
# AKI : Risk Assessment & Prevention

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SPACeR group
Surrey Peri-operative, Anaesthesia & Critical Care Collaborative Research Group

Royal Surrey County Hospital NHS
NHS Foundation Trust


# Disclosures:

Research Funding : Astute Medical, SBRI/D4D's Renal Technologies
Commercial Trials: Roche
Honorarium/Travel Expenses: Fresenius/Astute Medical

*"Before we begin this family meeting, how about we go around and say our names and a little something about ourselves."*

# In the Beginning….

- There was Acute Renal Failure : Remember that?
- Defining it could be relatively straightforward…..

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- There was Acute Renal Failure : Remember that?
- Defining it could be relatively straightforward…..
- **"The patient has acute renal failure when I say they have…."**


ARF : Was A Bit like
Pornography….

# ARF : Was A Bit like Pornography….

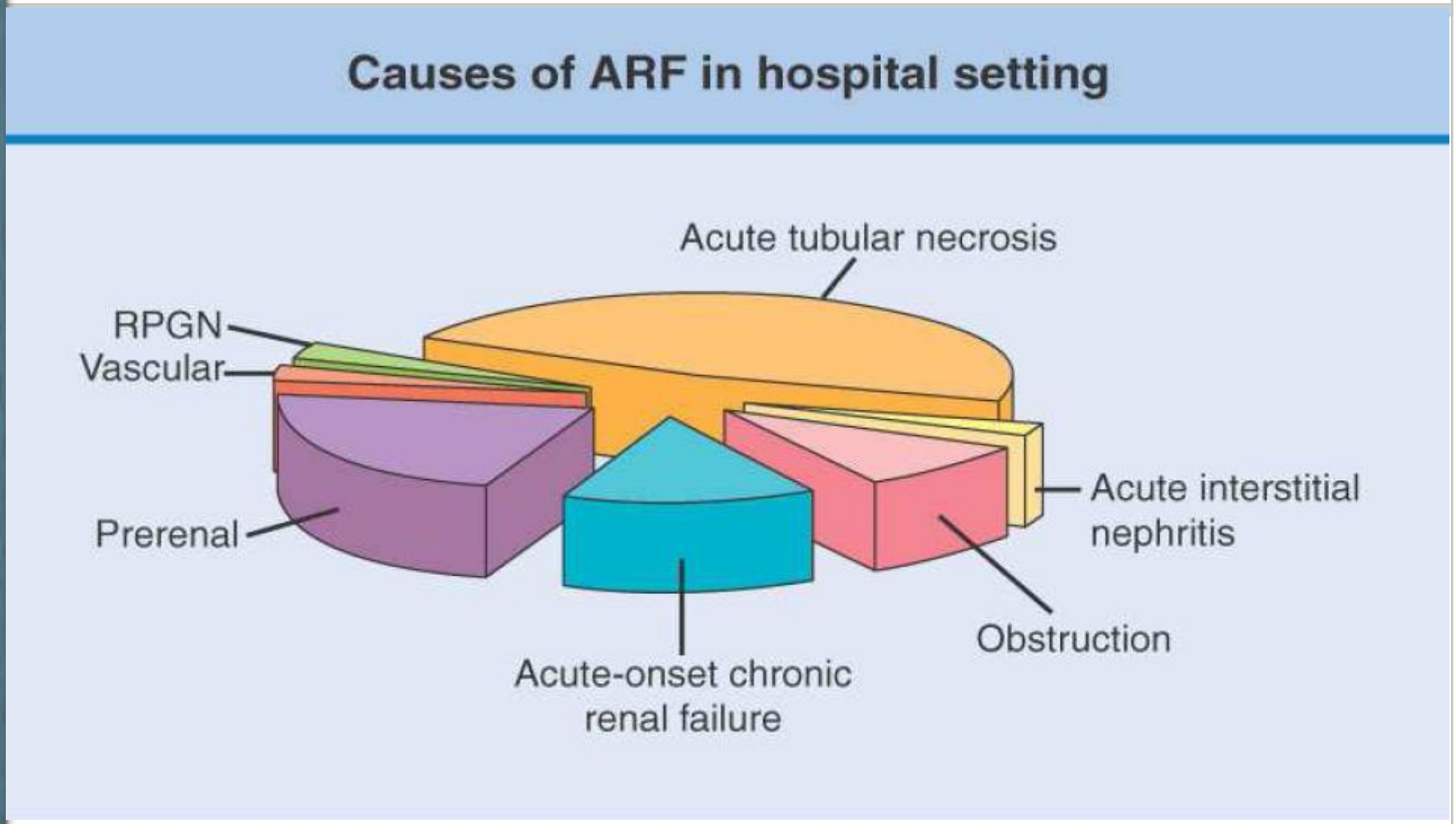

ARF : Was A Bit like
Pornography….


ARF : Was A Bit like Pornography….
Easy to Recognise….. Hard to Define!

# We Now Have Definitions…

| Stage | Serum Creatinine | Urine Output |
|---|---|---|
| 1 | ≥ 1.5-1.9 times baseline or<br>0.3 mg/dl (>26.4 µmol/L) increase | < 0.5 ml/kg.h for ≥ 6-12 hrs |
| 2 | ≥ 2.0-2.9 times baseline | < 0.5 ml/kg.h for ≥ 12 hrs |
| 3 | ≥ 3.0 times baseline<br>OR increase in creatinine ≥ 4 mg/dl<br>(352 µmol/L)<br><br>In patients < 18 yrs decrease of eGFR to 35 ml/kg/1.73 $m^2$ | < 0.3 ml/kg.h for ≥ 24 hrs<br>OR<br>Anuria ≥ 12 hrs |

# Is All AKI Equal?



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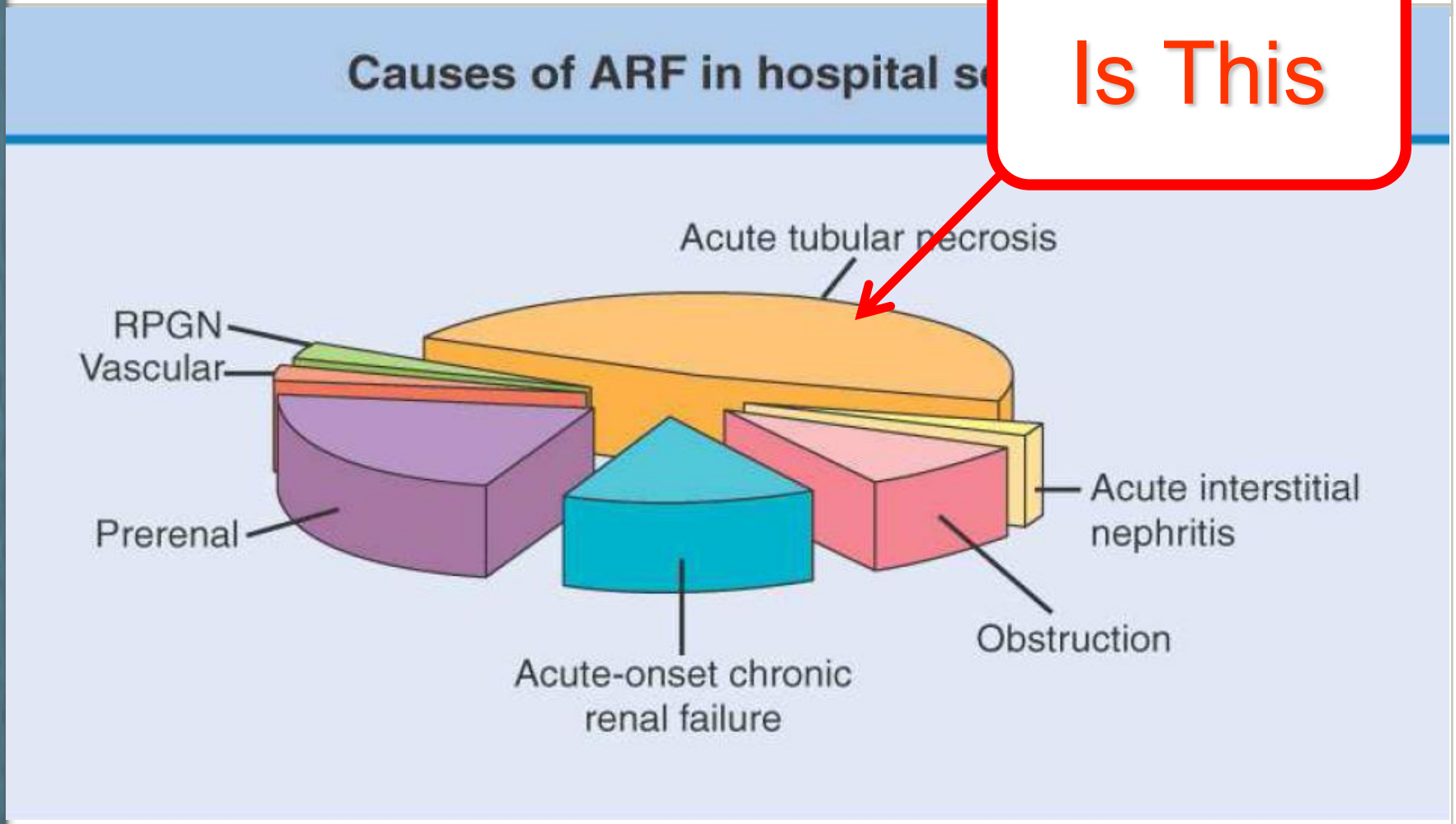

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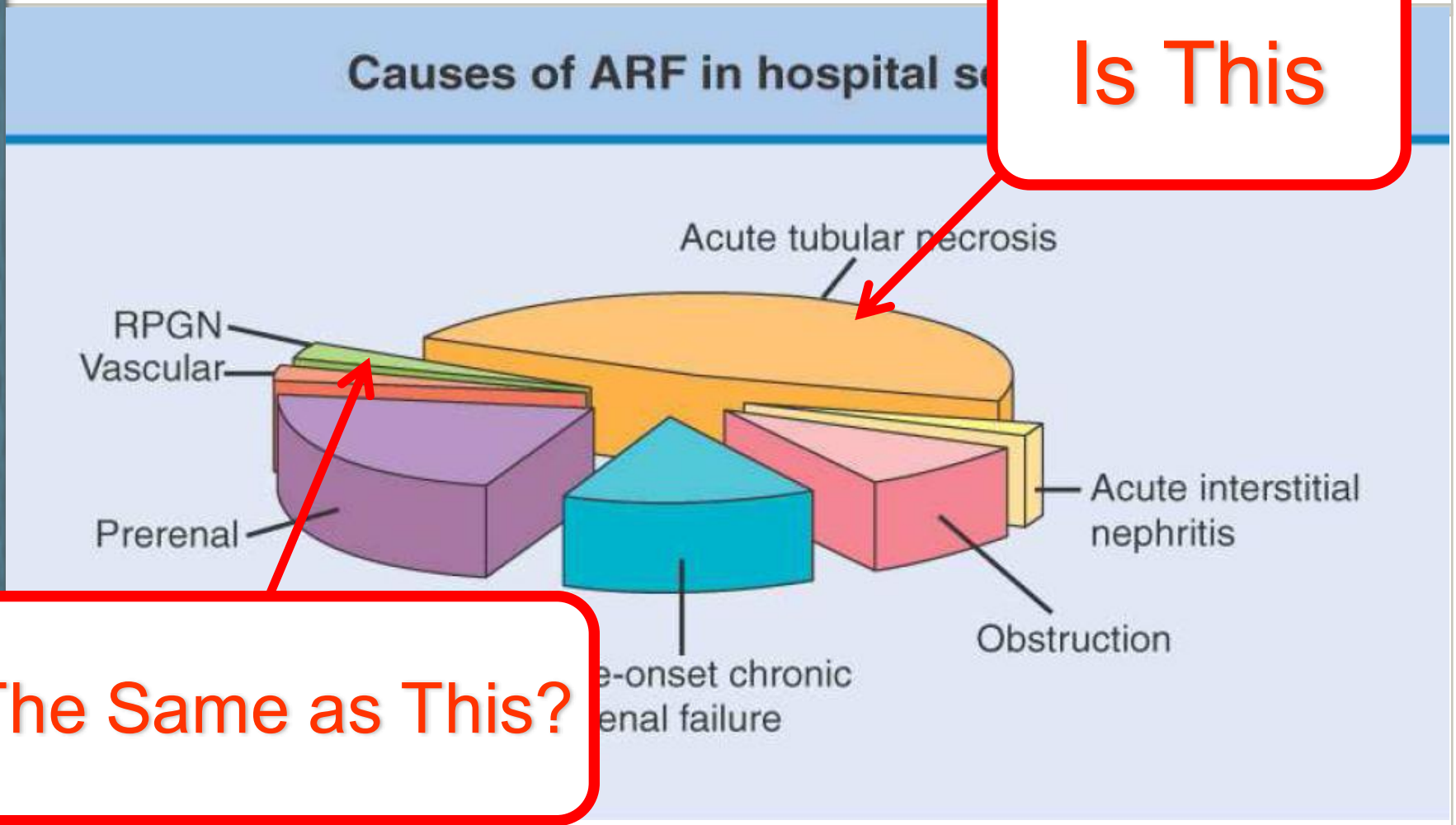


I'm AKI


I'm AKI
No…I'm AKI

# Does AKI suffer from the Pinocchio effect?

- Geppetto created a toy to be his little boy
- The toy was so lifelike it behaved like a boy

Neil Soni Anaesthesia, 2010, 65, pages 971–979

# Does AKI suffer from the Pinocchio effect?

- Geppetto created a toy to be his little boy
- The toy was so lifelike it behaved like a boy
- **But no matter how much he wished it be otherwise, in reality it was always a toy**

Neil Soni Anaesthesia, 2010, 65, pages 971–979

# The Pinocchio Effect*

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# The Pinocchio Effect*

We create diseases

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# The Pinocchio Effect*

We create diseases

We convince ourselves they exist

Neil Soni Anaesthesia, 2010, 65, pages 971–979

# The Pinocchio Effect*

We create diseases

We convince ourselves they exist

**But no matter how much we wish it otherwise, in reality a syndrome (and its acronym) is not a disease…**

Neil Soni Anaesthesia, 2010, 65, pages 971–979

# We don't have a Fairy Godmother…

Neil Soni Anaesthesia, 2010, 65, pages 971–979

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Neil Soni Anaesthesia, 2010, 65, pages 971–979

# Why Is AKI Important?

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- **Common**
- **High Mortality**
- **Heavy Burden of Illness**
  - **Acute**
  - **'Chronic'**
- **Cost Implications**

# AKI : Must be very Important…

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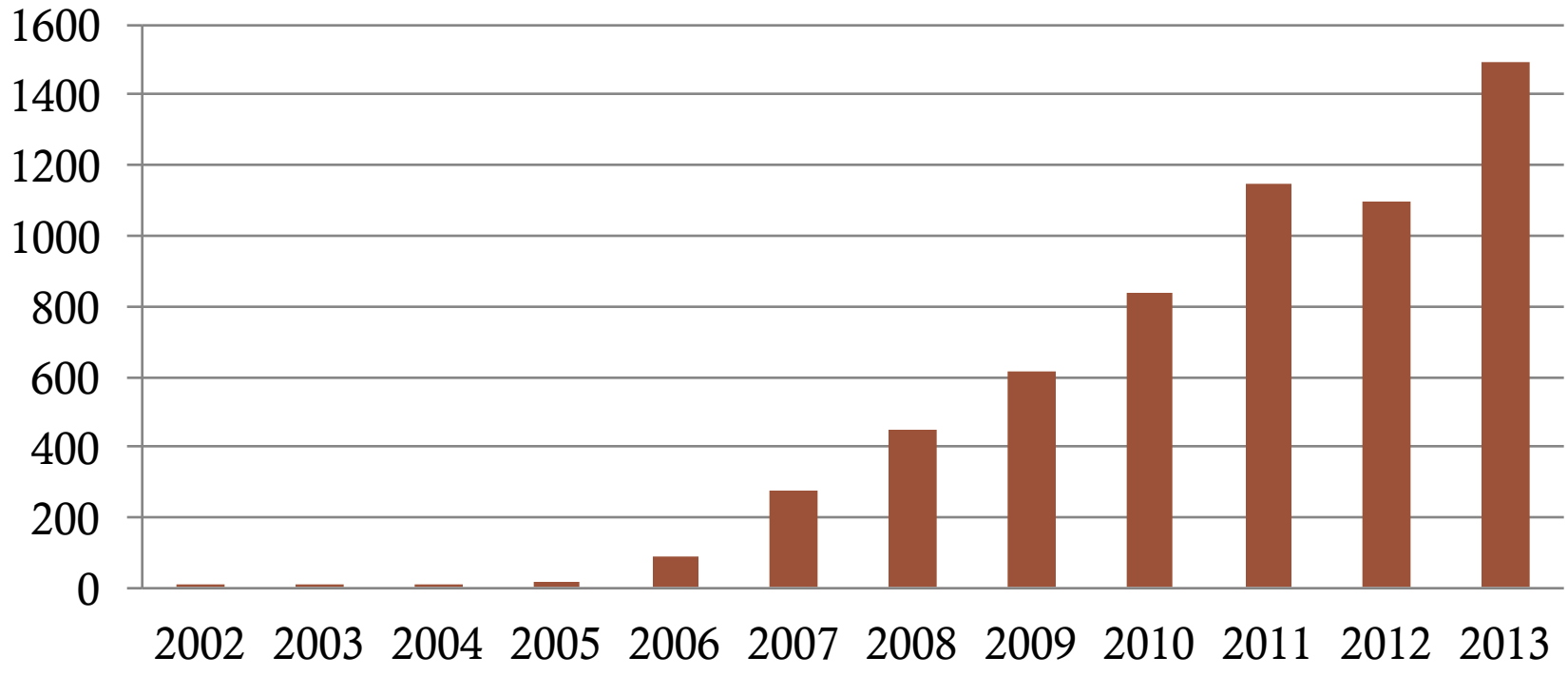
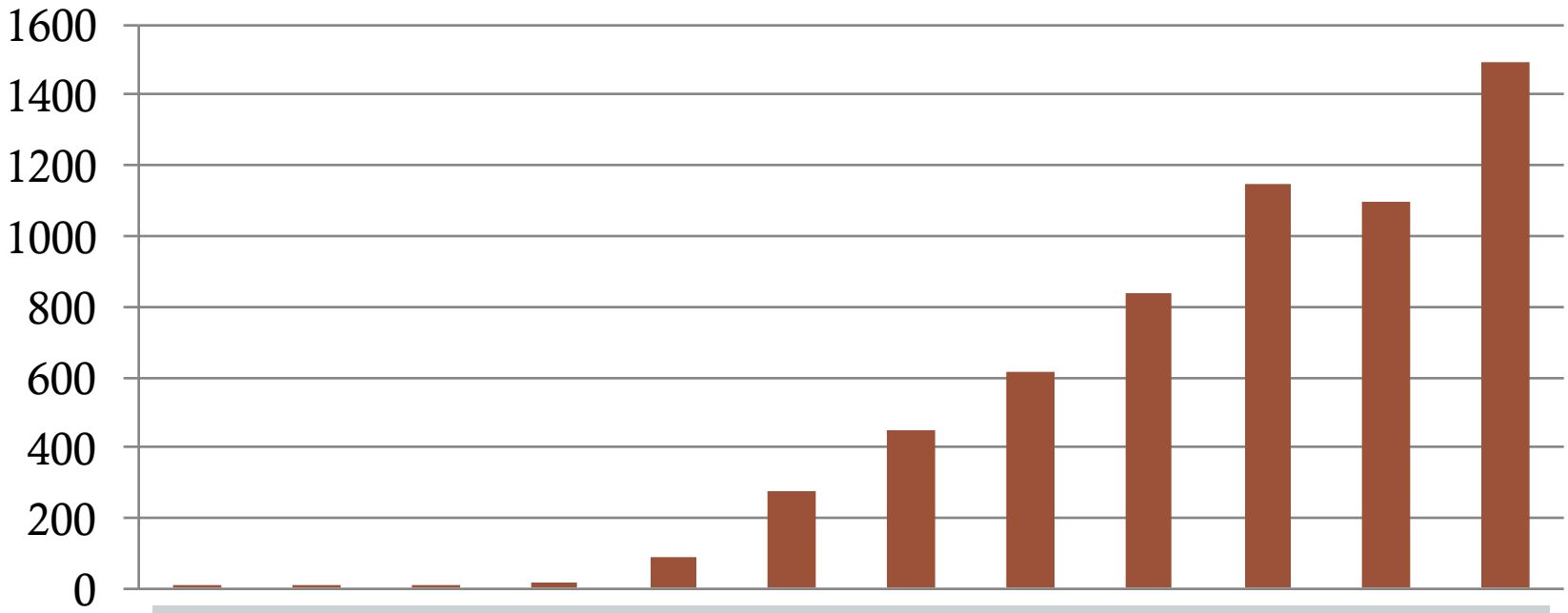


# AKI : Must be very Important…




More Than 4 Papers a Day..

# AKI : A Broad Clinical Syndrome

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- **Specific Kidney Diseases**
  - (e.g., acute interstitial nephritis, acute glomerular and vasculitic renal diseases)

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- **Extrarenal Pathology**
  - (e.g., prerenal azotemia, and acute postrenal obstructive nephropathy)

# AKI : A Broad Clinical Syndrome

We Can Define AKI
But Not The Cause

- **Non-Specific Conditions**
  - (e.g, ischemia, toxic injury)
- **Extrarenal Pathology**
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# AKI : A Broad Clinical Syndrome

We Can Define AKI
But Not The Cause

Not One Disease : No One Diagnostic Test

- (e.g., prerenal azotemia, and acute postrenal obstructive nephropathy)

# Where Do We Begin?

HSE

Health and Safety Executive

# Five steps to risk assessment

## Step 1
## Identify the hazards

Step 1
Identify the hazards

Step 2
Decide who might be harmed and how

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Step 3
Evaluate the risks and decide on precautions

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Step 4
Record your findings and implement them

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Step 2
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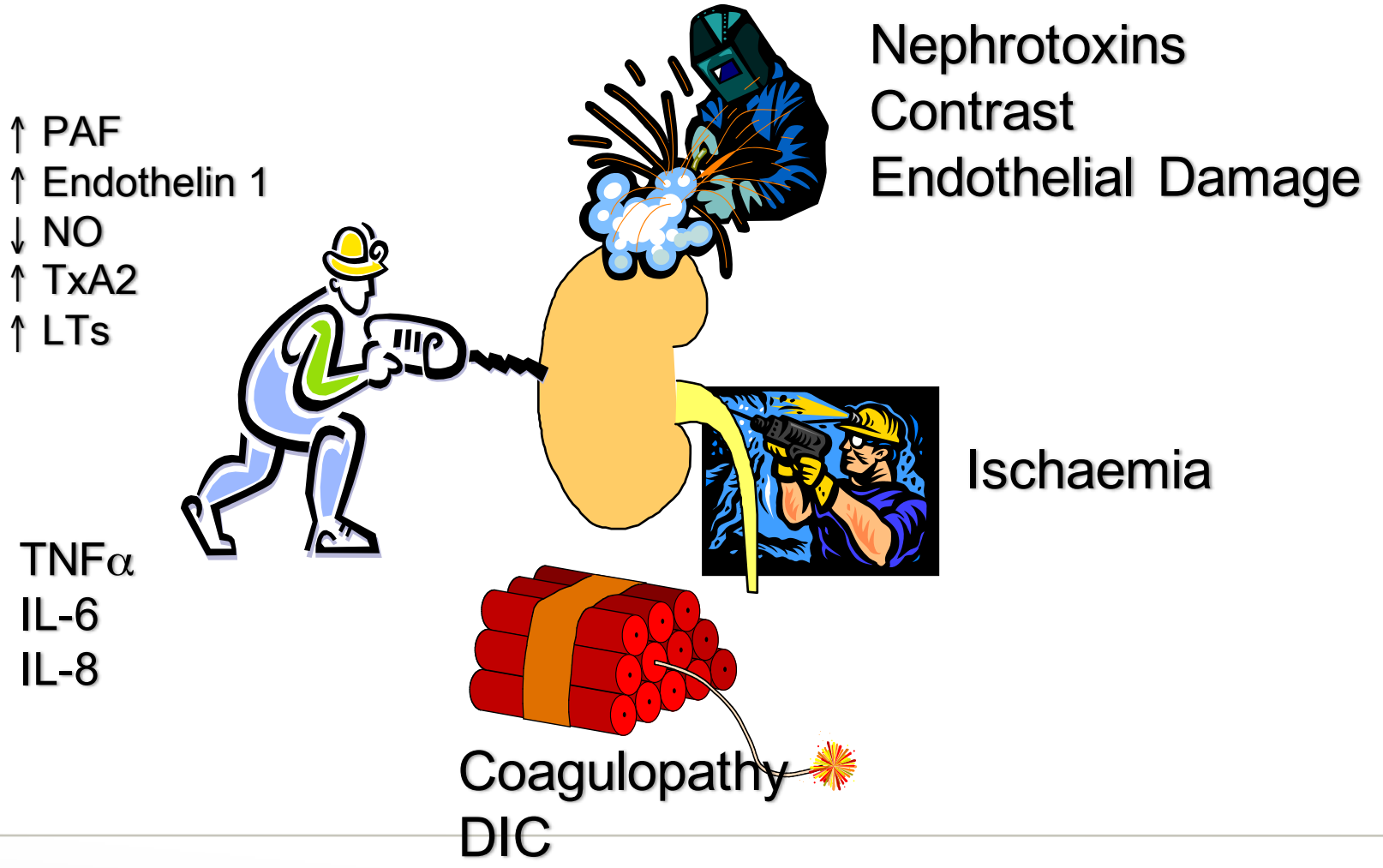
Step 3
Evaluate the risks and decide on precautions

Step 4
Record your findings and implement them

Step 5
Review your assessment and update if necessary

# Step 1: Identify The Hazards



# Step 1: Identify The Hazards

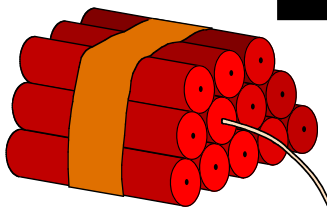
Nephrotoxins
Contrast
Endothelial Damage

↑ PAF
↑ Endothelin 1

**All Out Attack…**

Ischaemia

TNFα
IL-6
IL-8



Coagulopathy
DIC

# Step 1: Id

↑ PAF
↑ Endothelin 1
↓ NO
↑ TxA2
↑ LTs

TNFα
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IL-8


ns

Damage

nia

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# So Who Is At Risk?

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Step 2
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# So Who Is At Risk?

# Where Do We Go For Guidance?

Prevention, Risk Assessment & Treatment of AKI

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KIDNEY DISEASE IMPROVING GLOBAL OUTCOMES

KDIGO®

## KDIGO Clinical Practice Guideline for Acute Kidney Injury

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# kidney INTERNATIONAL supplements

141 Pages Long

132 Page Appendix

64 Pages of Tables

KDIGO Clinical Practice Guideline for Acute Kidney Injury

# The GRADE System

**Table 1 | Implications of the strength of a recommendation**

| | Implications | | |
|---|---|---|---|
| Grade* | Patients | Clinicians | Policy |
| Level 1<br>"We recommend" | Most people in your situation would want the recommended course of action and only a small proportion would not. | Most patients should receive the recommended course of action. | The recommendation can be evaluated as a candidate for developing a policy or a performance measure. |
| Level 2<br>"We suggest" | The majority of people in your situation would want the recommended course of action, but many would not. | Different choices will be appropriate for different patients. Each patient needs help to arrive at a management decision consistent with her or his values and preferences. | The recommendation is likely to require substantial debate and involvement of stakeholders before policy can be determined. |

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- A = High
- B = Moderate
- C = Low
- D = Very Low

National Clinical Guideline Centre

Acute kidney injury

# Acute kidney injury

## Prevention, detection and management up to the point of renal replacement therapy

*Clinical guideline <CG 169>*

*Methods, evidence and recommendations*

*August 2013*

*Final draft*

*Commissioned by the National Institute for Health and Care Excellence*

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**126 References**

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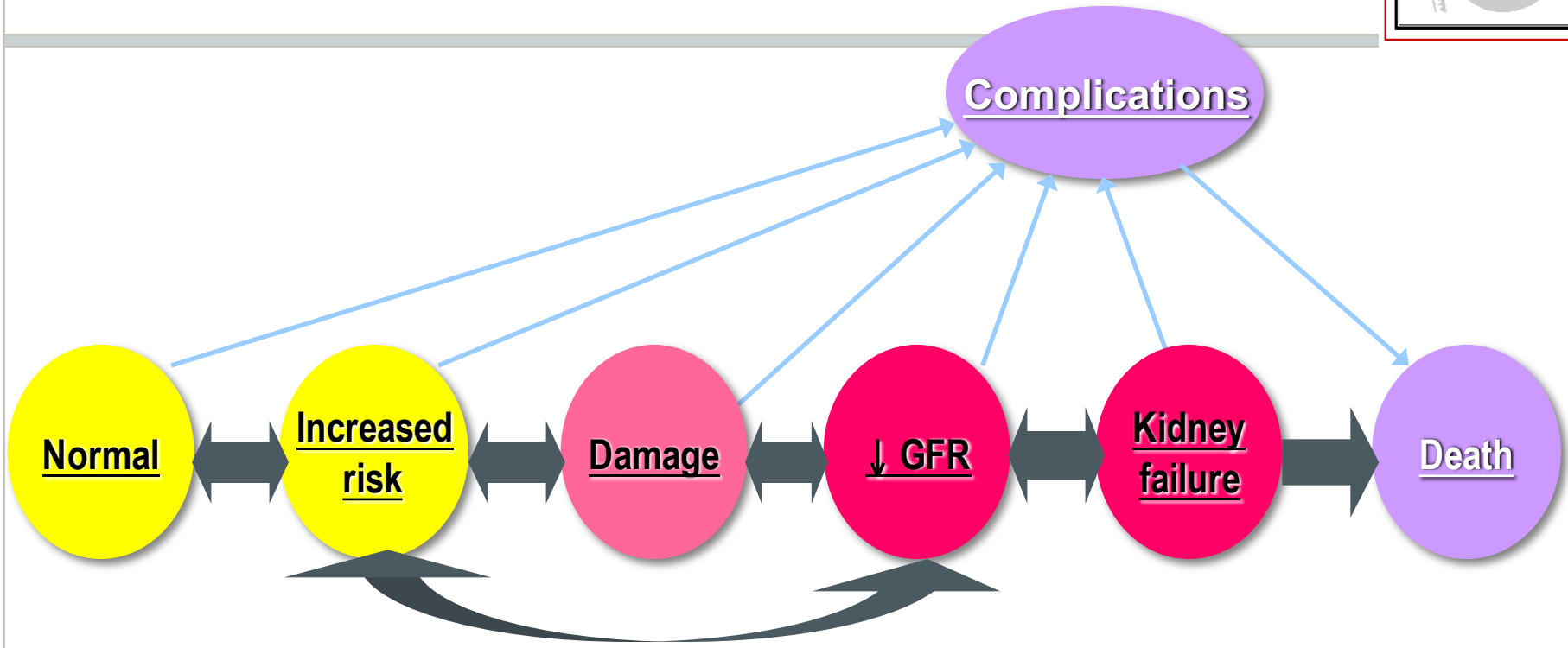


Vancouver meeting 2006

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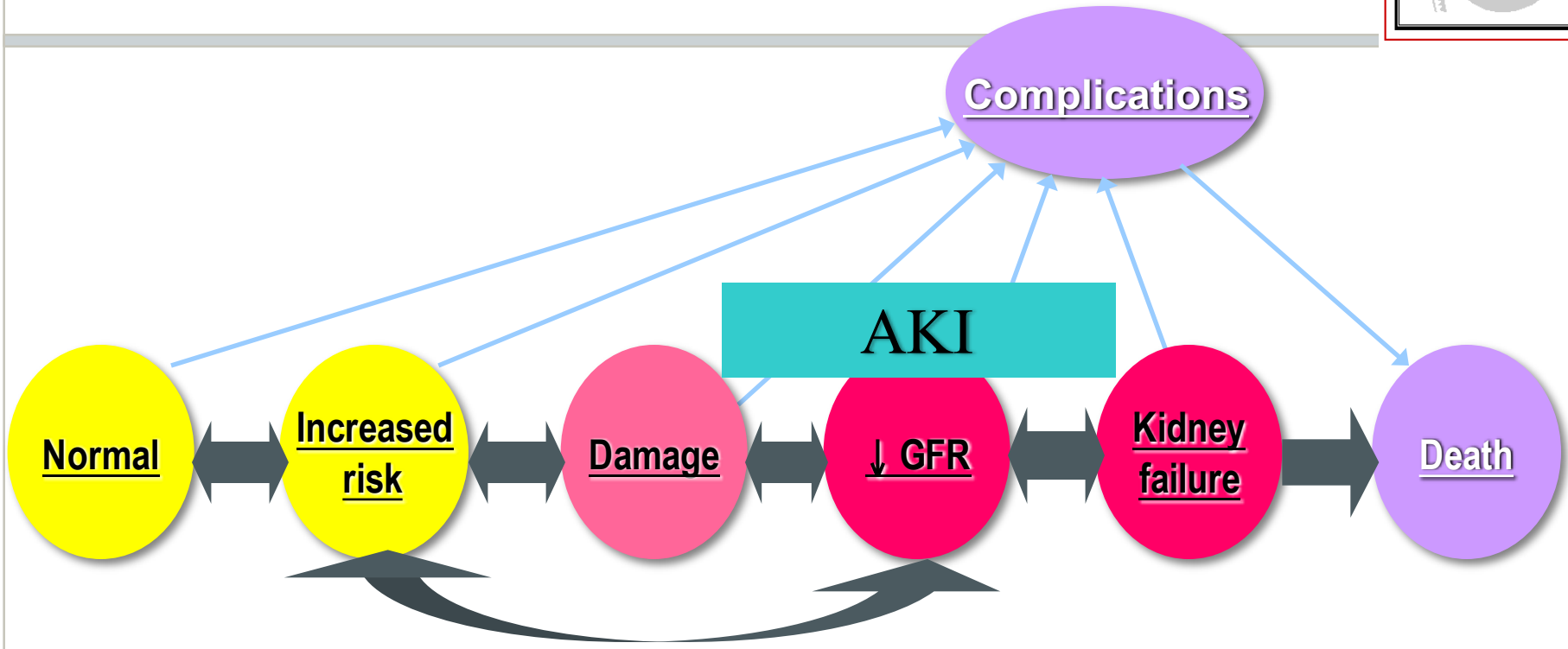


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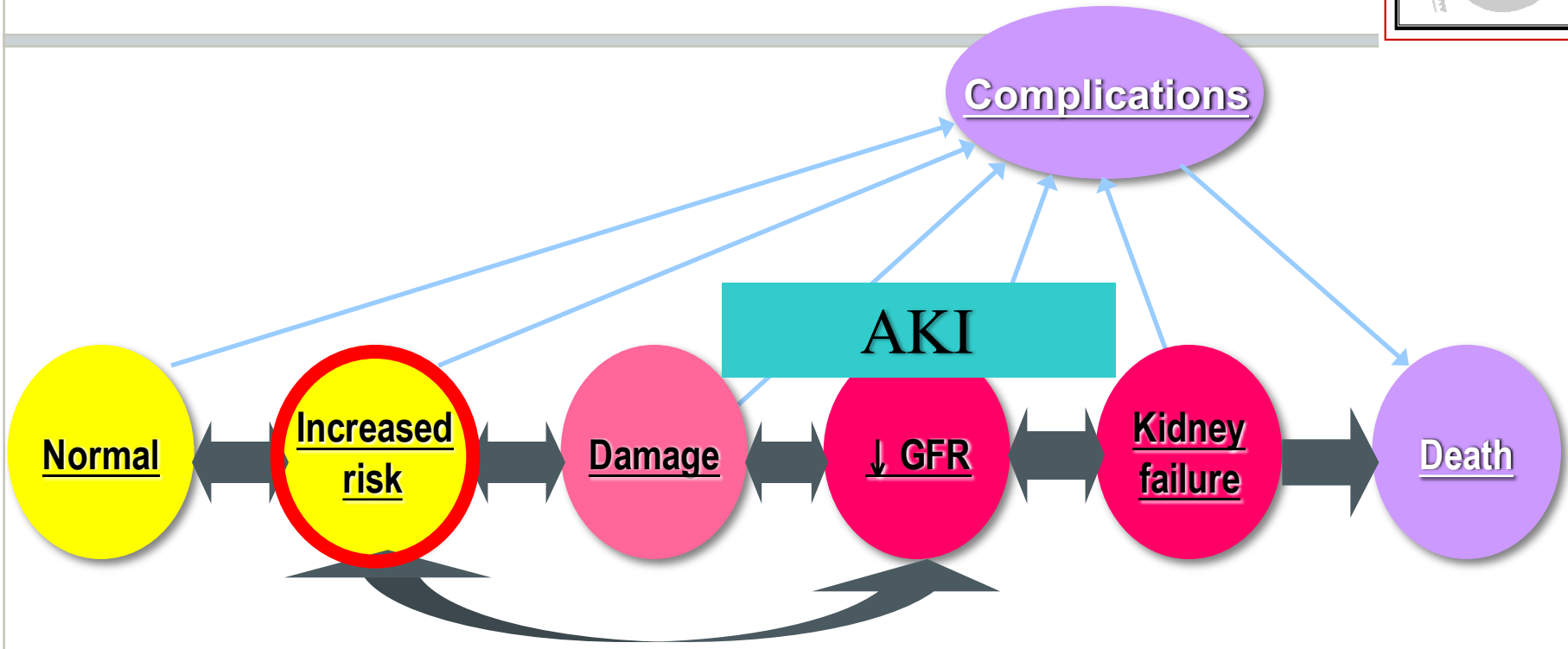


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2.2.2: Manage patients according to their susceptibilities and exposures to reduce the risk of AKI (see relevant guideline sections). (*Not Graded*)

2.2.3: Test patients at increased risk for AKI with measurements of SCr and urine output to detect AKI. (*Not Graded*) Individualize frequency and duration of monitoring based on patient risk and clinical course. (*Not Graded*)

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**Table 6 | Causes of AKI: exposures and susceptibilities for non-specific AKI**

| Exposures | Susceptibilities |
|---|---|
| Sepsis | Dehydration or volume depletion |
| Critical illness | Advanced age |
| Circulatory shock | Female gender |
| Burns | Black race |
| Trauma | CKD |
| Cardiac surgery (especially with CPB) | Chronic diseases (heart, lung, liver) |
| Major noncardiac surgery | Diabetes mellitus |
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**non-sp**

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| --- |
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| Critical i |
| Circulat |
| Burns |
| Trauma |
| Cardiac |
| with CP |
| Major n |
| Nephrot |
| Radioco |
| Poisono |

Yellow Oleander Flower

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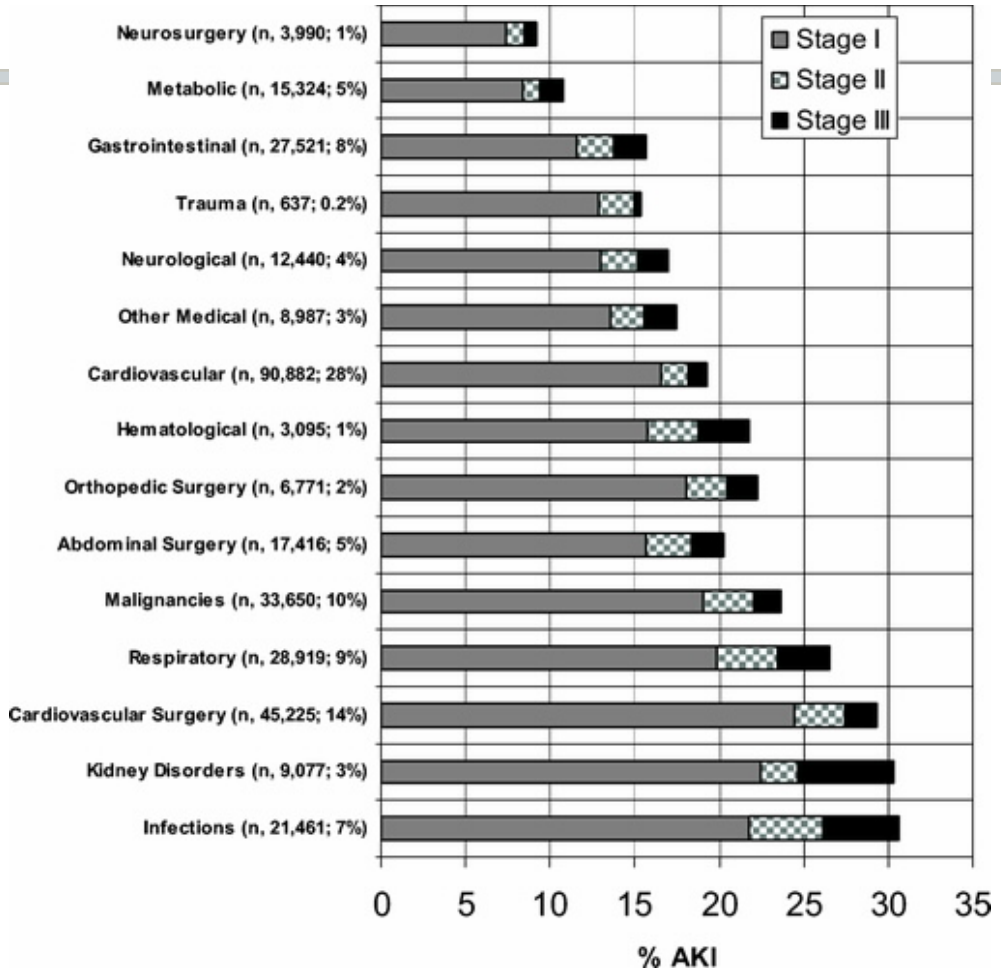
# Incidence and outcomes of acute kidney injury in intensive care units: A Veterans Administration study




**Risk Dependent on Cause**

CV Thakar et al, Crit Care Med 2009

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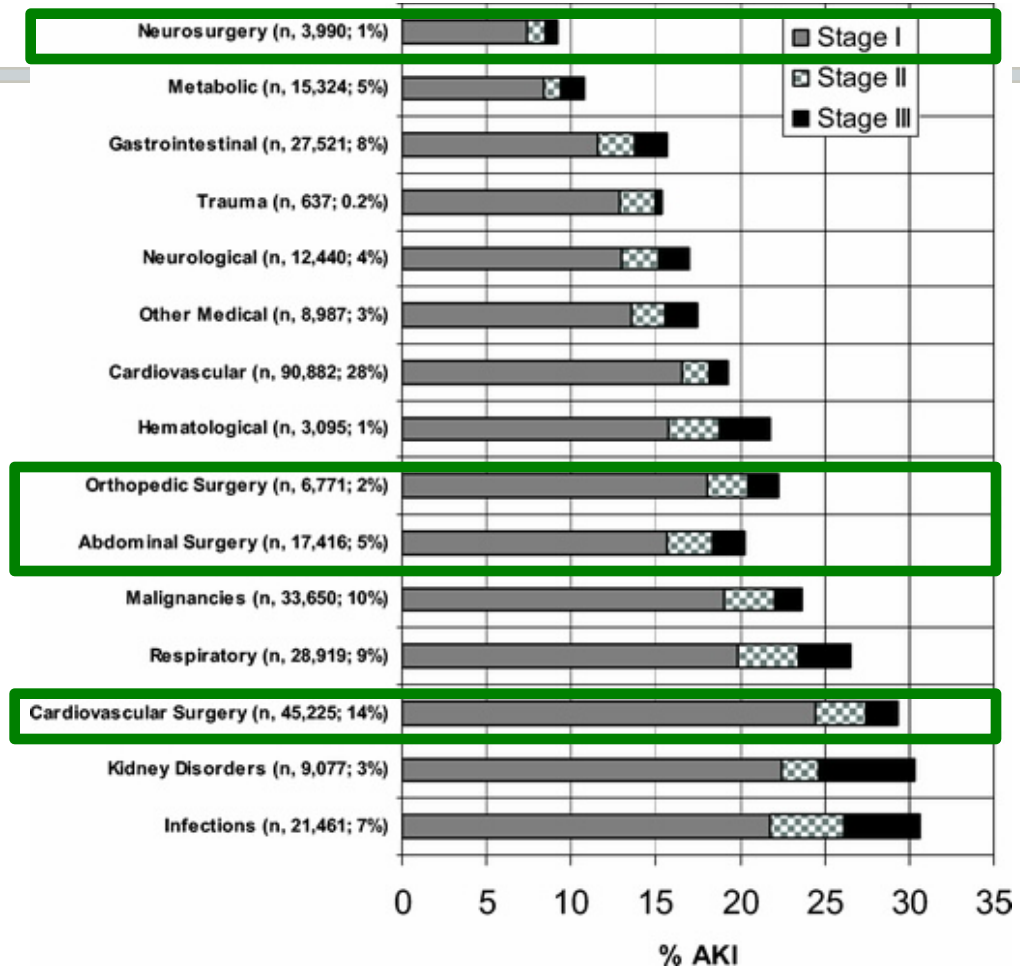


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CV Thakar et al, Crit Care Med 2009

# Can We Predict AKI??

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# Common Risk Factors In AKI Scores

- Age, Gender
- Hypotension, Oliguria
- Liver Failure, Hypoalbuminaemia
- Sepsis

# Common Risk Factors In AKI Scores

- Age, Gender
- Hypotension, Oliguria
- Liver Failure, Hypoalbuminaemia
- Sepsis
- **Mechanical Ventilation**

| Author/Study | Year | Number |
|---|---|---|
| Rasmussen | 1985 | 148 |
| Lohr | 1988 | 126 |
| Schaefer | 1991 | 134 |
| Liano | 1993 | 328 |
| Paganini | 1996 | 506 |
| Chertow | 1998 | 256 |
| Lins | 2000 | 197 |
| Mehta | 2002 | 605 |
| Lins | 2004 | 293 |
| Dharan | 2005 | 265 |
| Chertow | 2006 | 618 |
| Demirjian | 2011 | 1122 |

| Author/Study | Year | Number | AKI (?) |
|---|---|---|---|
| Rasmussen | 1985 | 148 | SCr > 160 |
| Lohr | 1988 | 126 | 50% Elevation |
| Schaefer | 1991 | 134 | RRT |
| Liano | 1993 | 328 | RRT |
| Paganini | 1996 | 506 | SCr > 160 |
| Chertow | 1998 | 256 | RRT |
| Lins | 2000 | 197 | Rise SCr > 80 |
| Mehta | 2002 | 605 | SCR > 160 |
| Lins | 2004 | 293 | SCr > 160 |
| Dharan | 2005 | 265 | 50% rise in SCr |
| Chertow | 2006 | 618 | SCr > 40 |
| Demirjian | 2011 | 1122 | SCr > 2 / RRT |

# Poorly Performing Variable Definitions

| Author/Study | Year | Number | AKI (?) |
|---|---|---|---|
| Mehta | 2002 | 605 | SCR > 160 |
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# What about in well defined populations?

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- **Cardiac Surgery**

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  - Known Baseline

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- Cardiac Surgery
  - Known Baseline
  - Timed Insult

# What about in well defined populations?

- Cardiac Surgery
  - Known Baseline
  - Timed Insult
  - Accurate Data Collection

The current models for AKI requiring dialysis are the most robust and externally validated. However, dialysis events are rare (1% to 2%) and frequently occur several days after the operation, limiting the benefit of application of these scoring systems. Models with a more sensi-

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**Variable Endpoints**
**Not Applicable to the Majority of our Patients**

**Can We Even Identify AKI?**

Original Paper

nephron Clinical Practice

Nephron Clin Pract 2013;123:143–150
DOI: 10.1159/000351509

Received: January 16, 2013
Accepted: April 16, 2013
Published online: July 25, 2013

# Identifying the Patient at Risk of Acute Kidney Injury: A Predictive Scoring System for the Development of Acute Kidney Injury in Acute Medical Patients

Lui G. Forni[a] Thomas Dawes[a] Hamish Sinclair[a] Elizabeth Cheek[c]
Vivien Bewick[c] Mark Dennis[b] Richard Venn[a]

[a]Department of Critical Care, Worthing Hospital, and [b]Department of Performance and Information, Western Sussex Hospitals Trust, Worthing, and [c]School of Computing, Mathematical and Information Sciences, University of Brighton, Brighton, UK

**Table 4.** APS – acute kidney injury prediction score

| | Score | | | |
|---|---|---|---|---|
| | 0 | 1 | 2 | 3 |
| Age | <60 | | 60–79 | ≥80 |
| RR | <20 | ≥20 | | |
| AVPU | alert | | | other |
| CKD stage 3a–5 | N | Y | | |
| CCF | N | Y | | |
| DM | N | | Y | |
| Liver disease | N | | | Y |

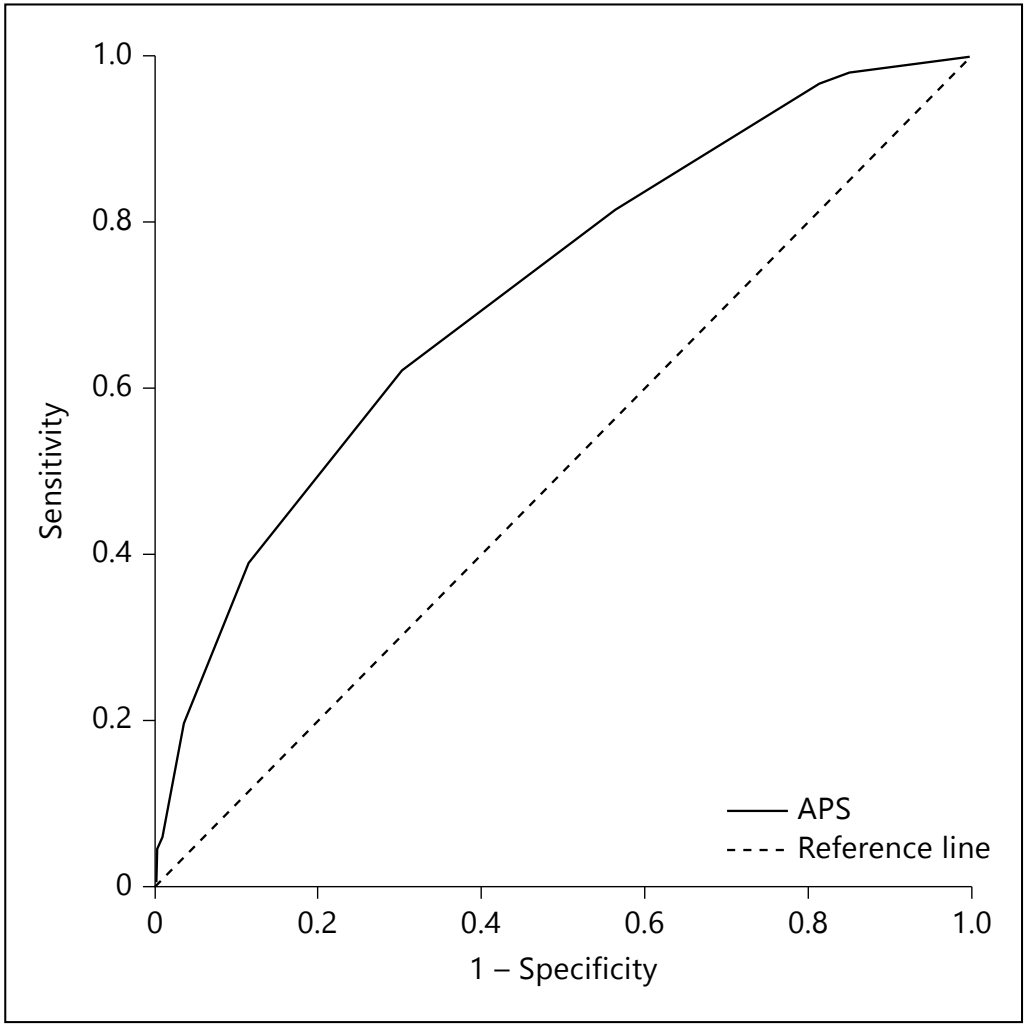
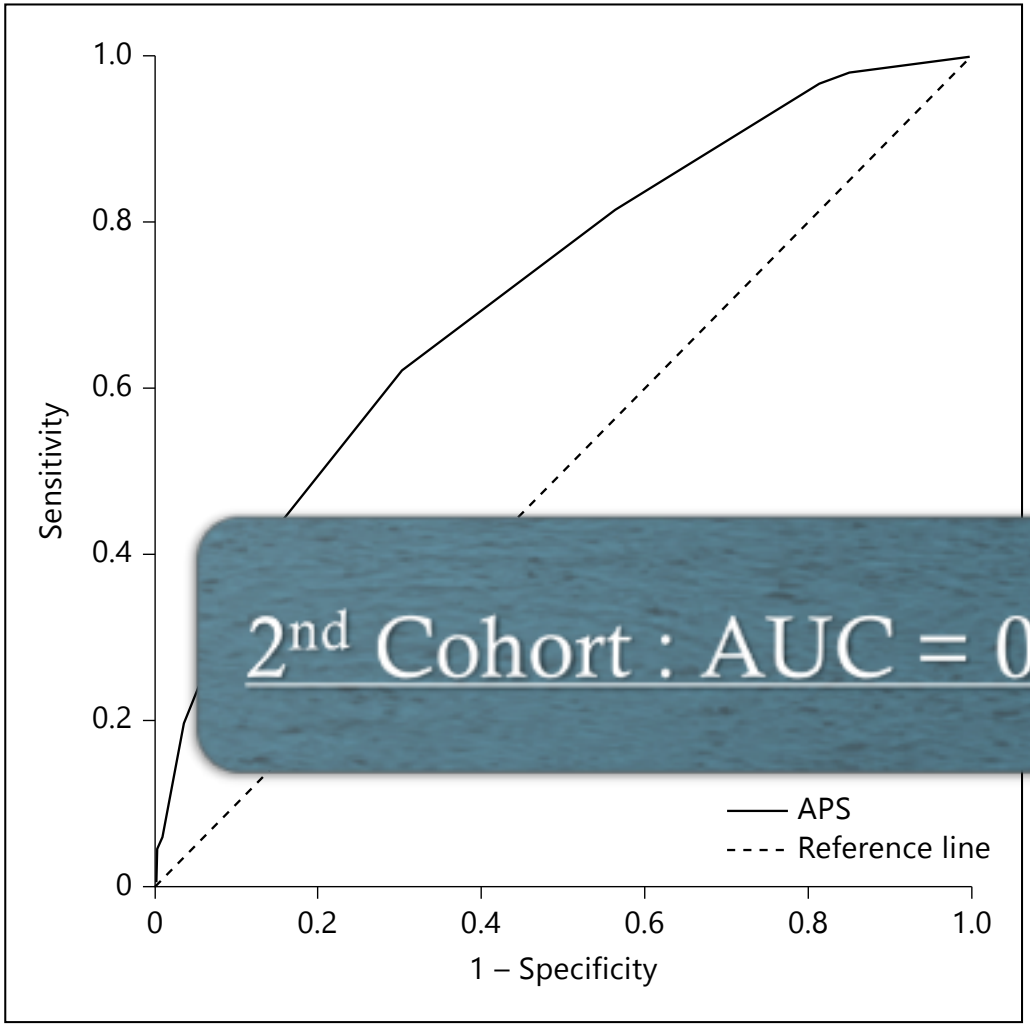



**Fig. 2.** Receiver operator characteristic curve for the AKI prediction score.

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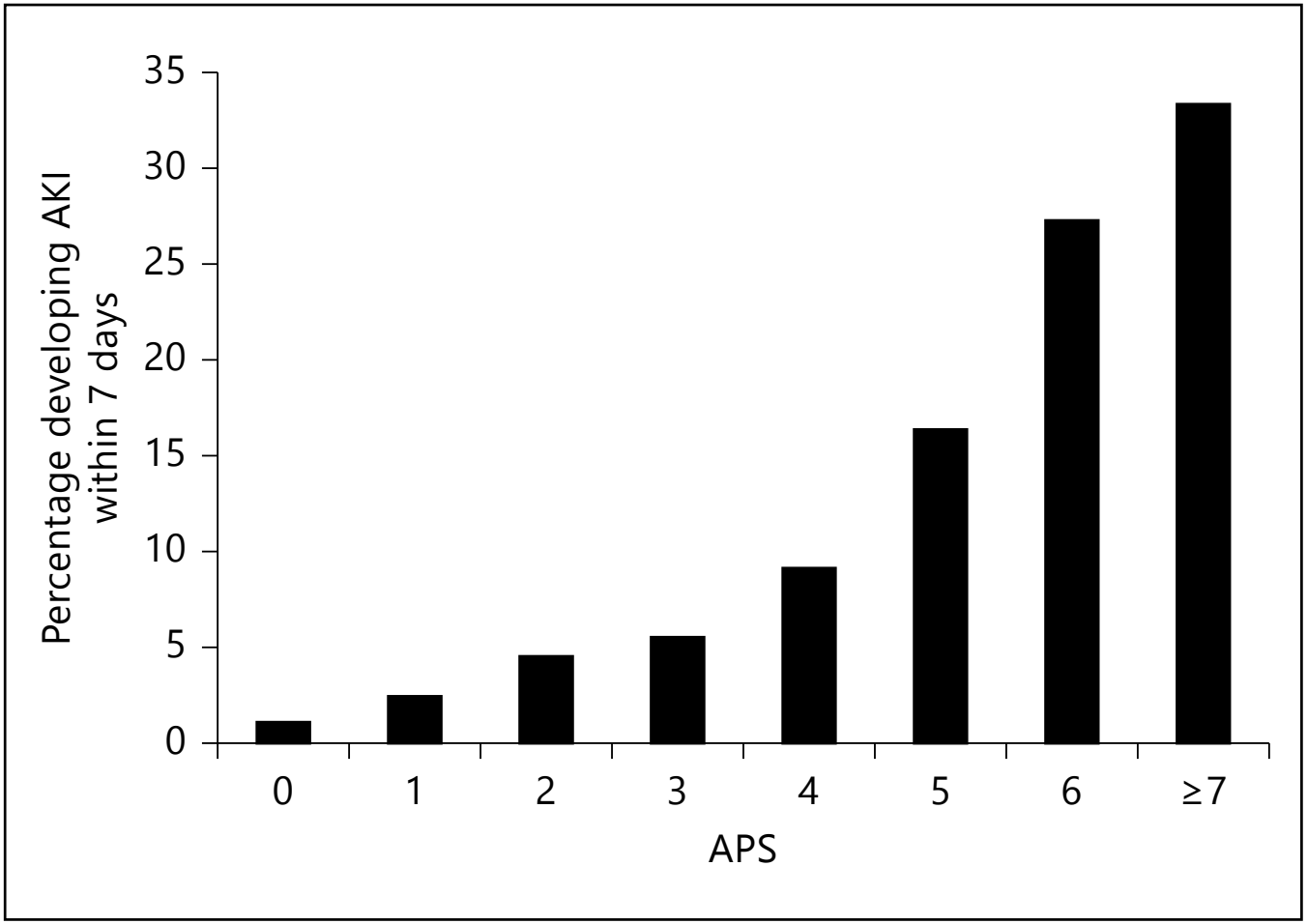
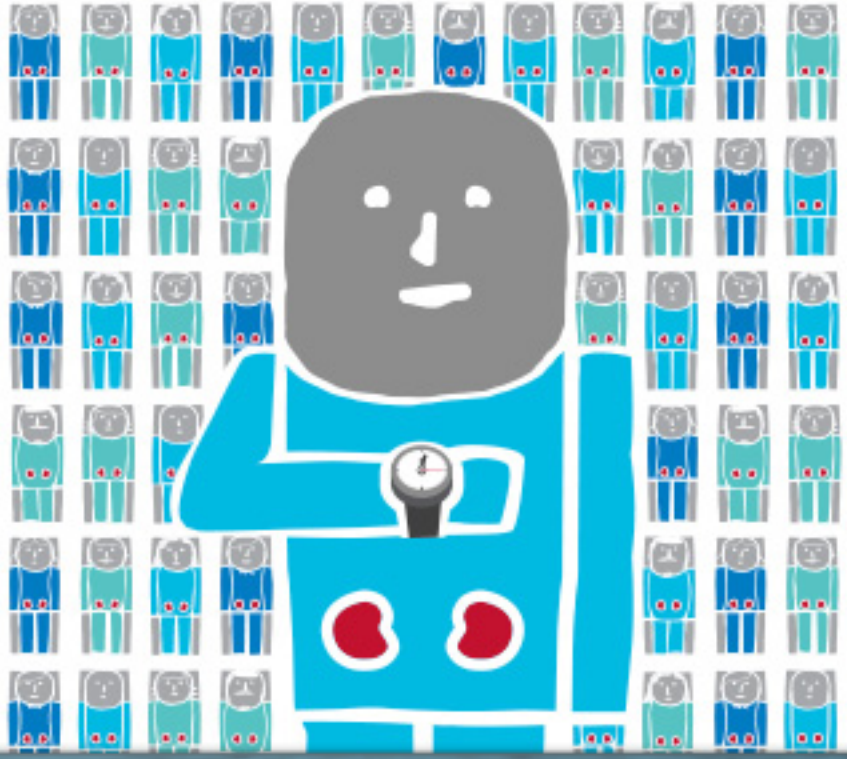



**Fig. 3.** Percentage of patients developing AKI within 7 days of admission according to the APS.



# When At Risk Identified? What Then?

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Step 2
Decide who might be harmed and how

Step 3
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# Prevention?

# How Do We Prevent AKI??

# Don’t Get Admitted to Hospital…

# UK Renal Association….

# UK Renal Association….

## 4. Acute Kidney Injury (AKI) (Guidelines AKI 4.1 – 4.5)

### Guideline 4.1 – AKI : Management; General Management

We recommend that general supportive measures include optimisation of haemodynamic status by appropriate fluid therapy, administration of vasopressors and/or inotropes and treatment of any underlying sepsis. Nephrotoxic medications should be stopped. (1A)

### Guideline 4.2 – AKI : Management; Pharmacological Therapy

We recommend that therapeutic drug dosing must be adapted to altered kinetics in AKI. (1B)

### Guideline 4.3 – AKI : Management; Pharmacological Therapy

We recommend that there is no specific pharmacological therapy proven to effectively treat AKI secondary to hypoperfusion injury and/or sepsis. (1B)

# UK Renal Association….

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2.2.3: Test patients at increased risk for AKI with measurements of SCr and urine output to detect AKI. (*Not Graded*) Individualize frequency and duration of monitoring based on patient risk and clinical course. (*Not Graded*)

So : Not a lot….

# Chapter 2.2: Risk assessment

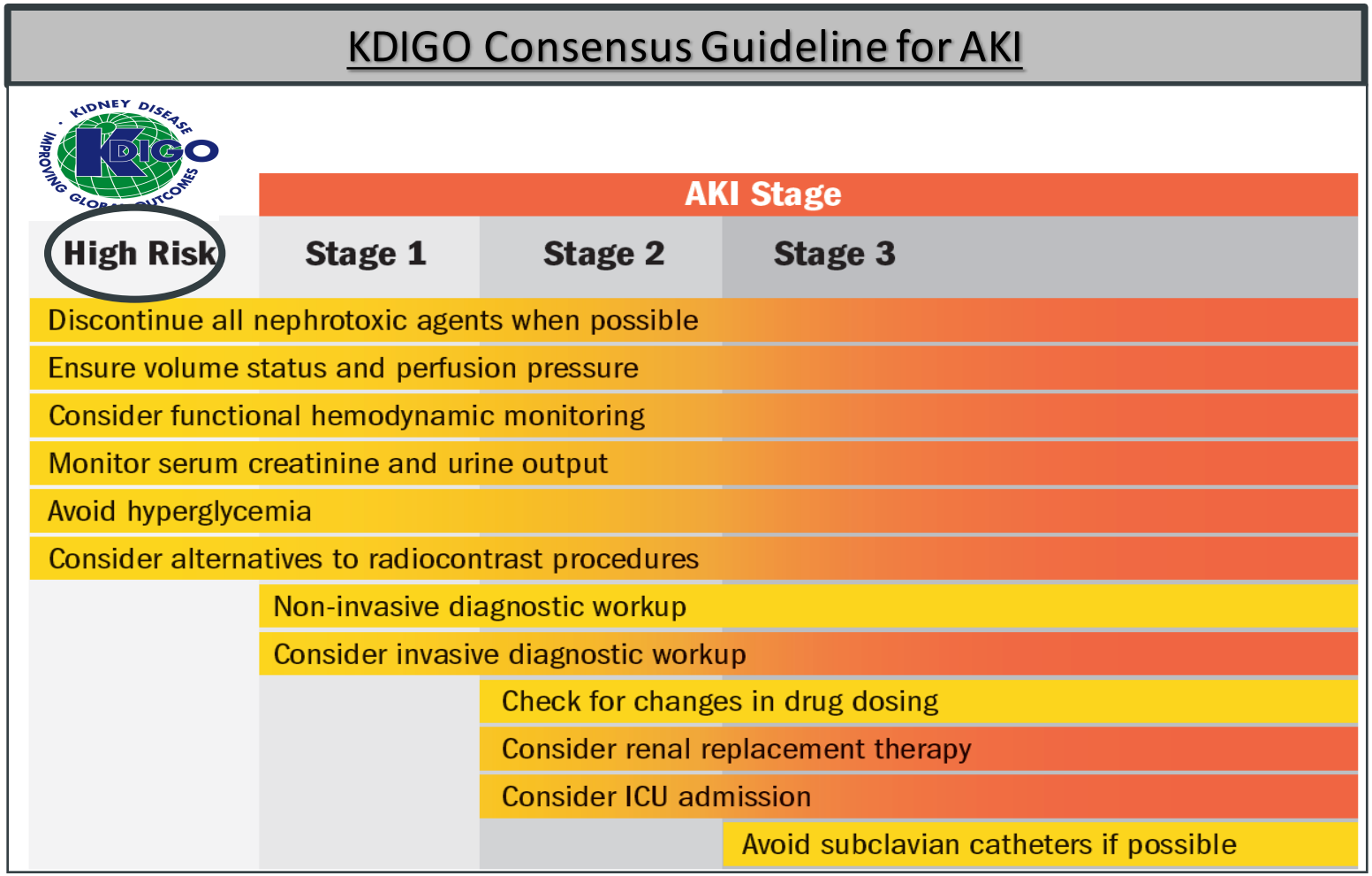
Intensive Care Med (2010) 36:379–380
DOI 10.1007/s00134-009-1683-1

EDITORIAL

Andrew Davenport

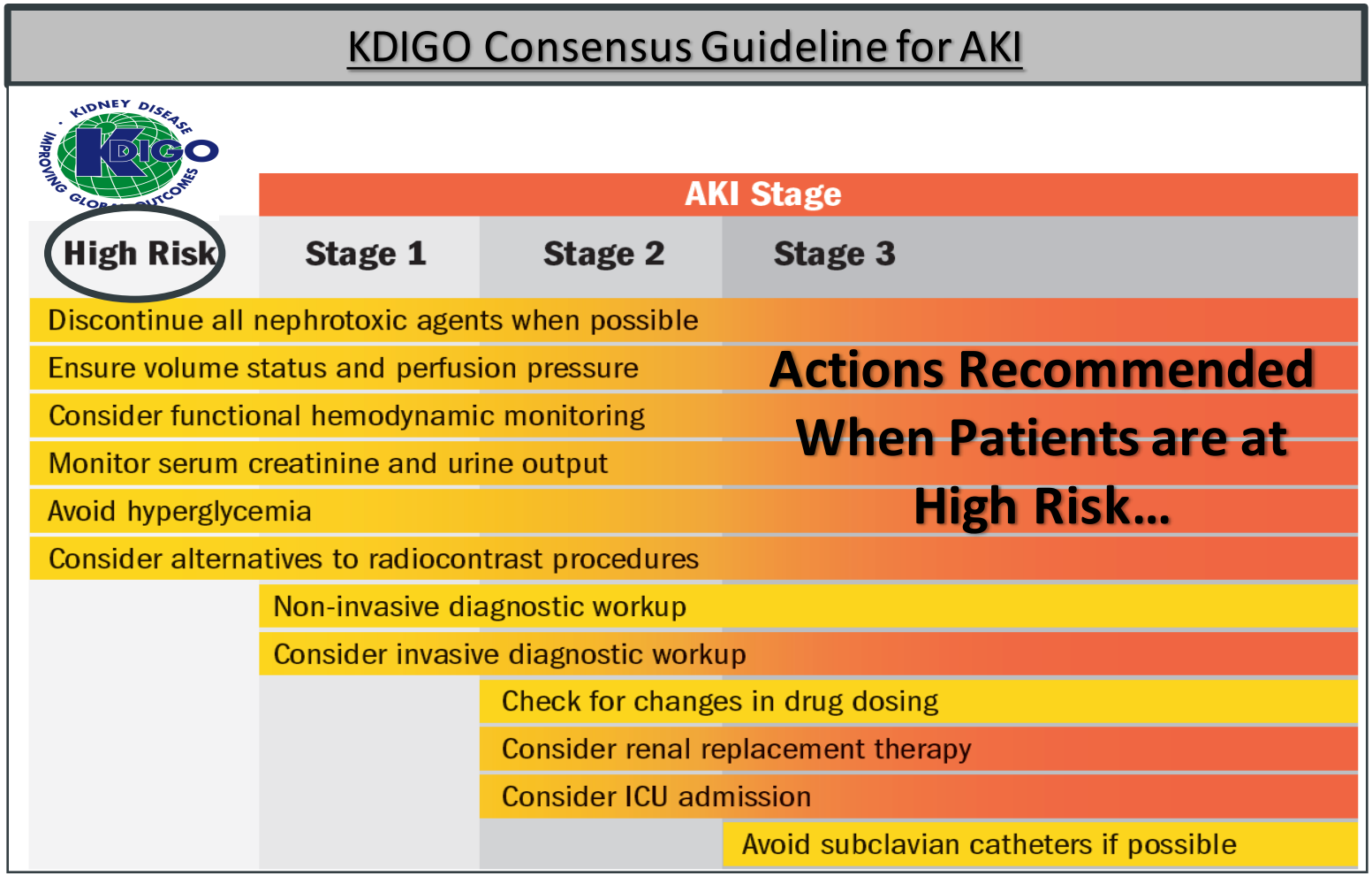
**Clinical guidelines for the protection of kidney function and prevention of acute kidney injury in the intensive care unit: common sense rather than magic bullets?**

# Stage Based Management Options




KDIGO: Kidney Disease Improving Global Outcomes; Kidney International Supplements (2012) 2, 1; doi: 0.1038/kisup.2012.1; MacLeod A. NCEPOD report on acute kidney injury- must do better. Lancet 2009; 374: 1405-1406

# Stage Based Management Options

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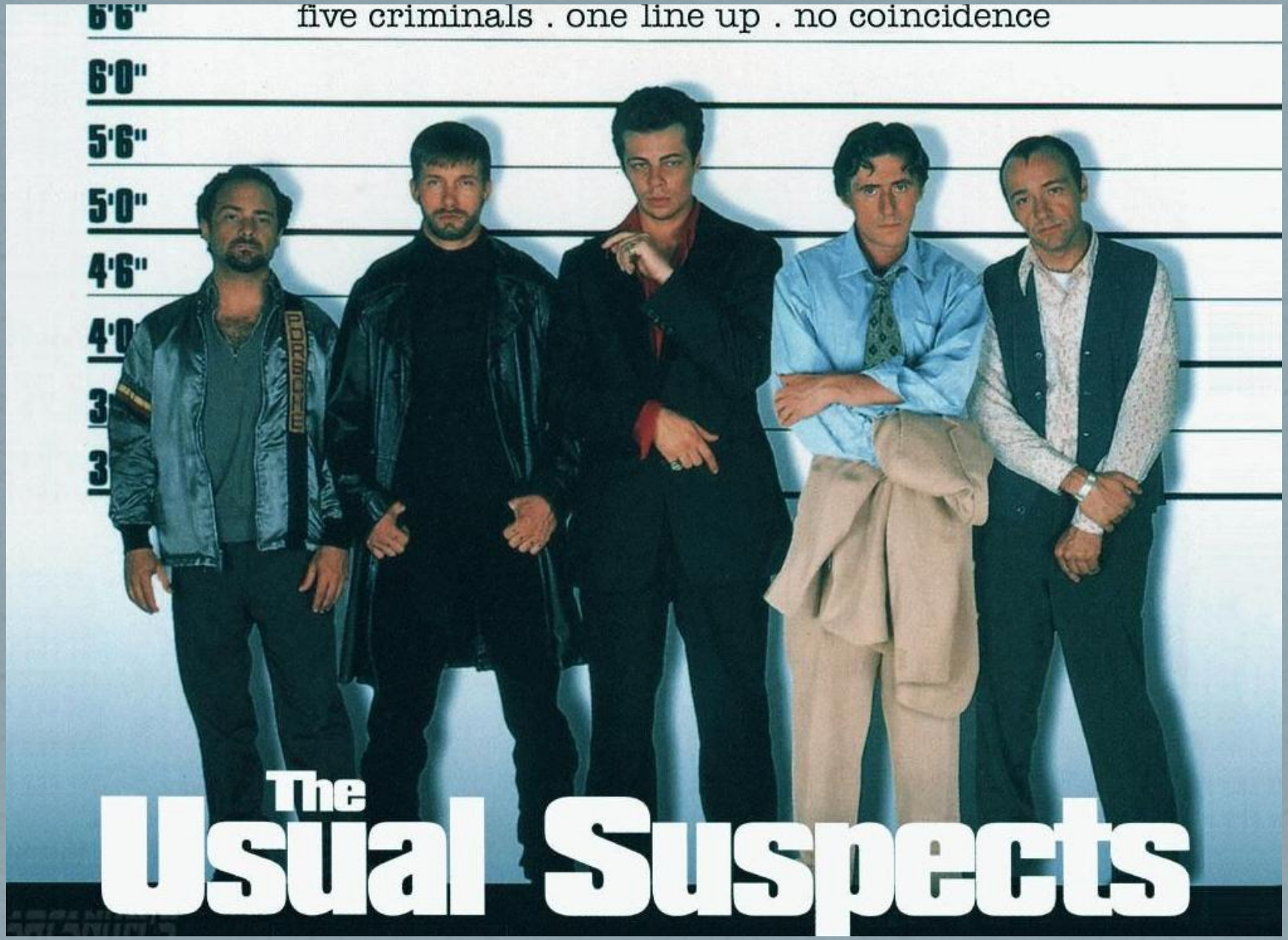
# Preventing AKI

- Often (always) multifactorial
- Can we expect to find a ‘cure-all’?

# Preventing AKI

- Often (always) multifactorial
- Can we expect to find a 'cure-all'?

- **What has been Tried?**


five criminals . one line up . no coincidence
6'6"
6'0"
5'6"
5'0"
4'6"
4'0"
3
3
The
Usual Suspects

# Vasoactive Drugs

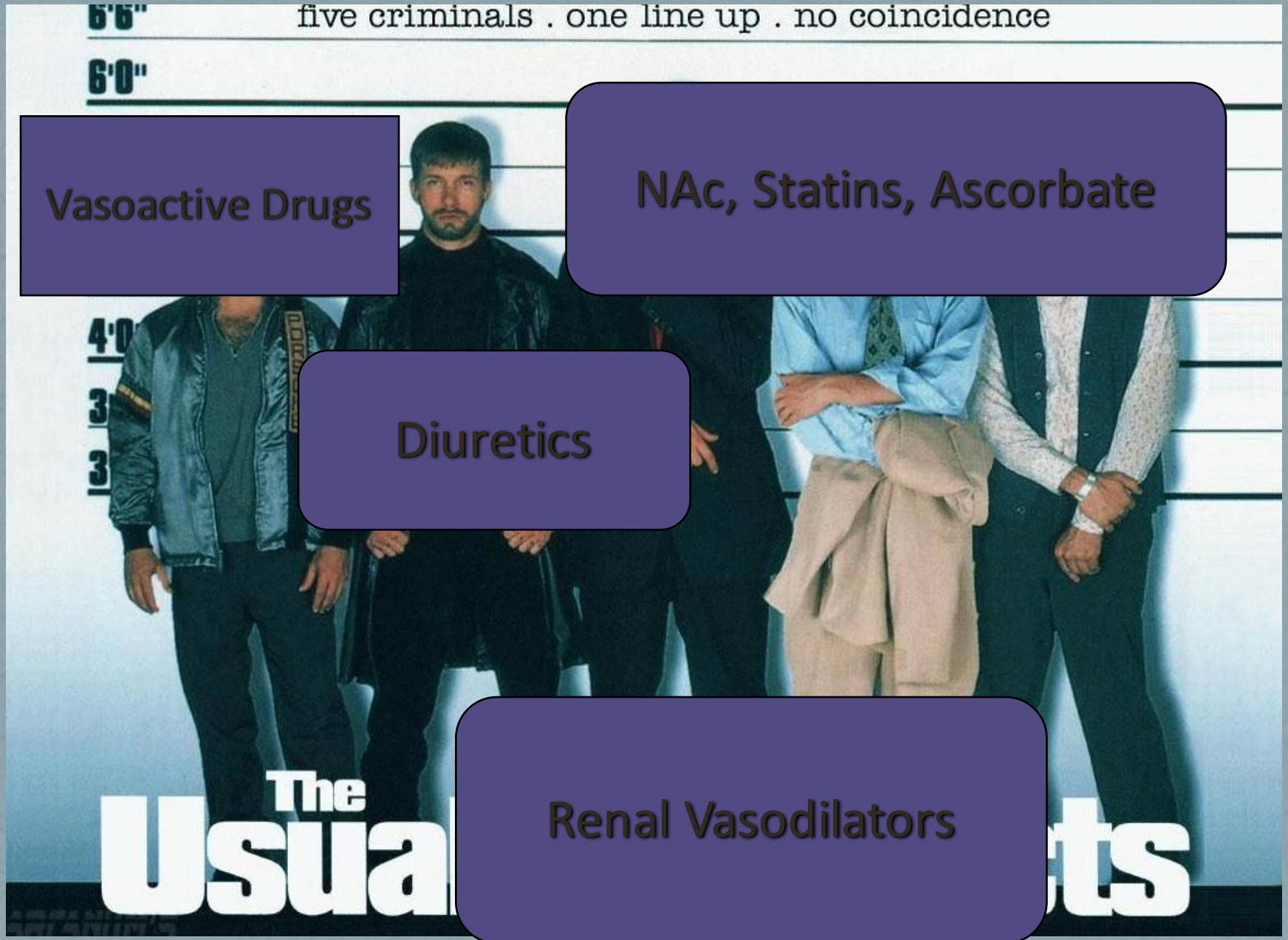

Vasoactive Drugs

Renal Vasodilators


Vasoactive Drugs

Diuretics

Renal Vasodilators

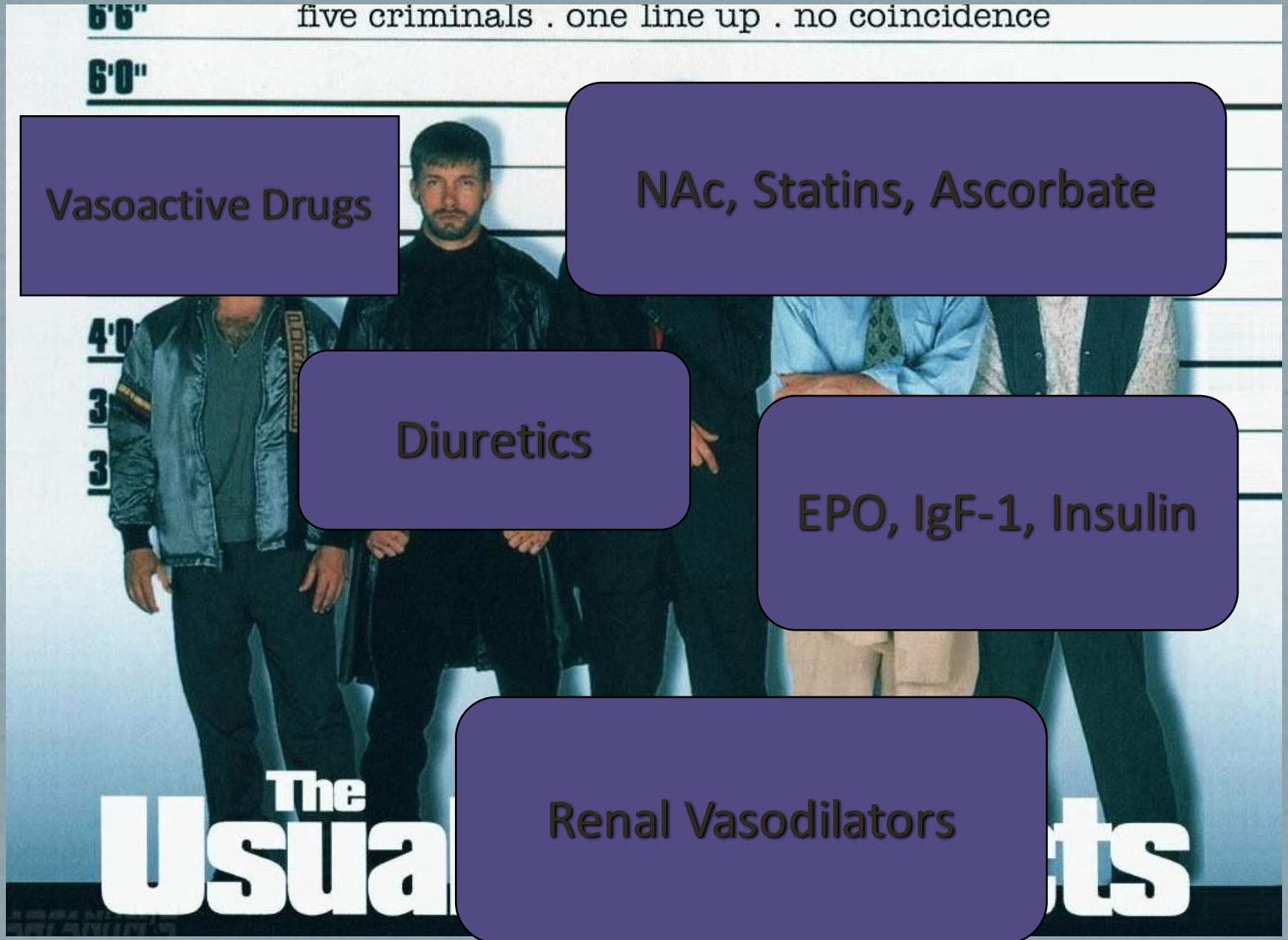



Vasoactive Drugs

NAc, Statins, Ascorbate

Diuretics

Renal Vasodilators




Vasoactive Drugs

NAc, Statins, Ascorbate

Diuretics

EPO, IgF-1, Insulin

Renal Vasodilators

MESNA

Carvedilol

Retinoic Acid

Statins

Pentoxifyline

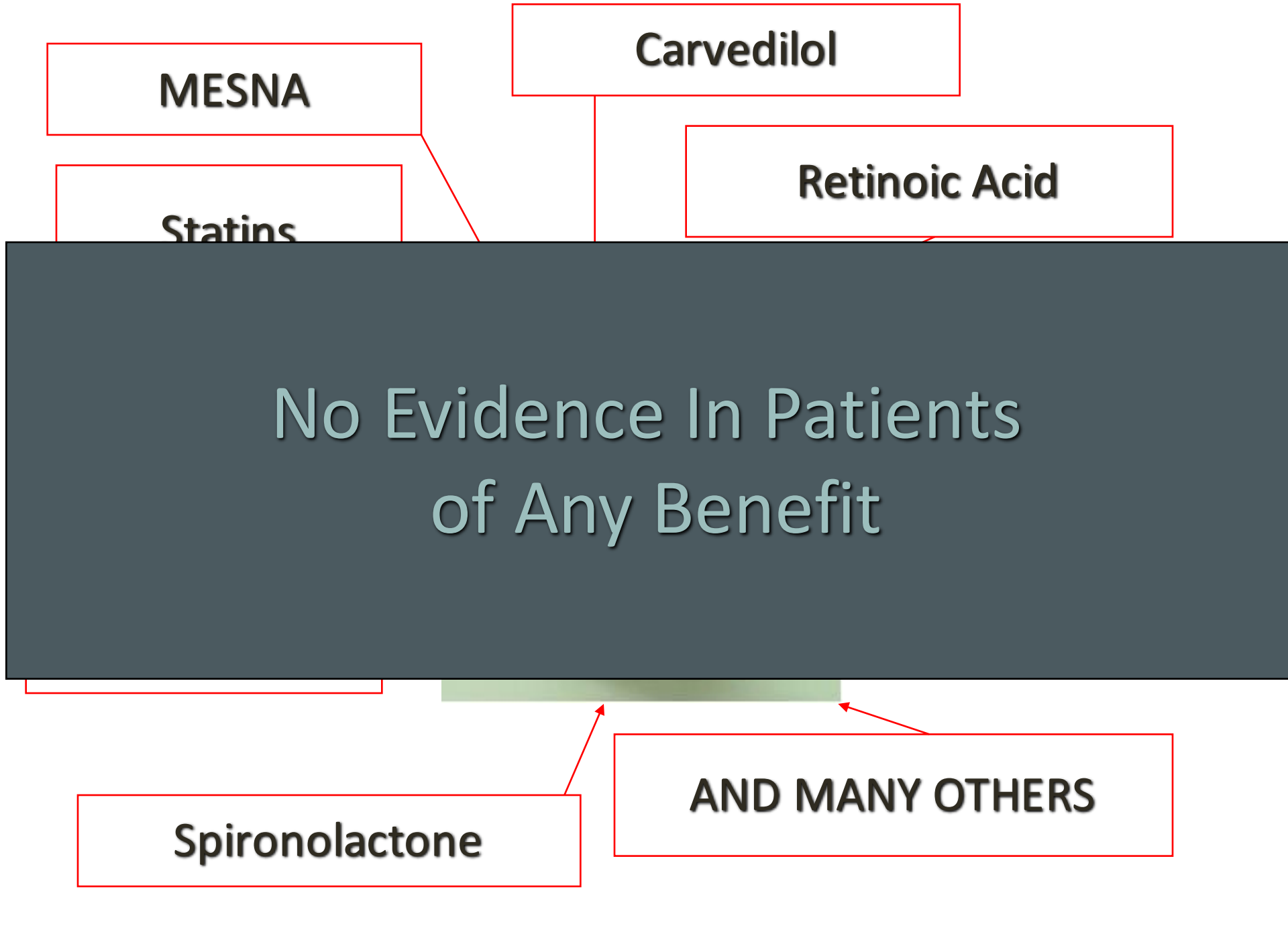
Silymarin

Urodilatin

Urodilatin

AND MANY OTHERS

Spironolactone


Carvedilol
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No Evidence In Patients of Any Benefit
Spironolactone
AND MANY OTHERS

# Preventing AKI: Fluids

- Fluid replacement : Must be a good thing
- But which fluid??

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Despite the recognition of volume depletion as an important risk factor for AKI, there are no randomized controlled trials (RCTs) that have directly evaluated the role of fluids vs. placebo in the prevention of AKI. However, RCTs mostly in the field of CI-AKI have

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Not entirely surprising…

# Preventing AKI: Colloids?

ORIGINAL ARTICLE

## Hydroxyethyl Starch or Saline for Fluid Resuscitation in Intensive Care

John A. Myburgh, M.D., Ph.D., Simon Finfer, M.D., Rinaldo Bellomo, M.D., Laurent Billot, M.Sc., Alan Cass, M.D., Ph.D., David Gattas, M.D., Parisa Glass, Ph.D., Jeffrey Lipman, M.D., Bette Liu, Ph.D., Colin McArthur, M.D., Shay McGuinness, M.D., Dorrilyn Rajbhandari, R.N., Colman B. Taylor, M.N.D., and Steven A.R. Webb, M.D., Ph.D. for the CHEST Investigators and the Australian and New Zealand Intensive Care Society Clinical Trials Group

N Engl J Med 2012; 367:1901-1911 | November 15, 2012 | DOI: 10.1056/NEJMoa1209759

# Preventing AKI: Colloids?

**CONCLUSIONS**

In patients in the ICU, there was no significant difference in 90-day mortality between patients resuscitated with 6% HES (130/0.4) or saline. However, more patients who received resuscitation with HES were treated with renal-replacement therapy. (Funded by the National Health and Medical Research Council of Australia and others; CHEST ClinicalTrials.gov number, NCT00935168.)

# Preventing AKI: Colloids?

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Evidence that colloids increase the need for RRT…

# Which Fluid…..

RESEARCH Open Access

## Hyperoncotic colloids and acute kidney injury: a meta-analysis of randomized trials

Christian J Wiedermann[1*], Stefan Dunzendorfer[2], Luigi U Gaioni[1], Francesco Zaraca[3], Michael Joannidis[2]

# Which Fluid…..

**Key messages**

- It has been hypothesized that hyperoncotic colloid solutions may damage the kidney. A meta-analysis of randomized controlled trials was performed to test this hypothesis.
- Hyperoncotic albumin decreased the odds of acute kidney injury by 76% and of death by 48%.
- Hyperoncotic hydroxyethyl starch increased the odds of acute kidney injury by 92% and of death by 41%.
- Hyperoncotic colloids *per se* do not appear to be harmful to the kidney.
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# Simplified Severe Sepsis Protocol: A Randomized Controlled Trial of Modified Early Goal–Directed Therapy in Zambia*

Andrews, Ben MD[1,2,3]; Muchemwa, Levy MBChB[3]; Kelly, Paul MD, FRCP[4]; Lakhi, Shabir MBChB, MMed, MPH[3,5]; Heimburger, Douglas C. MD, MS, FACP[1]; Bernard, Gordon R. MD[6]

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# Section 3: Prevention and Treatment of AKI

## FLUIDS

**3.1.1:** In the absence of hemorrhagic shock, we suggest using isotonic crystalloids rather than colloids (albumin or starches) as initial management for expansion of intravascular volume in patients at risk for AKI or with AKI. (*2B*)

# Diuretics

Rationale

- Reduced $O_2$ Consumption
- Increased Tubular Flow
- Increased Urea Excretion
- Volume Management

# High-dose Furosemide in patients with Established AKI

**Table 2. Study End Points in the Population Assessable for Efficacy With Stratification According to SAPS**

| | Furosemide (n = 166) | Placebo (n = 164) | Significance (*P*) |
|---|---|---|---|
| Patients alive at the end of the study (n = 221) | | | |
| SAPS ≤15 | 60 | 67 | 0.36* |
| SAPS >15 | 47 | 47 | |
| Total | 107 | 114 | |
| Deaths (n = 109) | | | |
| SAPS ≤15 | 16 | 11 | |
| SAPS >15 | 43 | 39 | |
| Total | 59 | 50 | |
| No. of RRT sessions | | | |
| SAPS ≤15 | 5.6 ± 5.5 | 5.7 ± 4.5 | 0.37† |
| SAPS >15 | 7.3 ± 5.3 | 7.9 ± 5.6 | |
| Total | 6.5 ± 5.4 | 6.9 ± 5.3 | |
| Time on RRT (d) | 11.4 ± 8.6 | 12.4 ± 8.7 | 0.21† |
| Time to achieve a serum creatinine level <2.26 mg/dL without RRT (d) | 19.7 ± 40.6 | 21.4 ± 65.1 | 0.99† |
| Time to achieve a 2-L/d diuresis (d) | 5.7 ± 5.8 | 7.8 ± 6.8 | 0.004† |

Cantarovic F, Am J Kidney Dis 2004

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Cantarovic F, Am J Kidney Dis 2004

Nephrol Dial Transplant (1997) 12: 2592–2596

Nephrology
Dialysis
Transplantation

*Original Article*

# Loop diuretics in the management of acute renal failure: a prospective, double-blind, placebo-controlled, randomized study

I. R. Shilliday[1], K. J. Quinn[2] and M. E. M. Allison[1,3]

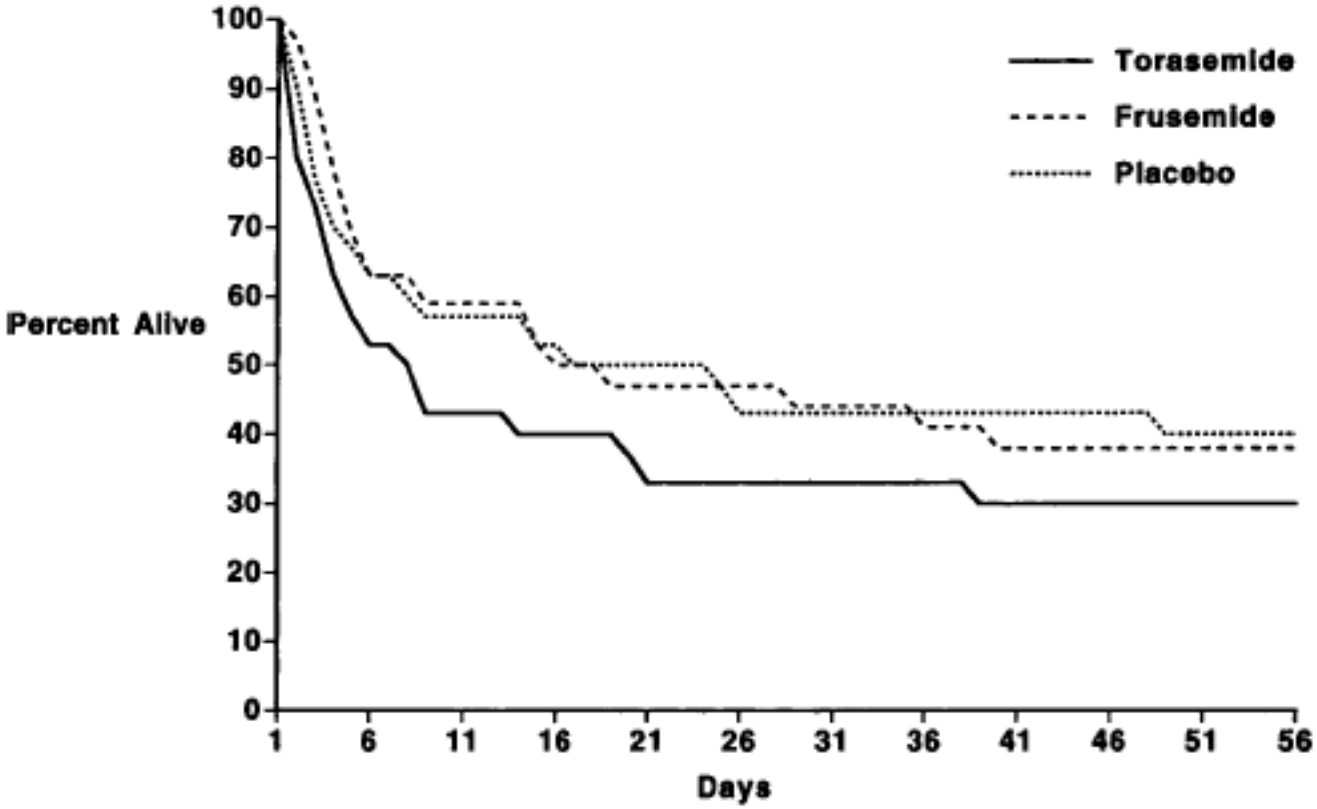



**Fig. 1.** Actuarial survival for the three groups of study patients, placebo, frusemide, and torasemide up to day 56.

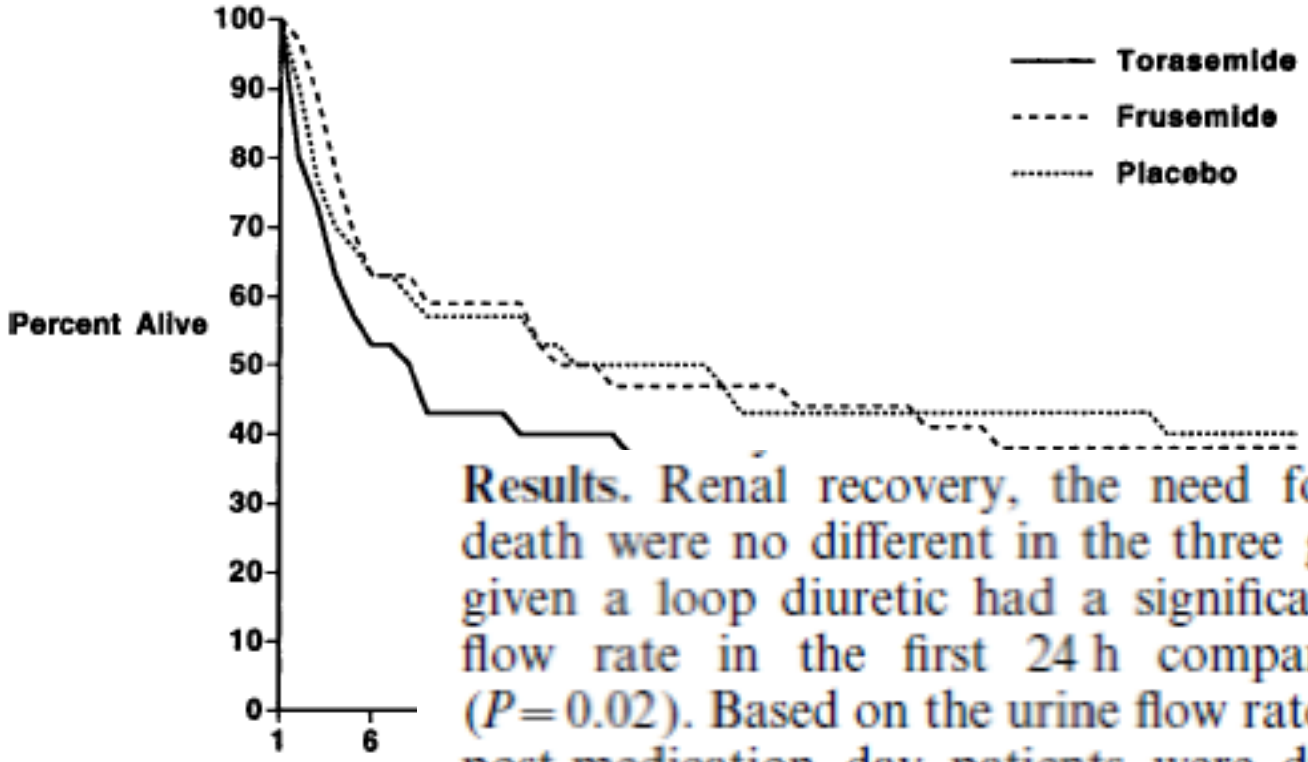
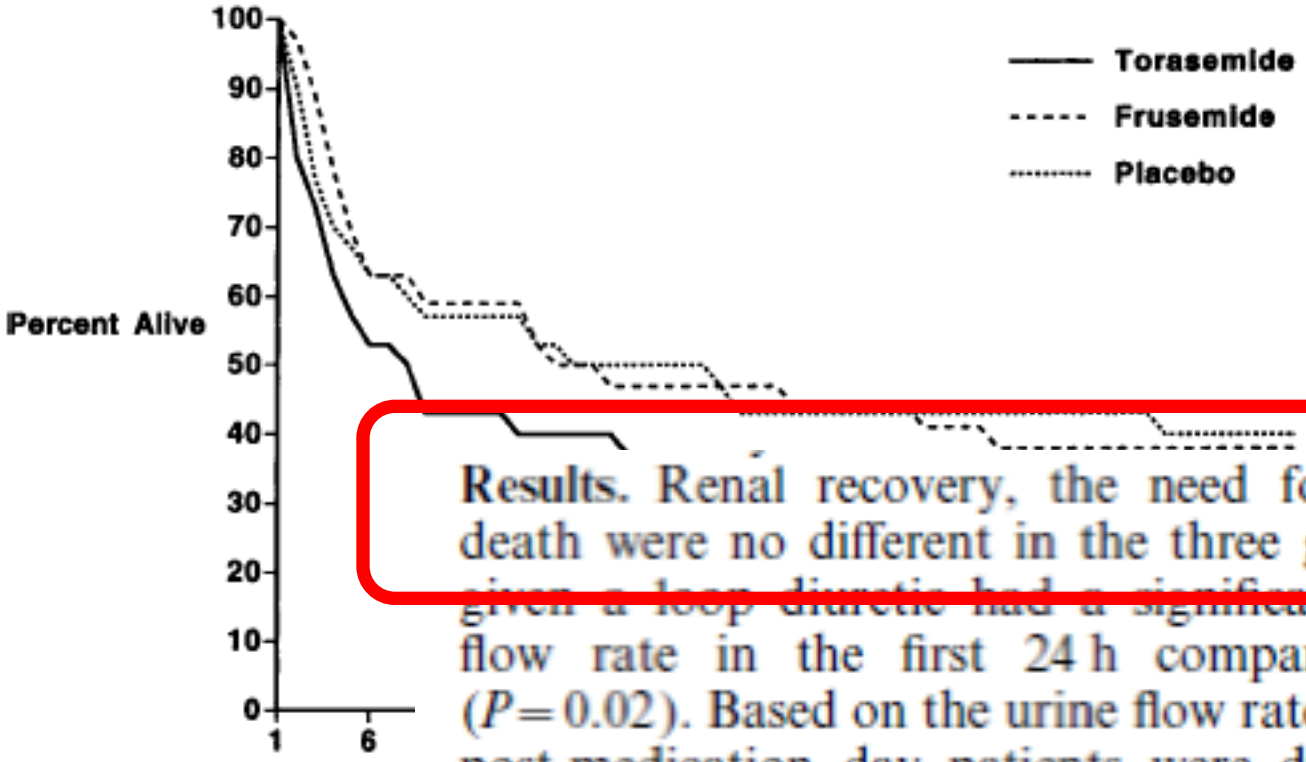



Fig. 1. Actuarial survival for the

**Results.** Renal recovery, the need for dialysis, and death were no different in the three groups. Patients given a loop diuretic had a significant rise in urine flow rate in the first 24 h compared to placebo ($P=0.02$). Based on the urine flow rate during the first post-medication day patients were divided into two groups—oliguric ($<50$ ml/h) and non-oliguric ($\geqslant 50$ ml/h). Non-oliguric patients had a significantly lower mortality than oliguric patients (43% *vs* 69%, $P=0.01$). However, they were less ill (APACHE II score 17.2 *vs* 20.6, $P=0.008$) and had less severe renal failure at entry (creatinine clearance 14 ml/min *vs* 4 ml/min, $P<0.0001$).

**Conclusion.** The use of loop diuretics in oliguric patients with ARF can result in a diuresis. There is no evidence that these drugs can alter outcome.

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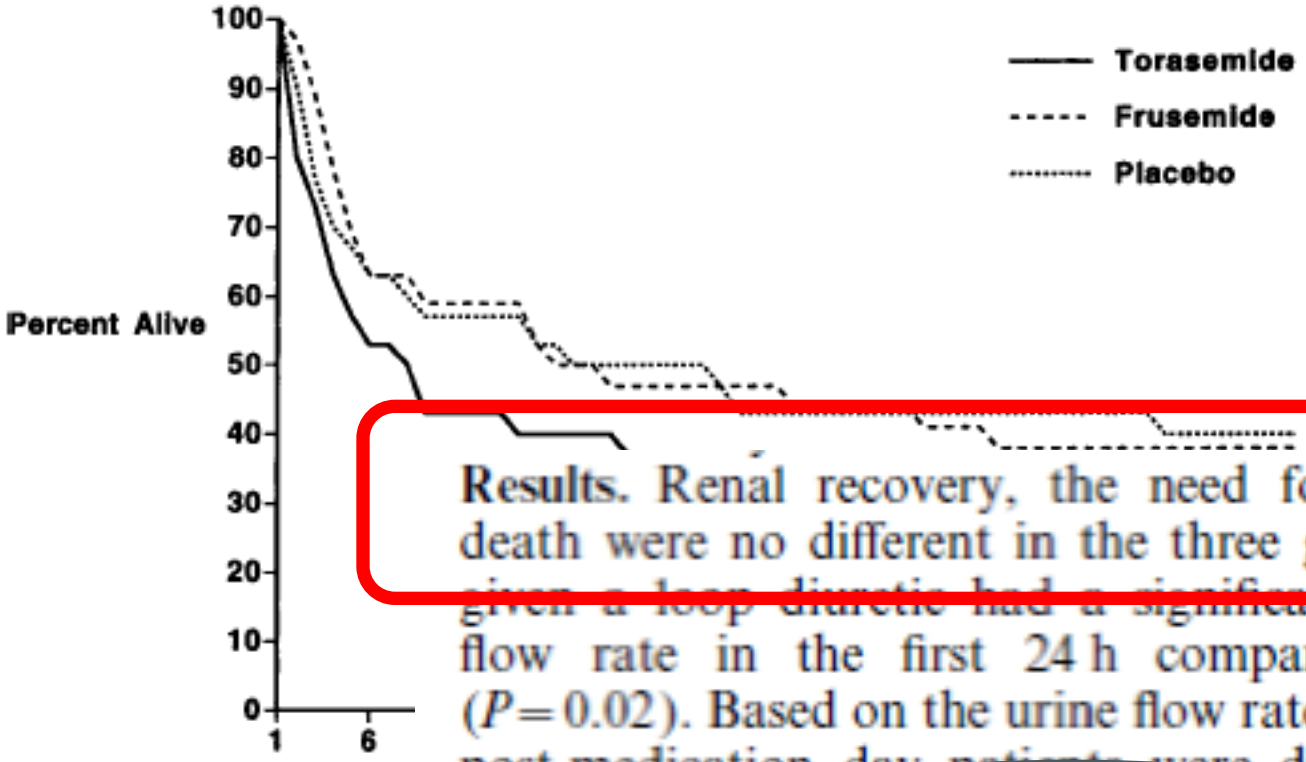


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# Chapter 3.4: The use of diuretics in AKI

**3.4.1:** We recommend not using diuretics to prevent AKI. (*1B*)

**3.4.2:** We suggest not using diuretics to treat AKI, except in the management of volume overload. (*2C*)

# Dopamine

- Rationale
- ? Preferential Renal Vasodilatation
- ?Evidence

# Effect of ´low-dose´ dopamine on Renal Resistive Index

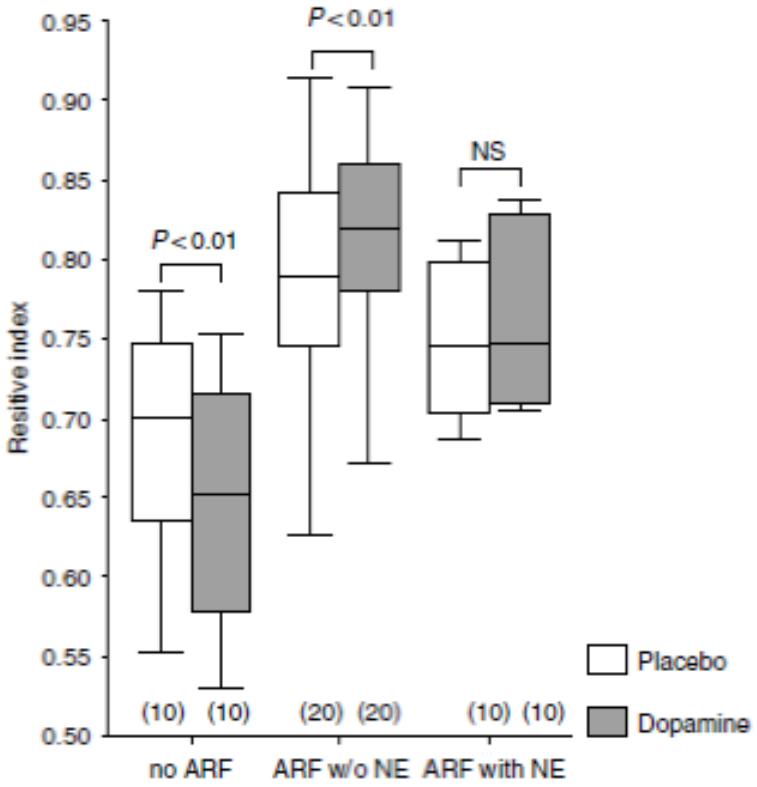


**Figure 5 | Effect of dopamine on RI values in patients with and without norepinephrine (NE) infusion.**

Lauschke A, Kidney Int 2006

# Effect of ´low-dose´ dopamine on Renal Resistive Index


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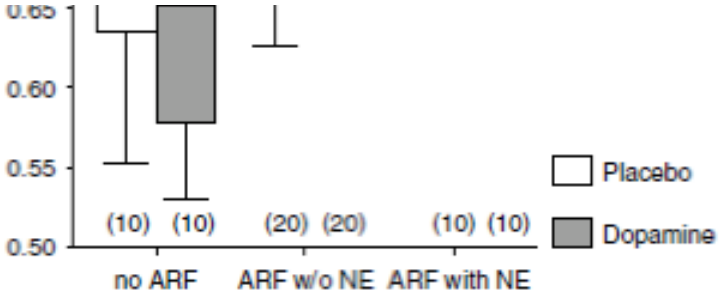
*Kidney International* (2006) **69,** 1669–1674. doi:10.1038/sj.ki.5000310;

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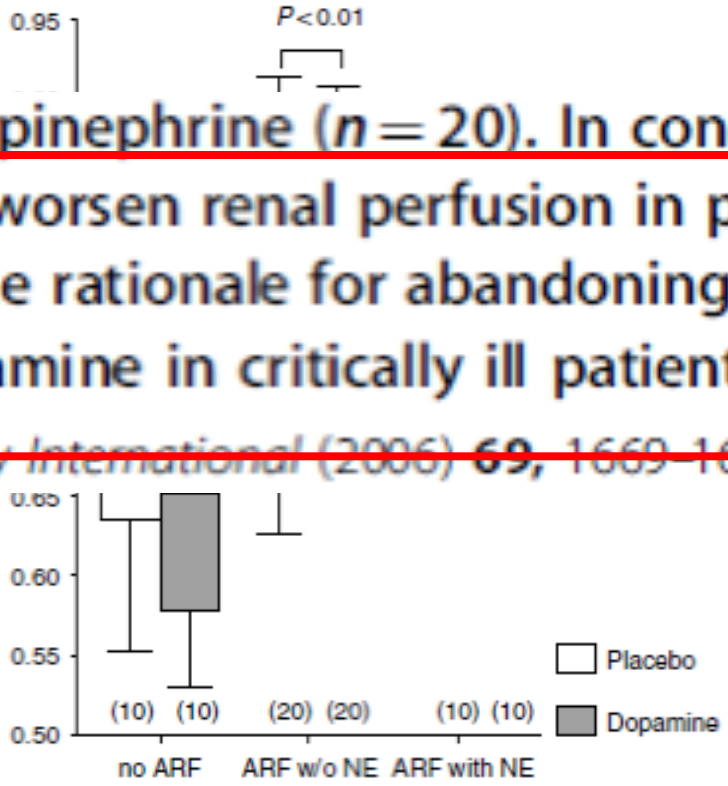


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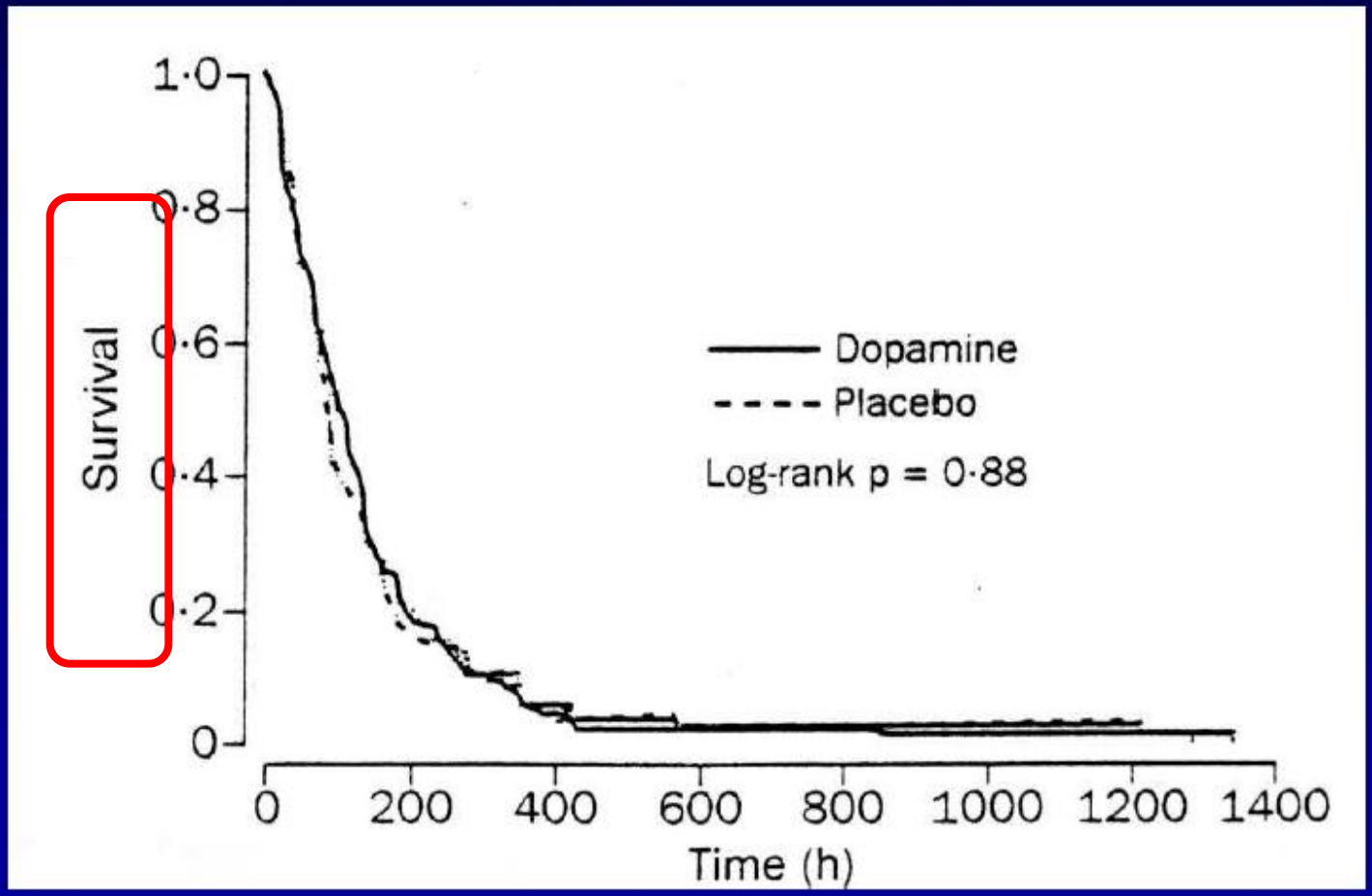
# DOPAMINE DOES NOT PREVENT AKI

## RCT - dopamine 2μg/kg/min throughout ITU stay




Lancet 2000;356:2139

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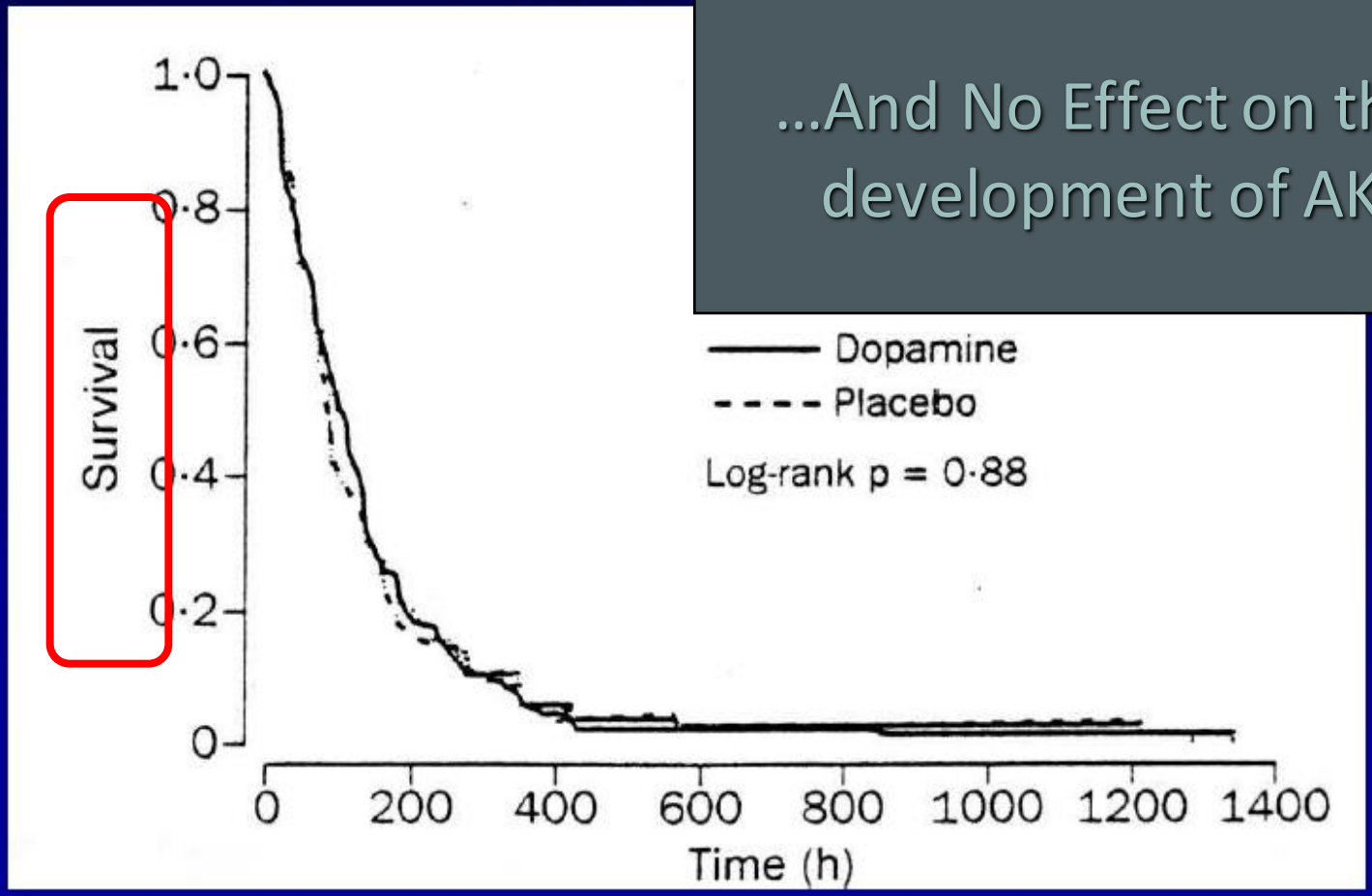



…And No Effect on the development of AKI

Lancet 2000;356:2139

# Chapter 3.5: Vasodilator therapy: dopamine, fenoldopam, and natriuretic peptides

**3.5.1:** We recommend not using low-dose dopamine to prevent or treat AKI. (*1A*)

**3.5.2:** We suggest not using fenoldopam to prevent or treat AKI. (*2C*)

**3.5.3:** We suggest not using atrial natriuretic peptide (ANP) to prevent (*2C*) or treat (*2B*) AKI.

# What of Vasoconstrictors?

Care Med (2010) 36:83–91
007/s00134-009-1687-x

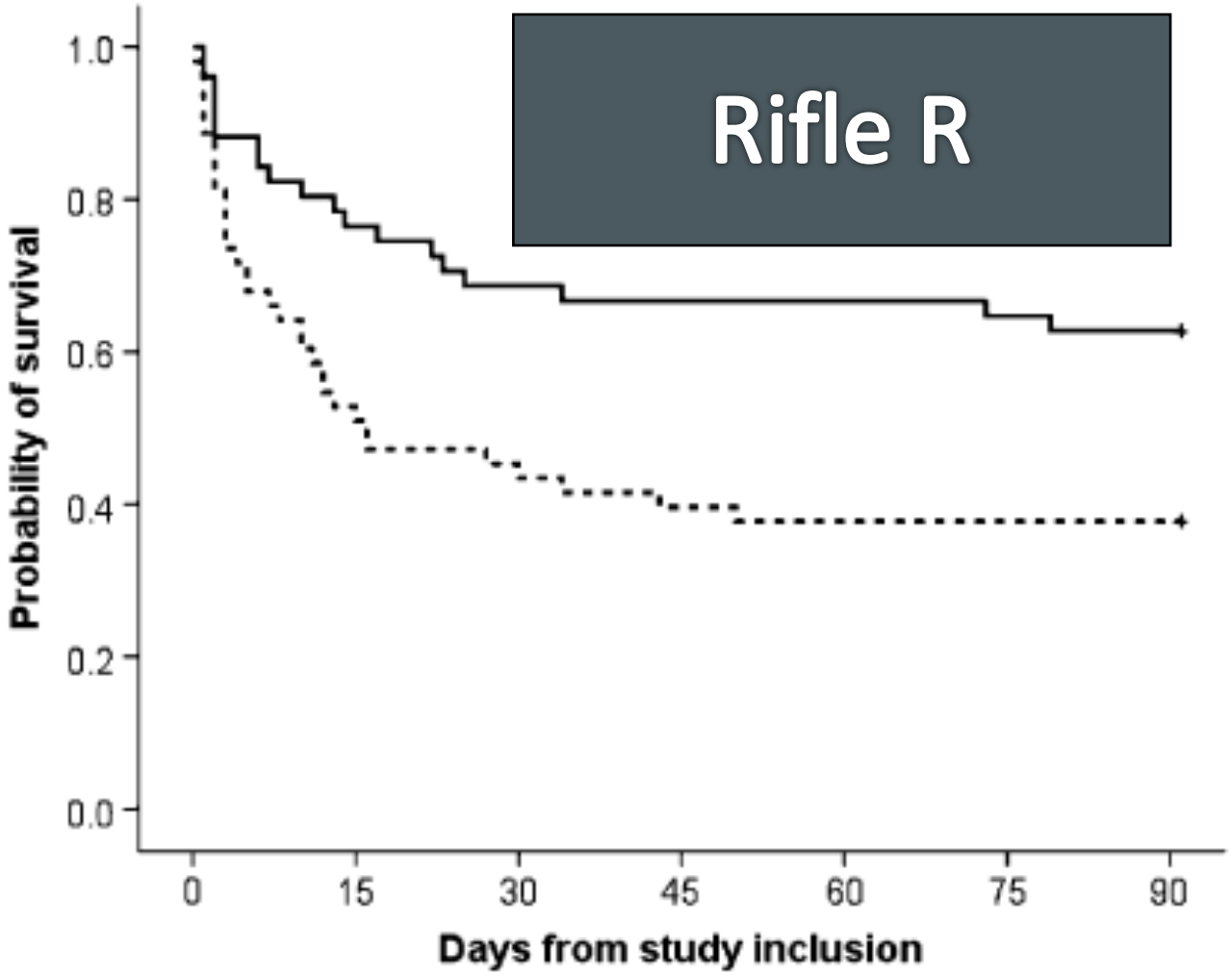
ORIGINAL

y C. Gordon
A. Russell
. Walley
ger
Ayers
e M. Storms
L. Holmes
Hébert
es Cooper
a Mehta
Granton
h J. Cook
J. Presneill

## The effects of vasopressin on acute kidney injury in septic shock

category was significant in predicting mortality. *Conclusions:* Vasopressin may reduce progression to renal failure and mortality in patients at risk of kidney injury who have septic shock.

# What of Vasoconstrictors?



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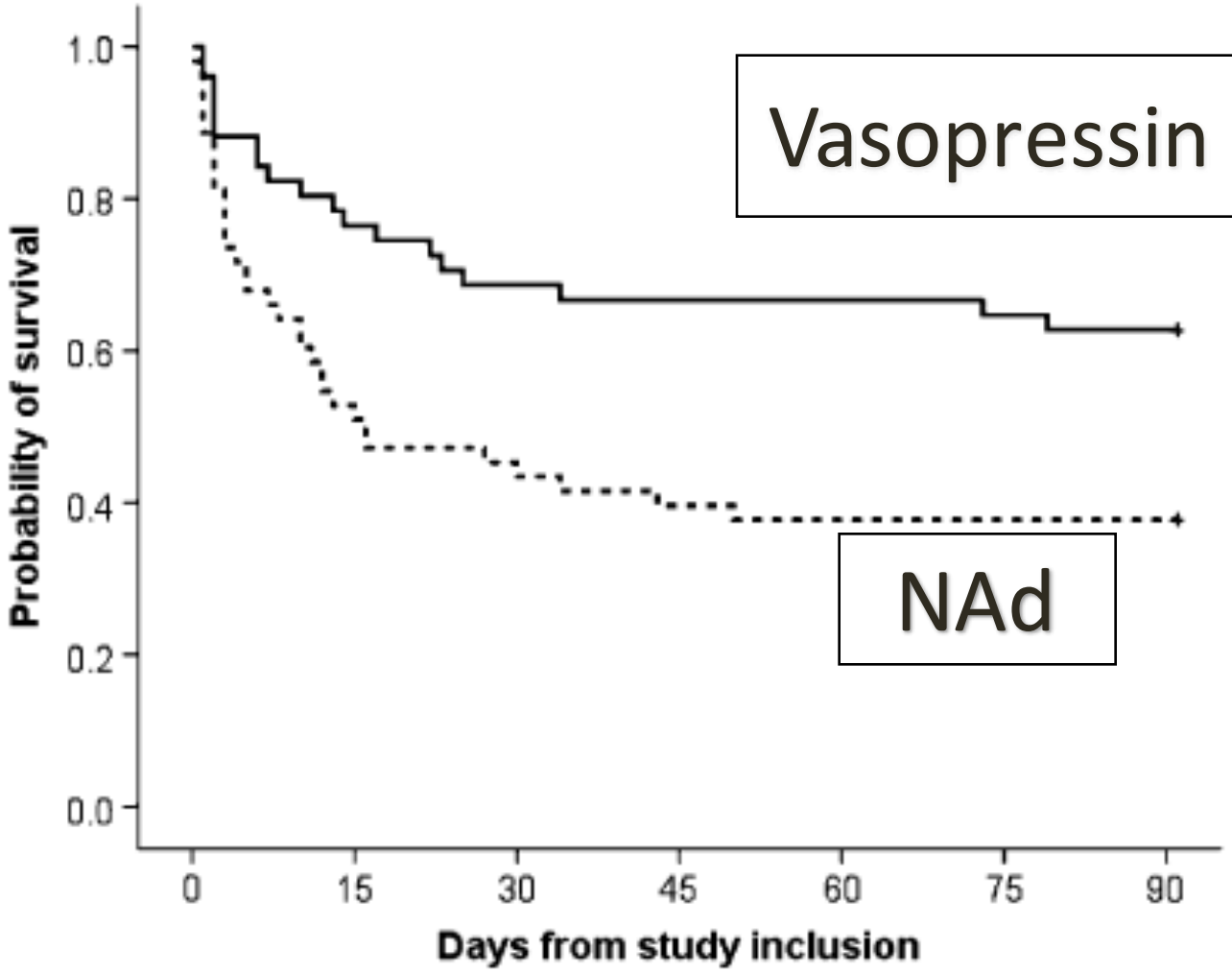

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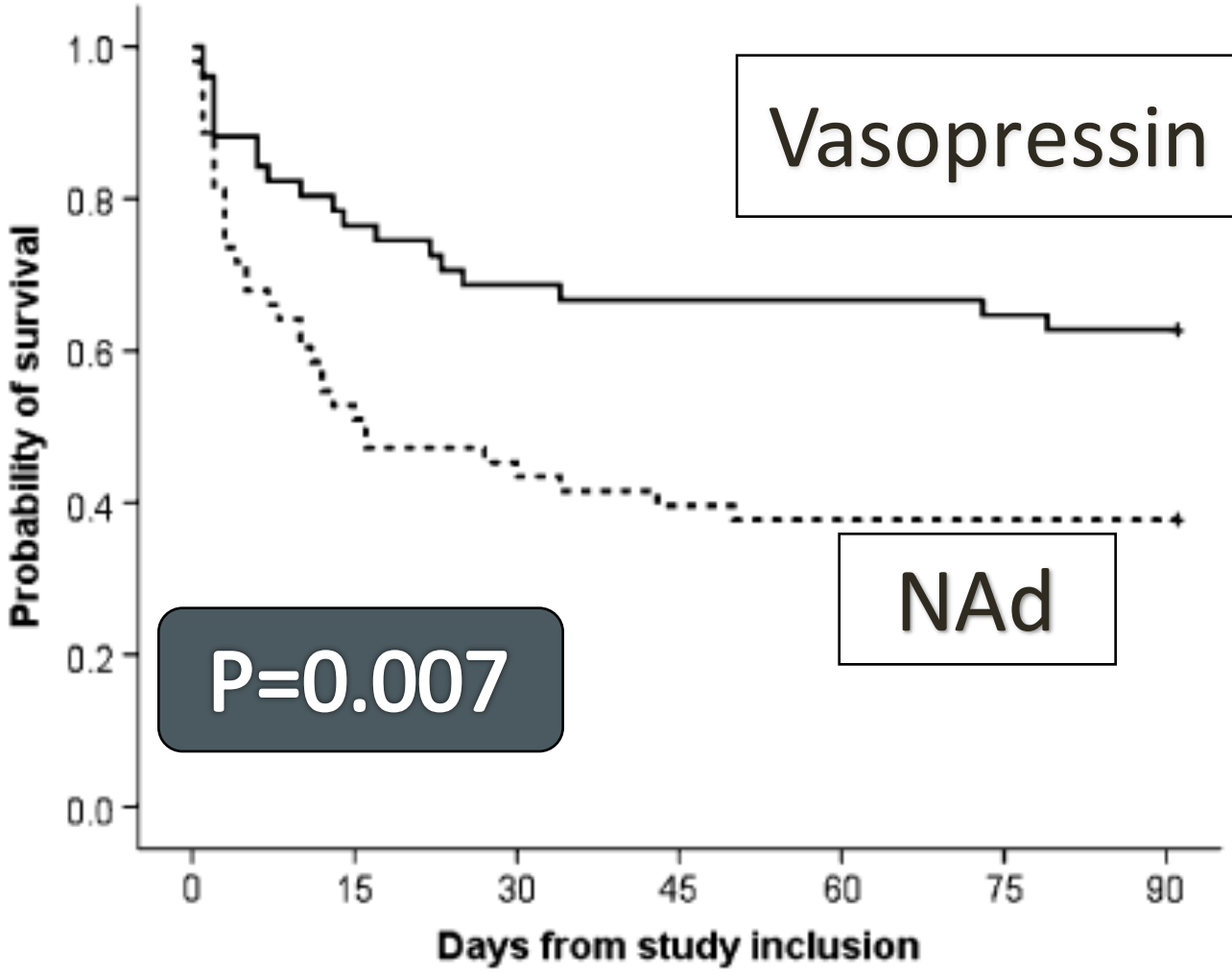

# Section 3: Prevention and Treatment of AKI

## VASOPRESSORS

**3.1.2:** We recommend the use of vasopressors in conjunction with fluids in patients with vasomotor shock with, or at risk for, AKI. (*1C*)

# Other Candidates?

- IGF-1
- ANP
- Fenoldapam
- NAc
- EPO

# Other Candidates?

| | |
|---|---|
| • IGF-1 | • Not Recommended |
| • ANP | • Not Recommended |
| • Fenoldapam | • Not Recommended |
| • NAc | • Not Recommended |
| • EPO | • Not Recommended |

# Insulin

- Pooled analysis failed to confirm early beneficial effects of IIT
- NICE-Sugar found that IIT increased mortality
  - BG target 4.5-6.0 higher mortality than ≤ 9.99
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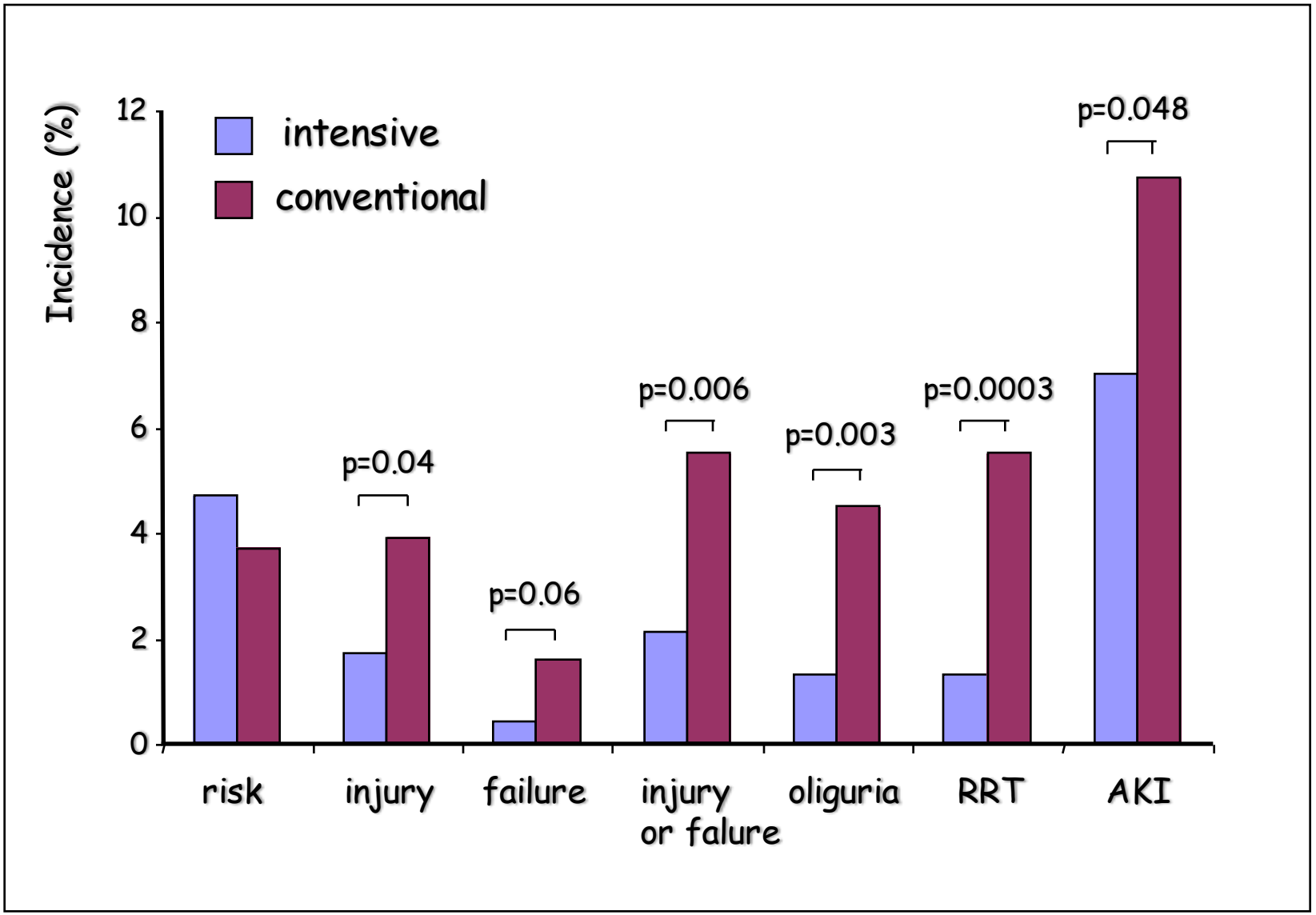
# Glycemic control and nutritional support

**3.3.1:** In critically ill patients, we suggest insulin therapy targeting plasma glucose 110–149 mg/dl (6.1–8.3 mmol/l). (*2C*)

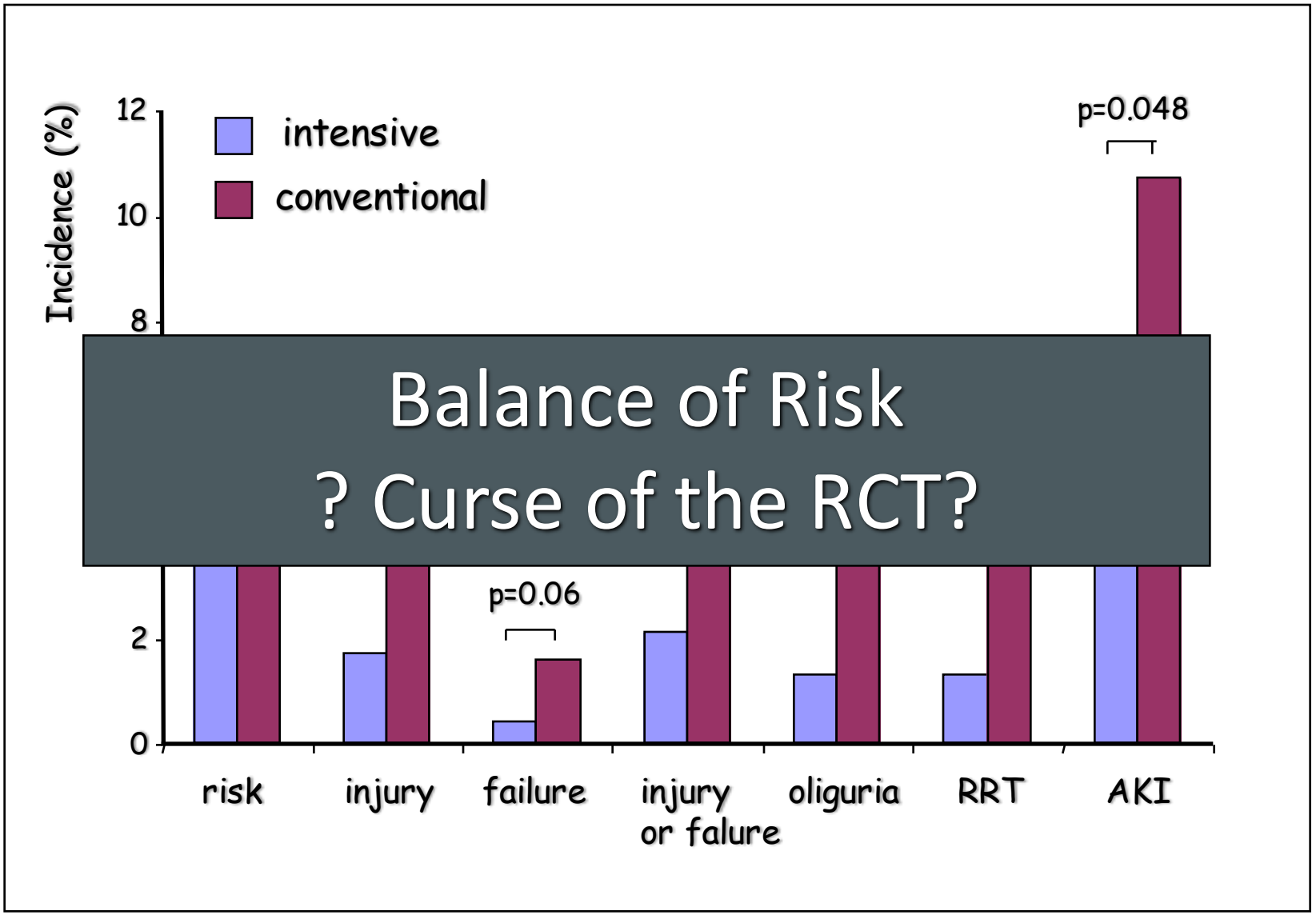
**3.3.2:** We suggest achieving a total energy intake of 20–30 kcal/kg/d in patients with any stage of AKI. (*2C*)

# Intensive Insulin Therapy and AKI




M. Schetz, JASN 2008

# Intensive Insulin Therapy and AKI

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# Glycemic control and nutritional support

**3.3.3:** We suggest to avoid restriction of protein intake with the aim of preventing or delaying initiation of RRT. (*2D*)

**3.3.4:** We suggest administering 0.8–1.0 g/kg/d of protein in noncatabolic AKI patients without need for dialysis (*2D*), 1.0–1.5 g/kg/d in patients with AKI on RRT (*2D*), and up to a maximum of 1.7 g/kg/d in patients on continuous renal replacement therapy (CRRT) and in hypercatabolic patients. (*2D*)

# What About Well Defined Conditions?

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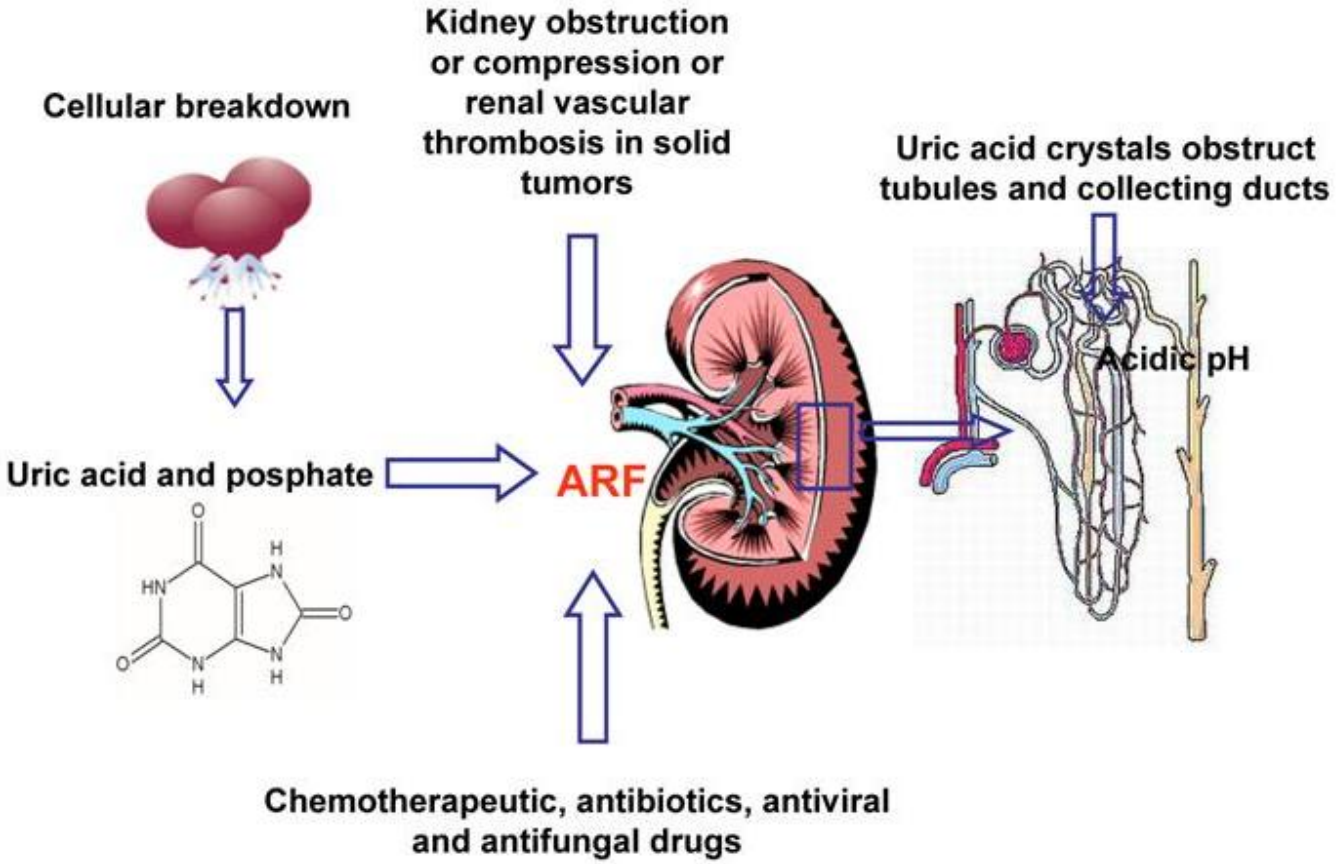


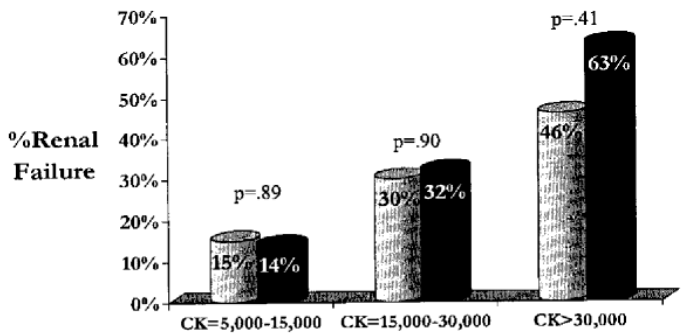
# Rhabdomyolysis

- Should be easy
- Identifiable (mostly)
- Biomarker (of sorts)
- Bicarbonate/Mannitol/Frusemide
- ?Evidence

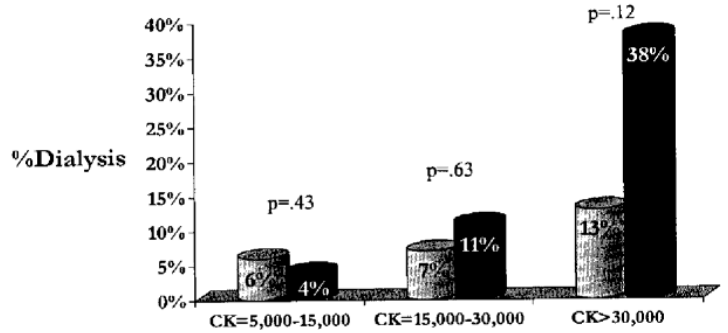
# Therapy for Rhabdomyolysis

- Retrospective analysis (5 yrs)
- 2083 patients
- 85% of them with increased CK

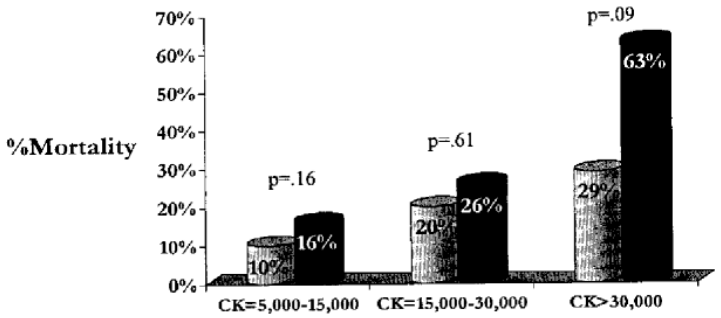
A




B




C

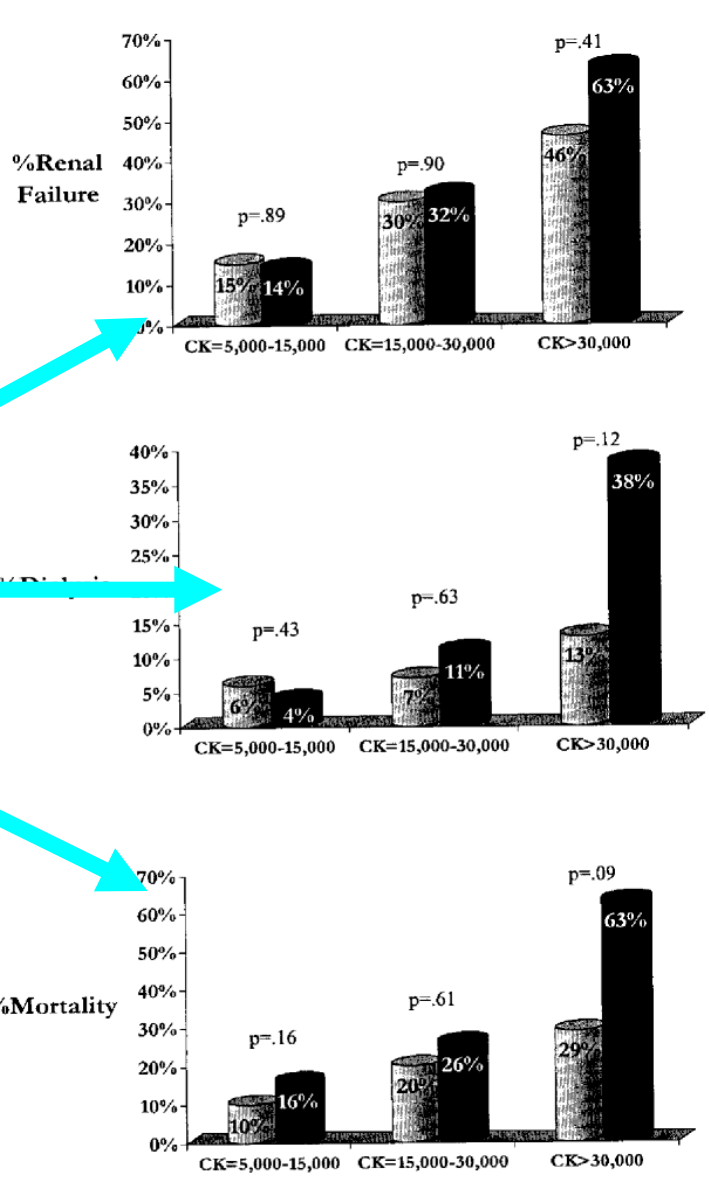



**Brown C et al.**

***J Trauma 2004; 30 : 1191-96***

# Therapy for Rhabdomyolysis

No Difference in:
% Renal Failure
% Dialysis
% Mortality

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# Therapy for Rhabdomyolysis

**Table 4. Comparative Studies on Preventive and Therapeutic Regimens in Rhabdomyolysis.**

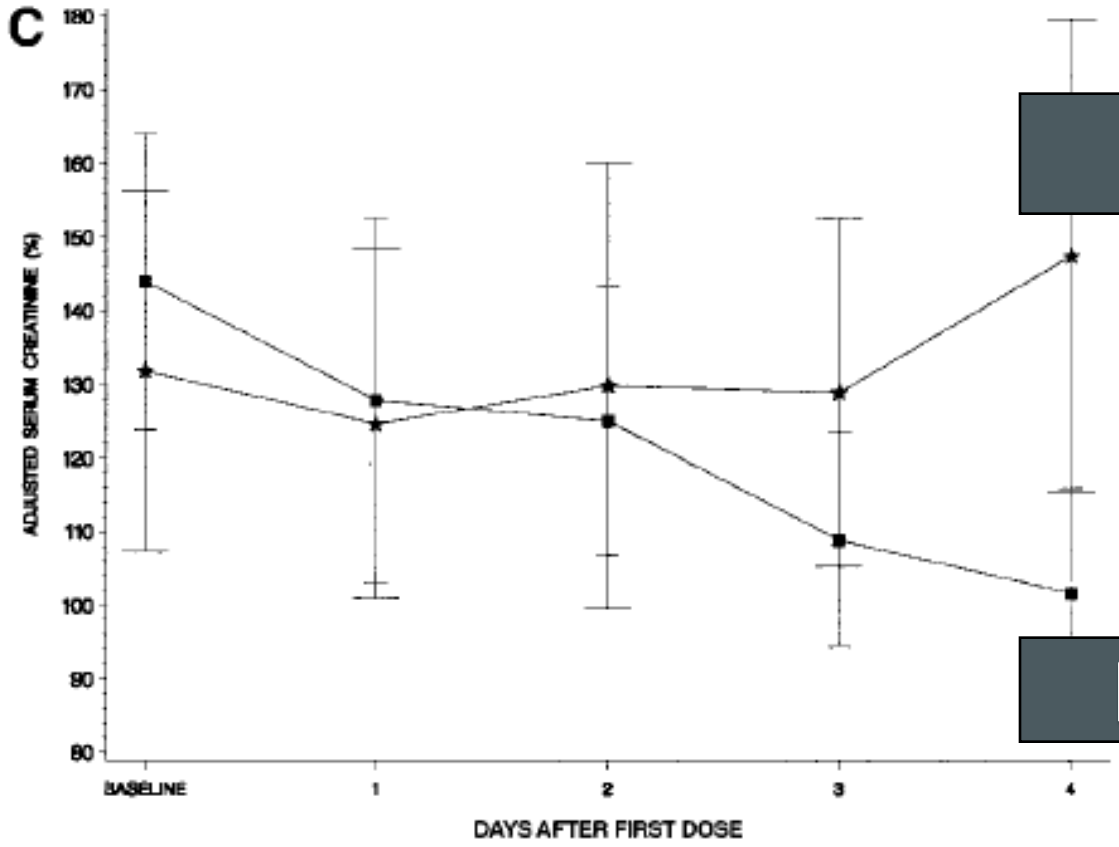
| Study | Study Design | Patient Group | No. in Sample | Therapeutic Strategy | Outcome in Patients with Acute Kidney Injury |
|---|---|---|---|---|---|
| Shimazu et al.[34] | Retrospective | Patients with the crush syndrome | 14 | Late vs. early initiation of therapy; high (>10 liters for 48 hours) vs. low volume of hydration | Better if therapy initiated early; high volume of hydration better |
| Gunal et al.[35] | Retrospective | Patients with the crush syndrome | 16 | Early vs. late treatment with normal saline followed immediately by bicarbonate | Better if treatment initiated early |
| Homsi et al.[36] | Retrospective | Patients in the intensive care unit | 24 | Normal saline vs. normal saline plus bicarbonate and mannitol | No difference |
| Brown et al.[37] | Retrospective | Patients with trauma | 2083 | Normal saline vs. bicarbonate plus mannitol | No difference |
| Cho et al.[38] | Prospective, randomized | Patients with intoxication from doxylamine | 28 | Ringer's lactate vs. normal saline; bicarbonate if urine pH is <6.5 | No effect on peak creatine kinase level or recovery with Ringer's lactate as compared with normal saline; more bicarbonate needed with normal saline than with Ringer's lactate |

NEJM 2009

# Tumour Lysis Syndrome

- TLS characterized by Severe
  - Hyperuricemia
  - Hyperphosphatemia
  - Hyperkalemia
  - Hypocalcemia,
  - Acute Kidney Injury

# Rasburicase




Allopurinol

Rasburicase

Goldman Blood 2001 97; 2998-3003

# Rasburicase

- Rasburicase Group
  - Adjusted SCr **fell** from 144% to 102%
- Allopurinol Group
  - Adjusted SCr **rose** from 132% to 147%

  - No difference in need for RRT
  - Peak Uric Acid reduced ($p<.0001$)
  - Mean Uric acid AUC less ($p<.0001$)

Goldman Blood 2001 97; 2998-3003

# Preventing AKI…..

- Beset by Problems:
- An incomplete understanding of the underlying pathophysiologic mechanisms
- The lack of robust early markers for AKI, and hence an unacceptable delay in initiating therapy

# Preventing AKI…..

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- Beset by Problems:

# Preventing AKI…..

- Beset by Problems:
- An incomplete understanding of the underlying pathophysiologic mechanisms

# Management ??

WG Nephrology of ESICM (Joannidis et al , Intensive Care Med 2009)

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- Hypovolemia -> Volume Expansion

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- Age -> ?

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WG Nephrology of ESICM (Joannidis et al , Intensive Care Med 2009)

- Age -> ?
- Gender -> ?

# NIHILISM

Believing in nothing can be exhausting.


At Present….Is this the best we can hope for?
NIHILISM
Believing in nothing can be exhausting.
ODDCULTURE.COM

# Section 3: Prevention and Treatment of AKI

## PROTOCOLIZED HEMODYNAMIC MANAGEMENT

3.1.3: We suggest using protocol-based management of hemodynamic and oxygenation parameters to prevent development or worsening of AKI in high-risk patients in the perioperative setting (*2C*) or in patients with septic shock (*2C*).

# How Do I Know When I Have Given Enough Fluid?

- **IS MY PATIENT FLUID RESPONSIVE?**

## ■ IS MY PATIENT FLUID RESPONSIVE?

The only reason to give a patient a fluid challenge is to increase stroke volume. The concept of "filling up the tank" is meaningless and reflects a poor understanding of human physiology.

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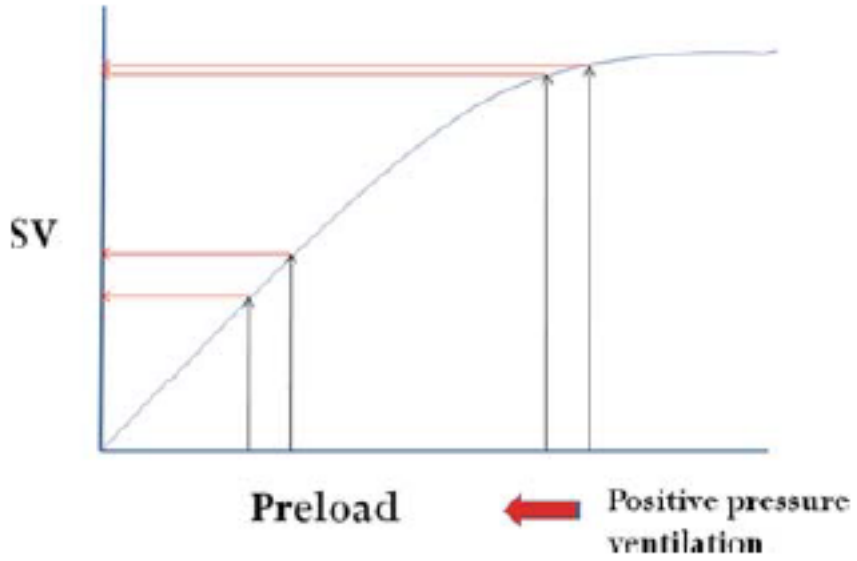
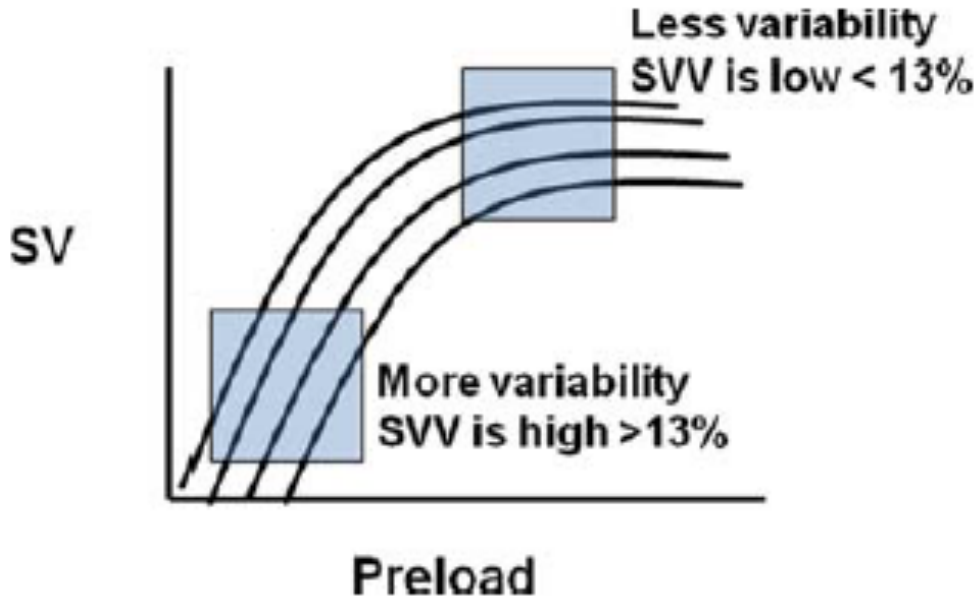
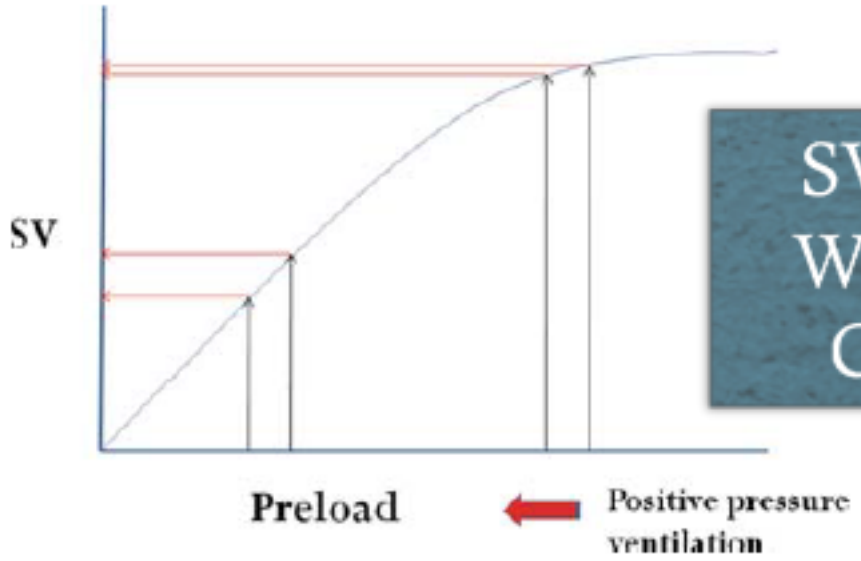
Dynamic Measurements : SVV/PPV

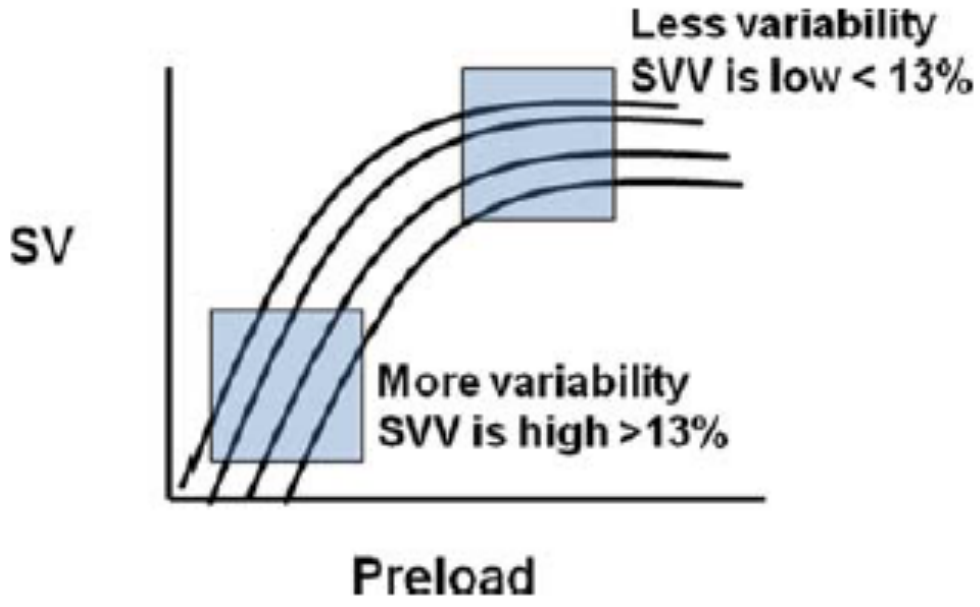
Passive Leg Raise ?

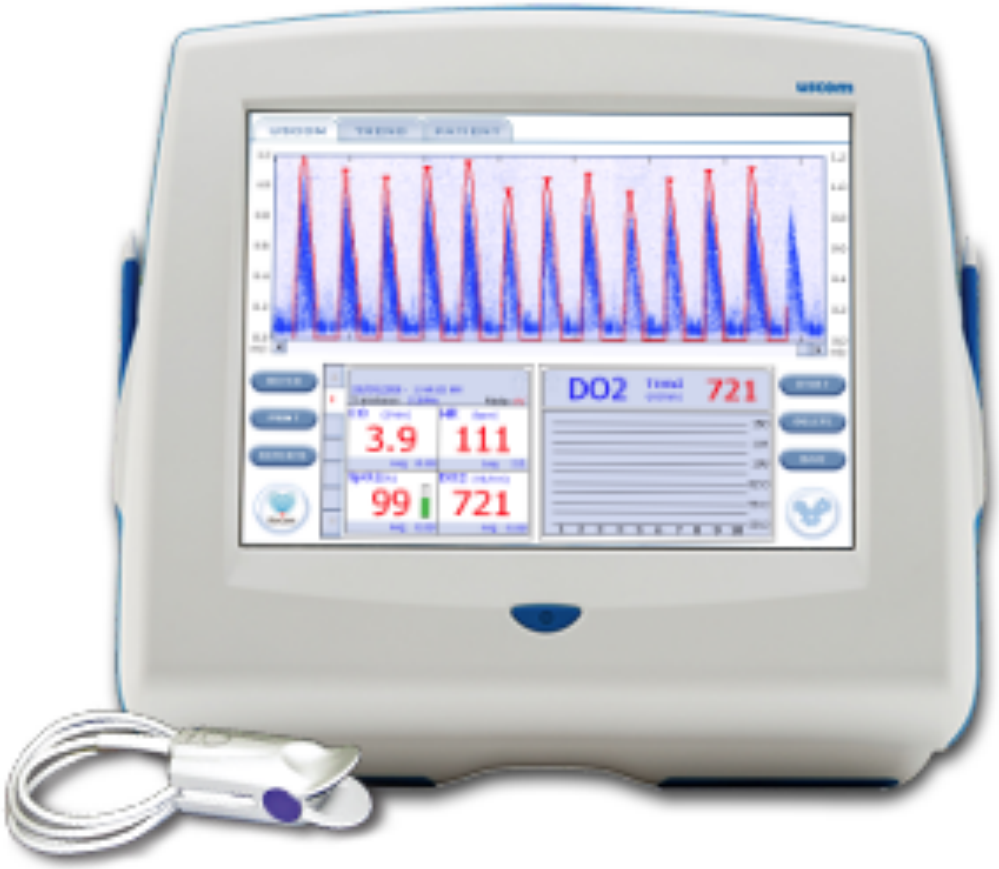

SV
Preload
Positive pressure ventilation


Less variability
SVV is low < 13%
SV
More variability
SVV is high >13%
Preload




## SVV Reduced When Starling Curve 'Flat'




DO2
721
3.9
111
99
721

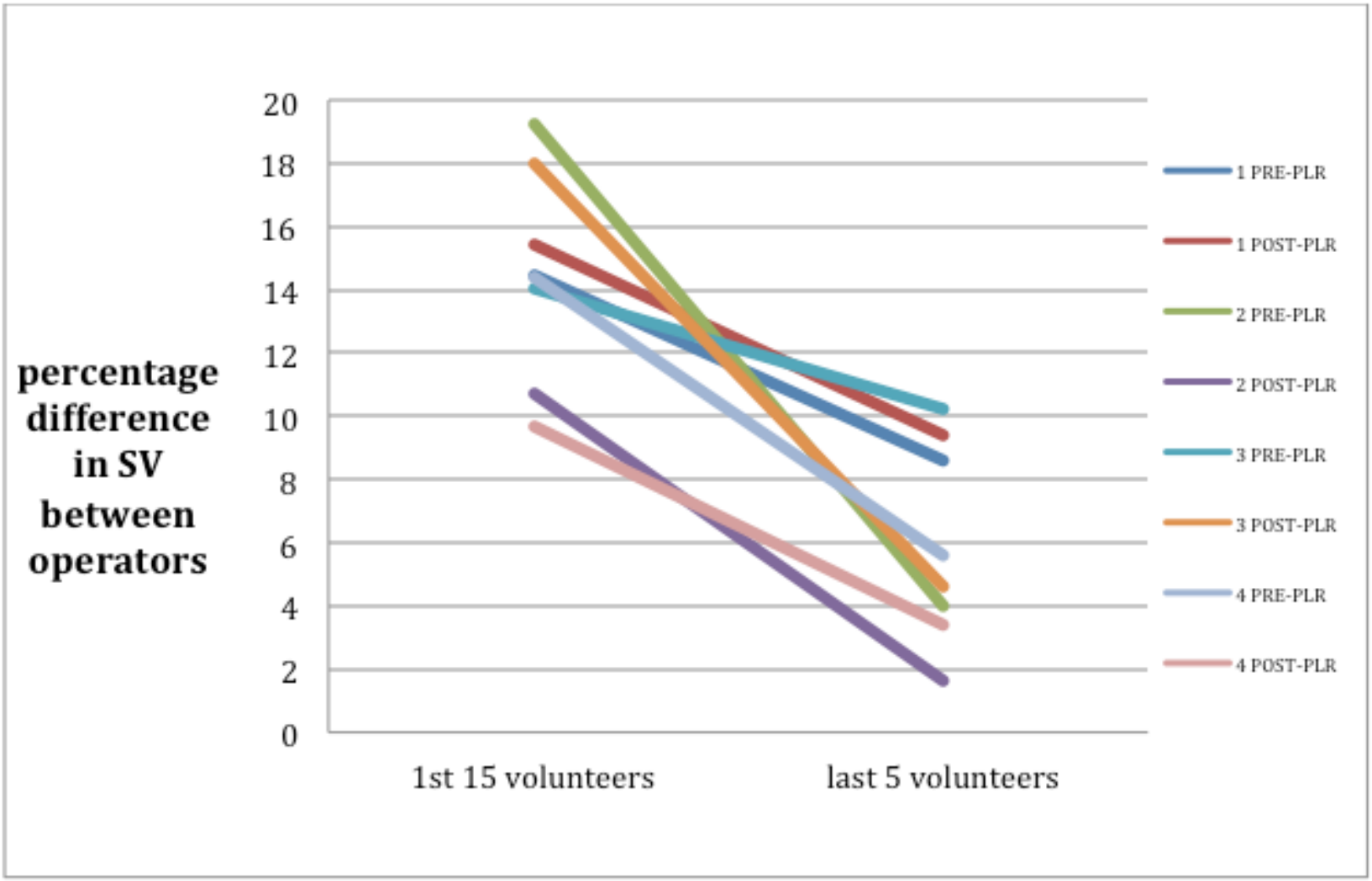
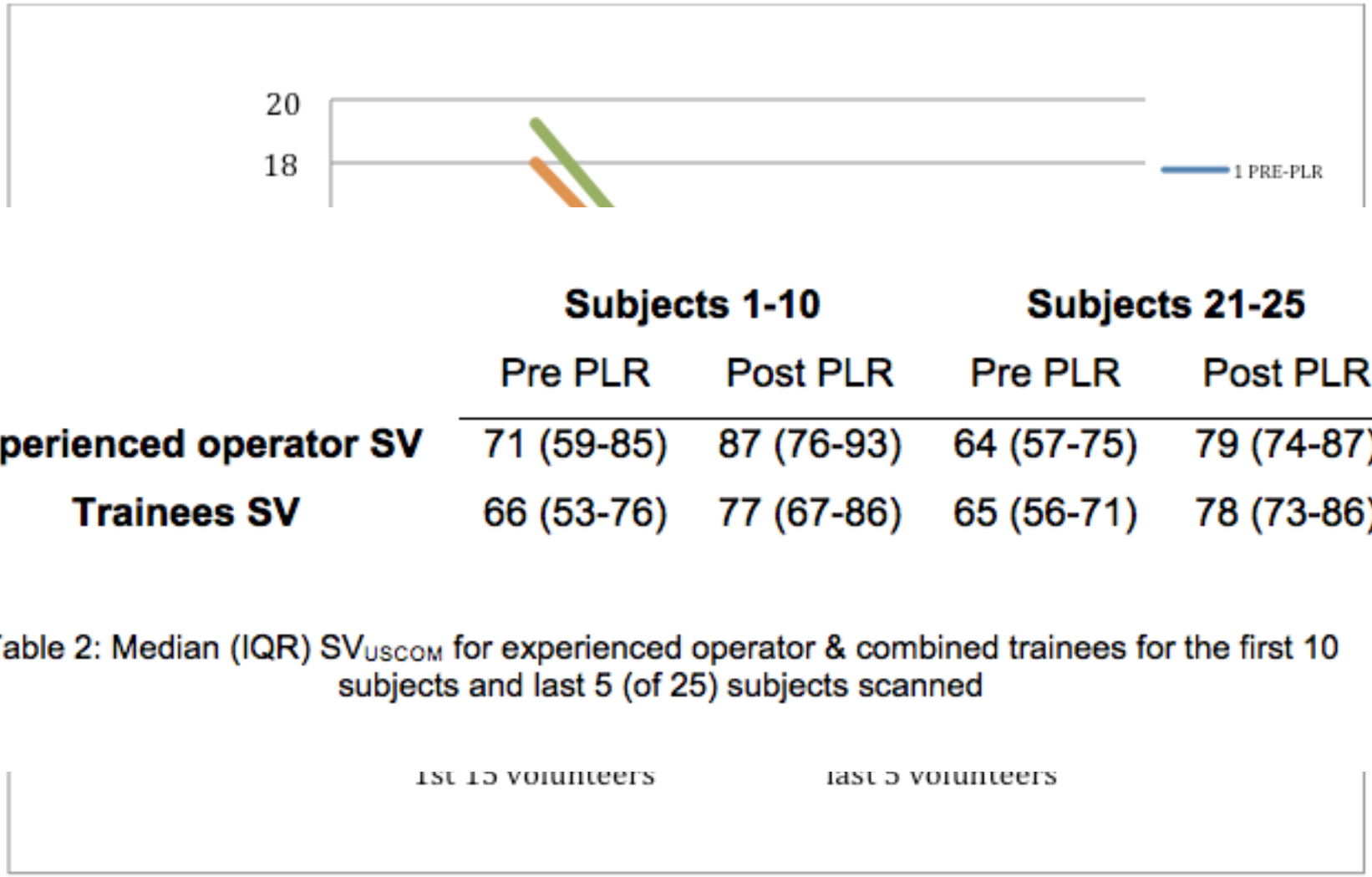



Figure 1 – Mean percentage difference in SV during training between the 4 trainees & the experienced operator comparing 1st 15 volunteers & the last 5 volunteers (includes pre and post PLR differences).




| | Subjects 1-10 | | Subjects 21-25 | |
|---|---|---|---|---|
| | Pre PLR | Post PLR | Pre PLR | Post PLR |
| **Experienced operator SV** | 71 (59-85) | 87 (76-93) | 64 (57-75) | 79 (74-87) |
| **Trainees SV** | 66 (53-76) | 77 (67-86) | 65 (56-71) | 78 (73-86) |

Table 2: Median (IQR) $SV_{USCOM}$ for experienced operator & combined trainees for the first 10 subjects and last 5 (of 25) subjects scanned

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# Conclusions:

- Use Haemodynamic Monitoring

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- Use Haemodynamic Monitoring
- Resist repeated fluid challenges to soft endpoints
- Consider early RRT to prevent/treat fluid overload
- Better data is needed to guide fluid resuscitation particularly in sepsis


I used to think this……
THE LIGHT AT THE END
OF THE TUNNEL
IS A TRAIN


I used to think this……

# Invitation to participate

**P**revalence in **E**urope of **A**cute and **C**hronic Kidney Disease in the ICU **E**nvironment

## PEACE

**Aims:**

- epidemiology of AKI and CKD, defined by RRT in ICU patients
- modalities of RRT
- indications for initiation of RRT
- who is performing RRT.
- renal outcomes and 28-d, ICU, and hospital mortality.


Info: AKI section
Eric.hoste@ugent.be

EUROPEAN CRITICAL CARE RESEARCH NETWORK ECCRN

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Thank You For Listening