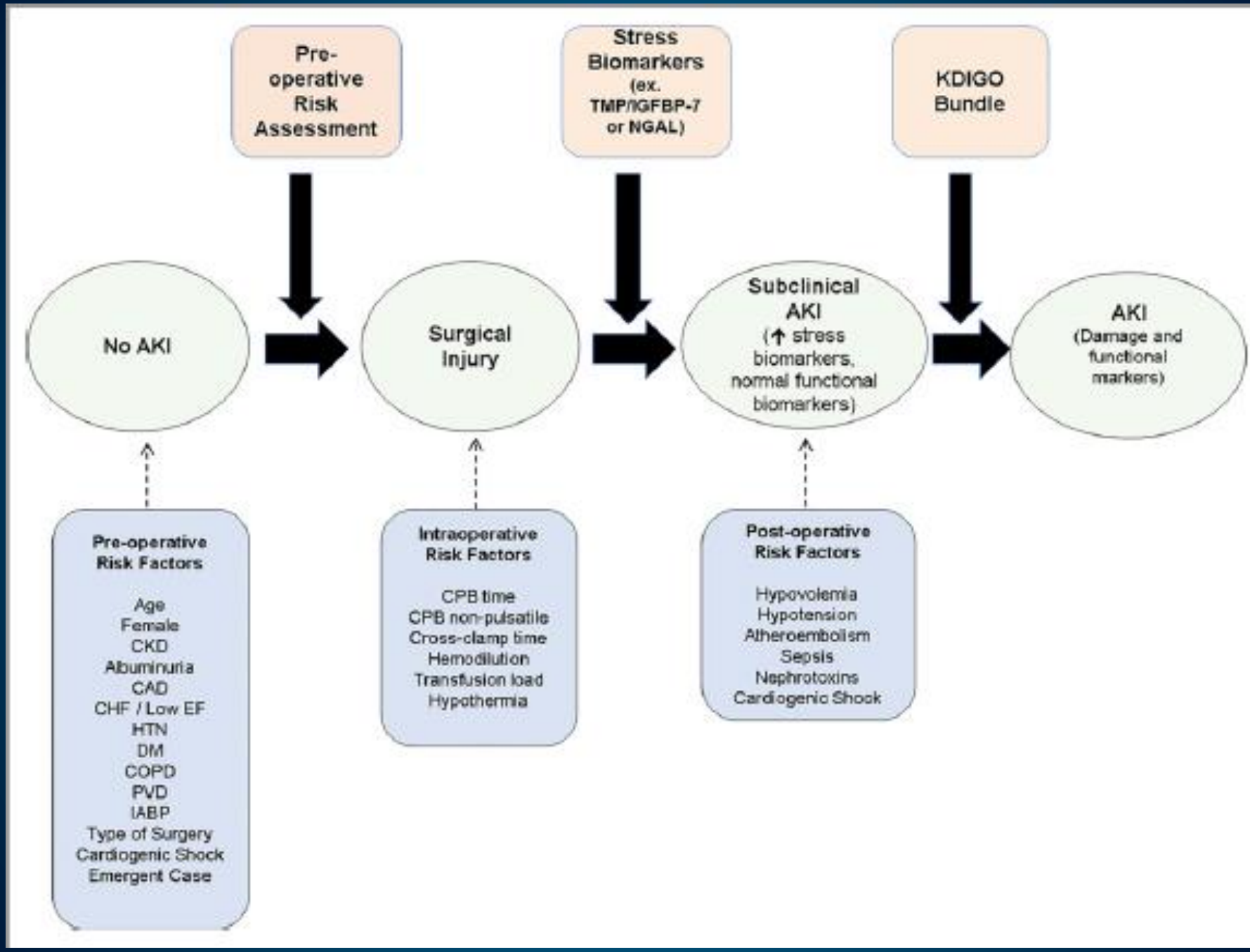

+ Hp/Hpx
protection
damage
- Hp/Hpx
Vascular
Acute Effects of Hemolysis
NO depletion + Oxidative stress
Hypertension
Vaso-occlusion
Chronic Effects of Hemolysis
Endothelial dysfunction
Vascular injury
Lipoprotein oxidation
Atherosclerosis
CD163+ / H01+ macrophage
Liver
Hepatic
Chronic Effects of Hemolysis
Dysregulated iron metabolism
blood vessel
hemoylsis
Kidney
Renal
Acute Effects of Hemolysis
Renal Hb exposure
Oxidative damage
Chronic Effects of Hemolysis
Tubular injury
Renal failure
Erythrocyte
Hb tetramer
Hb dimer
Hb(Fe3+) dimer
Heme
Haptoglobin
Hemopexin
Spleen
Splenic
Chronic Effects of Hemolysis
Extramedullary hematopoesis
Immune Dysregulation
CD163+ / H01+ macrophage

Other mechanisms

- Oxygen free radical generation and metabolism.
- Genetic predisposition to injury.
- Precise nature of the genetic (and epigenetic) variables involved also remains unclear.
- Cholesterol emboli.
- Tissue injury releases mitochondrial damage–associated molecular patterns including mitochondrial DNA, which can act as a direct activator of neutrophils, which in turn elicit a systemic inflammatory response.

Diagnosis and Risk Assessment

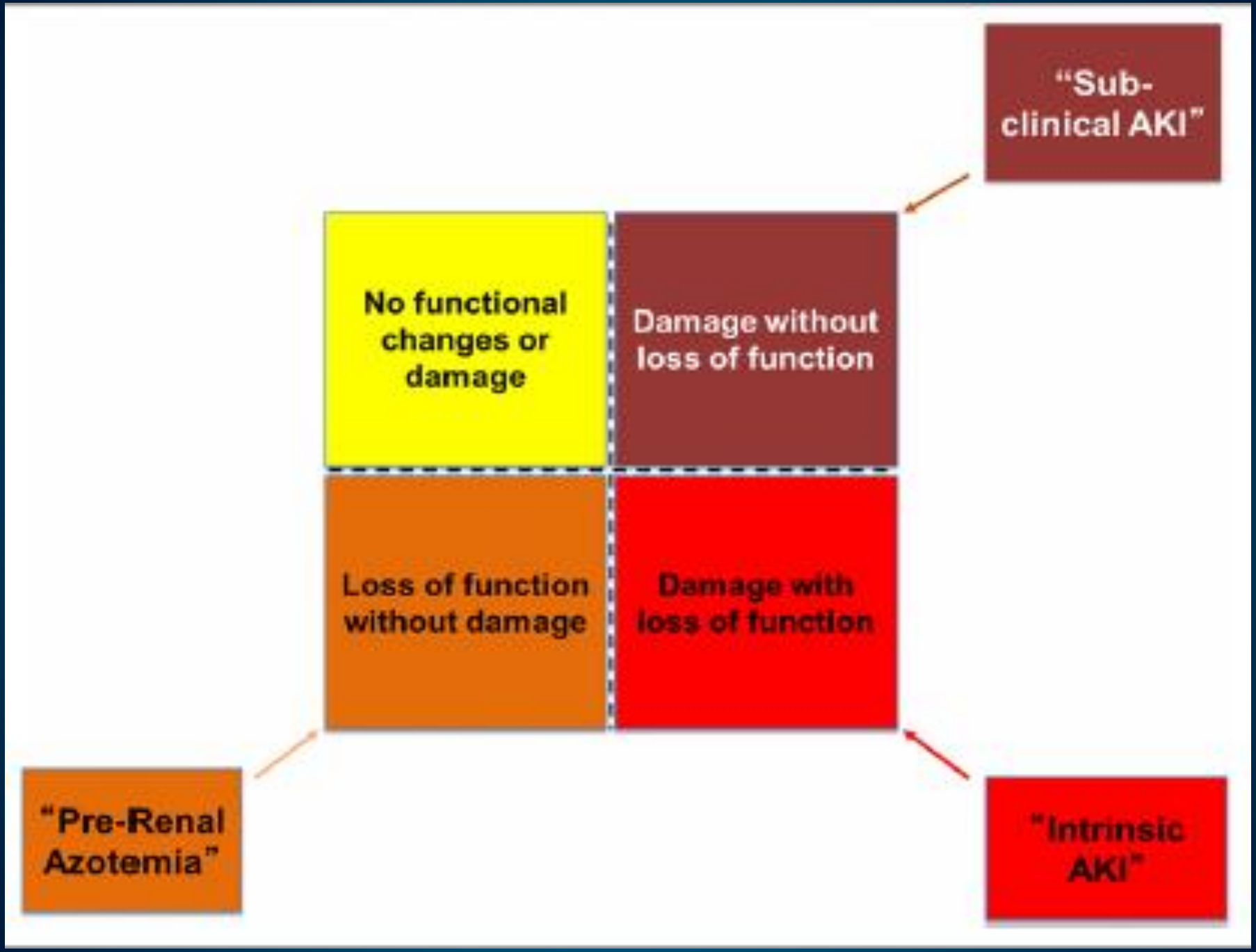



Pre-operative Risk Assessment
Stress Biomarkers (ex. TMP/IGFBP-7 or NGAL)
KDIGO Bundle
No AKI
Surgical Injury
Subclinical AKI (↑ stress biomarkers, normal functional biomarkers)
AKI (Damage and functional markers)
Pre-operative Risk Factors
Age
Female
CKD
Albuminuria
CAD
CHF / Low EF
HTN
DM
COPD
PVD
IABP
Type of Surgery
Cardiogenic Shock
Emergent Case
Intraoperative Risk Factors
CPB time
CPB non-pulsatile
Cross-clamp time
Hemodilution
Transfusion load
Hypothermia
Post-operative Risk Factors
Hypovolemia
Hypotension
Atheroembolism
Sepsis
Nephrotoxins
Cardiogenic Shock

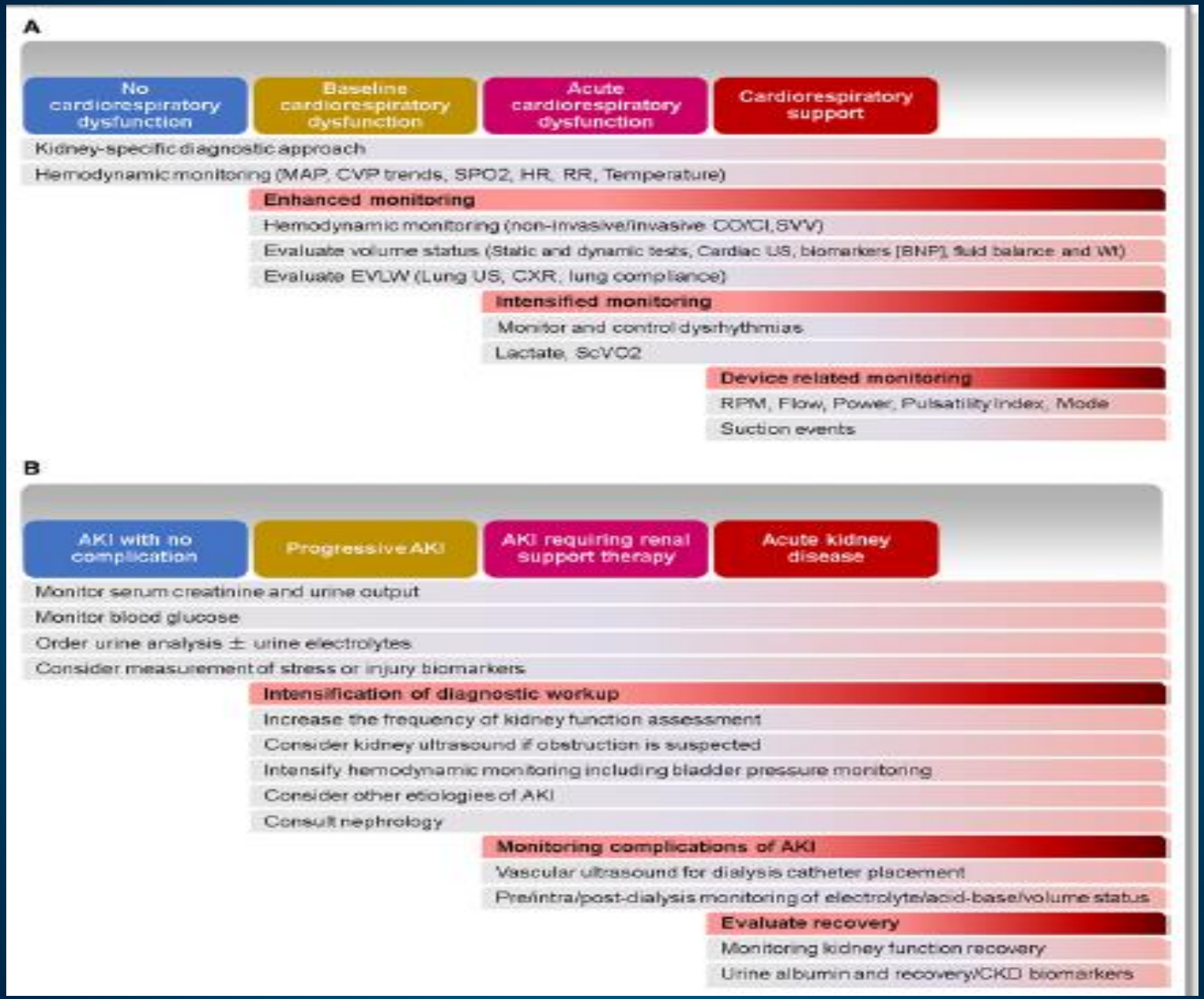
Acute kidney injury stages

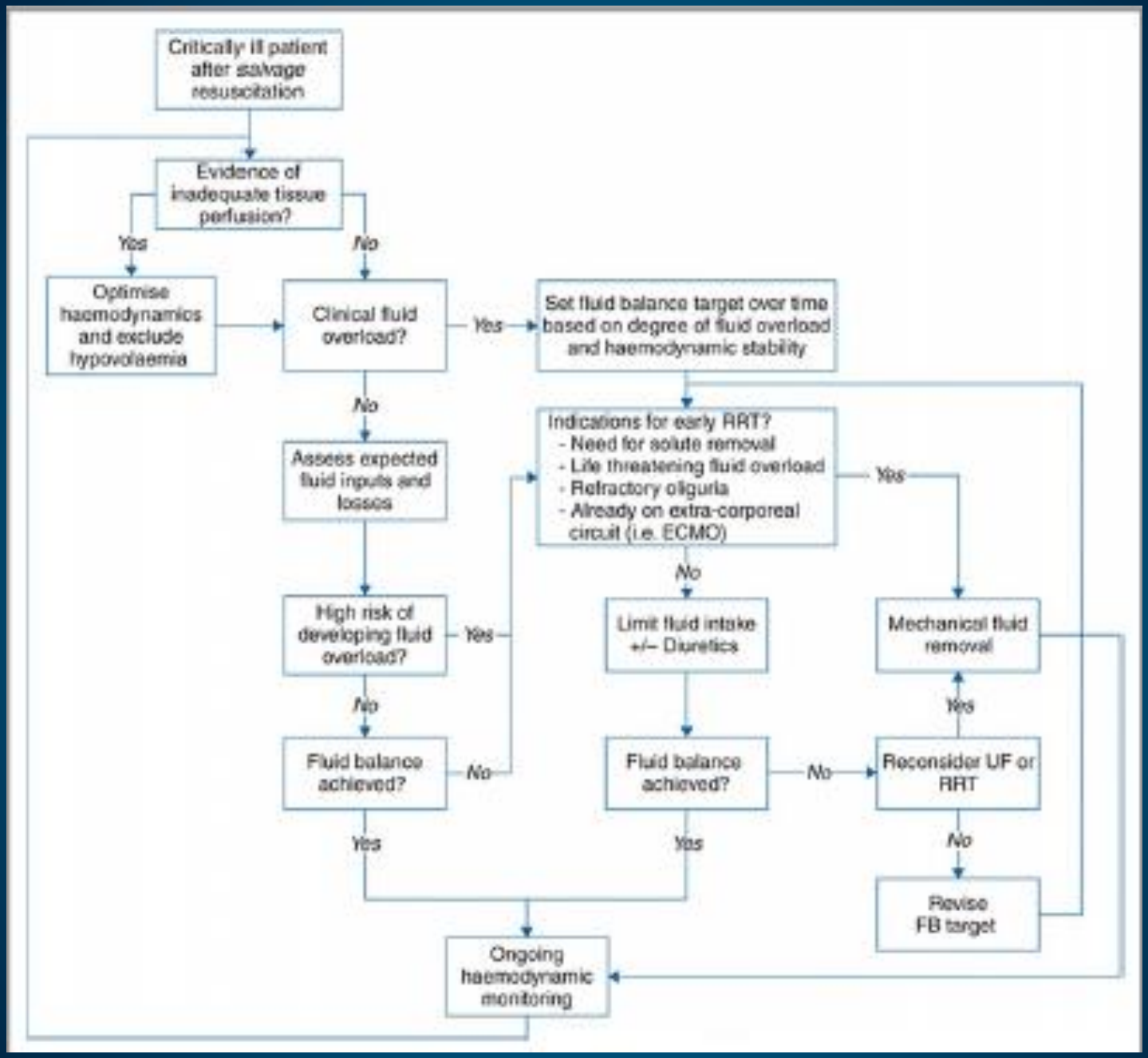
AKI STAGE	Serum creatinine criteria	Urine output criteria
1	Increase in serum creatinine of 26 micromol/litre or more within 48 hours OR 1.5 to 2-fold increase from baseline	Less than 0.5 ml/kg/hour for more than 6 hours*
2	Increase in serum creatinine to more than 2 to 3-fold from baseline	Less than 0.5 ml/kg/hour for more than 12 hours
3	Increase in serum creatinine to more than 3-fold from baseline OR Serum creatinine more than 354 micromol/litre with an acute increase of at least 44 micromol/ litre	Less than 0.3 ml/kg/hour for 24 hours or anuria for 12 hours

* Urine output of less than 0.5 ml/kg/hour more than 8 hours in children and young people

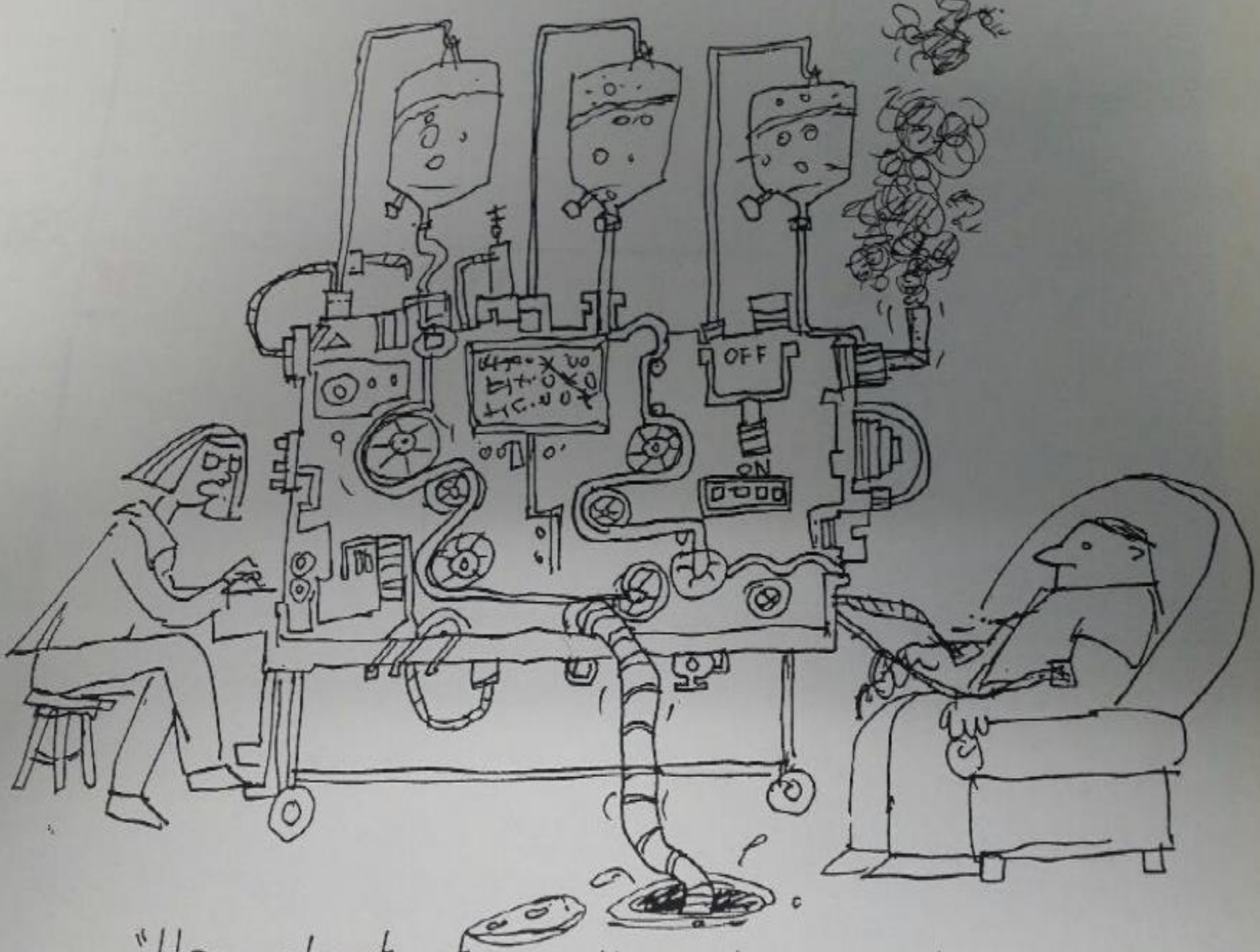

"Sub-clinical AKI"
No functional changes or damage
Damage without loss of function
Loss of function without damage
Damage with loss of function
"Pre-Renal Azotemia"
"Intrinsic AKI"

Timing	Strategy	Population	Recommended	Not Recommended
Perioperative	Avoidance of glucose variability	Cardiac	1B	. . .
	Balanced crystalloid (vs saline)	Cardiac and vascular	1B	. . .
	Dexmedetomidine	Cardiac	2C	. . .
	Statins	Cardiac	. . .	1A
	N-acetylcysteine	Cardiac	. . .	1A
	Sodium bicarbonate	Cardiac	. . .	1A
	Levosimendan	Cardiac	. . .	1A
	Limited use of blood transfusion	Cardiac vascular	1A	More research needed
	Albumin (vs crystalloid)	Cardiac	. . .	More research needed
	Erythropoietin	Cardiac and vascular	. . .	More research needed
Preoperative	Discontinuation of ACEIs and ARBs	Cardiac	1C	. . .
	Albumin in patients with hypoalbuminemia	Cardiac (OPCAB)	2C	. . .
	24- to 72-h delay postcontrast before cardiac surgery	Cardiac	2C	. . .
	IABP	Cardiac	2C*	. . .
Intraoperative	Volatile anesthetic agents (vs propofol)	Cardiac	2C	. . .
	Cold renal perfusion for AAA	Vascular	2C	. . .
	Avoidance of hyperthermia	Cardiac	2C	. . .
	Pulsatile CPB	Cardiac	2D*	. . .
	Avoidance of hemodilution	Cardiac	2C	. . .
	Techniques to prevent procedure-related atheroembolism	Vascular	2C	. . .
	OPCAB technique	Cardiac	. . .	1A
	Remote ischemic preconditioning	Cardiac	2B*	More research needed for vascular and low risk cardiac surgery
	Minimization of aortic manipulation	Cardiac	. . .	More research needed
	MAP >75	Cardiac	. . .	More research needed
	Intraoperative ultrafiltration	Cardiac	. . .	More research needed
Postoperative	KDIGO bundle	Cardiac	1B*	. . .
	Low tidal volume ventilation strategy	Cardiac	1C	. . .
	Loop diuretics (for prevention of AKI)	Cardiac and vascular	. . .	1B
	Levosimendan	Cardiac	. . .	1A
	Dopamine	Cardiac	. . .	1A
	A-melanocyte-stimulating hormone	Cardiac	. . .	1B
	Vasopressin for vasoplegic shock (vs norepinephrine)	Cardiac	. . .	More research needed
	Natriuretic peptides	Cardiac	. . .	More research needed
	Fenoldopam	Cardiac	. . .	More research needed
	Mannitol	Cardiac and vascular	. . .	More research needed


A
No cardiorespiratory dysfunction
Baseline cardiorespiratory dysfunction
Acute cardiorespiratory dysfunction
Cardiorespiratory support
Kidney-specific diagnostic approach
Hemodynamic monitoring (MAP, CVP trends, SPO2, HR, RR, Temperature)
Enhanced monitoring
Hemodynamic monitoring (non-invasive/invasive CO/CI,SVV)
Evaluate volume status (Static and dynamic tests, Cardiac US, biomarkers [BNP], fluid balance and Wt)
Evaluate EVLW (Lung US, CXR, lung compliance)
Intensified monitoring
Monitor and control dysrhythmias
Lactate, ScVO2
Device related monitoring
RPM, Flow, Power, Pulsatility index, Mode
Suction events
B
AKI with no complication
Progressive AKI
AKI requiring renal support therapy
Acute kidney disease
Monitor serum creatinine and urine output
Monitor blood glucose
Order urine analysis ± urine electrolytes
Consider measurement of stress or injury biomarkers
Intensification of diagnostic workup
Increase the frequency of kidney function assessment
Consider kidney ultrasound if obstruction is suspected
Intensify hemodynamic monitoring including bladder pressure monitoring
Consider other etiologies of AKI
Consult nephrology
Monitoring complications of AKI
Vascular ultrasound for dialysis catheter placement
Pre/intra/post-dialysis monitoring of electrolyte/acid-base/volume status
Evaluate recovery
Monitoring kidney function recovery
Urine albumin and recovery/CKD biomarkers


Critically ill patient after salvage resuscitation
Evidence of inadequate tissue perfusion?
Yes
No
Optimise haemodynamics and exclude hypovolaemia
Clinical fluid overload?
Yes
Set fluid balance target over time based on degree of fluid overload and haemodynamic stability
No
Assess expected fluid inputs and losses
Indications for early RRT?
- Need for solute removal
- Life threatening fluid overload
- Refractory oliguria
- Already on extra-corporeal circuit (i.e. ECMO)
Yes
No
High risk of developing fluid overload?
Yes
Limit fluid intake +/– Diuretics
Mechanical fluid removal
No
Yes
Fluid balance achieved?
No
Fluid balance achieved?
No
Reconsider UF or RRT
Yes
Yes
No
Revise FB target
Ongoing haemodynamic monitoring

Knowledge Gap	Future Research Directions
Risk assessment	1 Defining the association of KDIGO stage 1 AKI by urine output and sCr with outcomes in the CVS settings 2 Investigation of acute kidney stress are warranted to better characterize the incidence and outcomes of those with elevations in injury and damage biomarkers before changes in sCr and urine output 3 Development of iterative risk-prediction models that allow reevaluation of risk in the pre-, peri-, and postoperative periods. In this context, we recommend evaluation of the incremental value of real-time estimated GFR assessment and renal injury/stress biomarkers as part of a risk stratification strategy 4 Feasibility studies to assess renal reserve in the preoperative period for unrecognized renal susceptibility in selected group of patients
Risk stratification	1 Development and validation of current and emerging biomarkers of AKI diagnosis, recovery, progression to CKD 2 Research and development of noninvasive, inexpensive, and highly accurate devices for kidney function, hemodynamic, and volume status monitoring (eg, real-time GFR monitoring devices, kidney perfusion, and intracapsular pressure monitors, etc) 3 Design and investigation of the impact of the biomarker or technology-guided protocols in the prevention or treatment of CVS-AKI
Prevention of CVS-AKI	1 Development of biomarker or diagnostic tool-guided protocols to prevent the progression of CVS-AKI or facilitate kidney function recovery 2 Investigation and validation of biomarkers and diagnostic tools with more resolution or ability to identify intravascular volume deficiency, microcirculation deficits, and kidney-related variables and outcomes (eg, severity and location of injury, real-time kidney function measures, biomarkers of kidney recovery, fibrosis or de novo or progression of CKD or need for RRT) 3 Development of noninvasive, inexpensive, and highly accurate devices for kidney function, hemodynamic, and volume status monitoring (eg, real-time GFR monitoring devices, kidney perfusion, and intracapsular pressure monitors, etc)
Management of CVS-AKI	1 Development of studies to verify if specific management approaches currently showed as effective in CVS-AKI primary prevention are also useful for secondary prevention 2 Improvement of definition and monitoring of fluid overload in order to better understand its relationship and management strategies in CVS-AKI patients 3 Development of large randomized trial on ANP for the prevention and treatment of AKI 4 Evaluation of the role of stem cells in treatment of AKI



"How about a tune, this thing is also a piano!"

QUESTIONS ????

Vital Signs PowerPoint Template

Insert your subtitle here

Vital Signs PowerPoint Template

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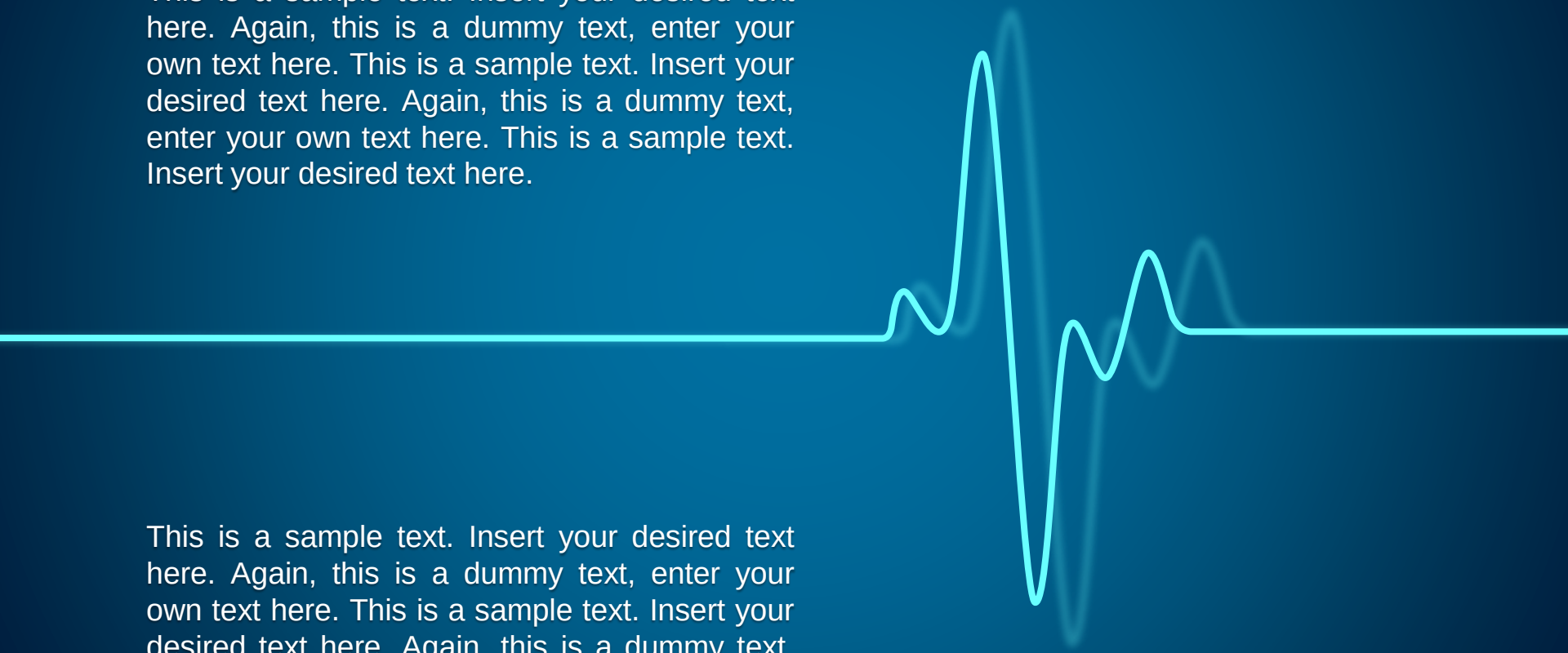

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Vital Signs PowerPoint Template

Vital State

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Dead State

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