Renal replacement therapy on cardiac surgery intensive care unit

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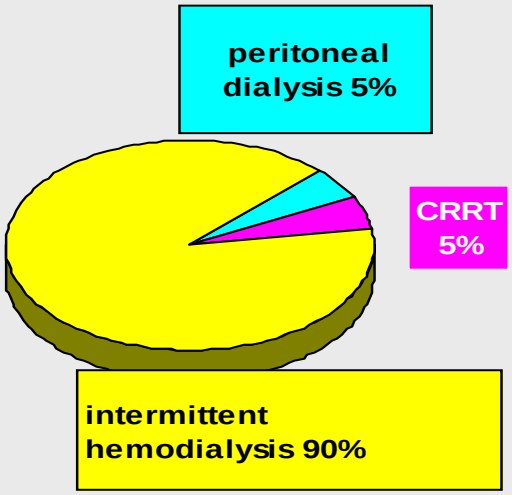
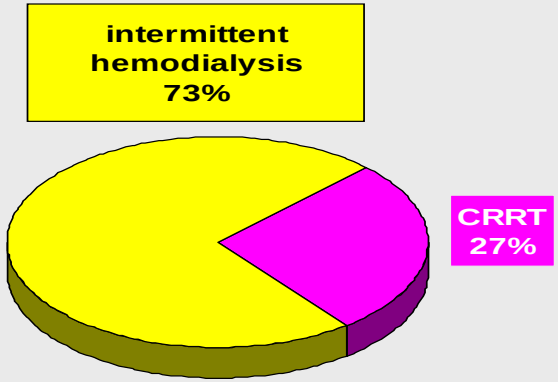
ARF in the ICU - mid 80's



- Intermittent HD is the treatment of choice for any type of ARF.
- CRRT started to develop.
- Peritoneal dialysis is still being practiced.

ARF in the ICU - late 90's



- CRRT

Western Europe 40%

North America 15%

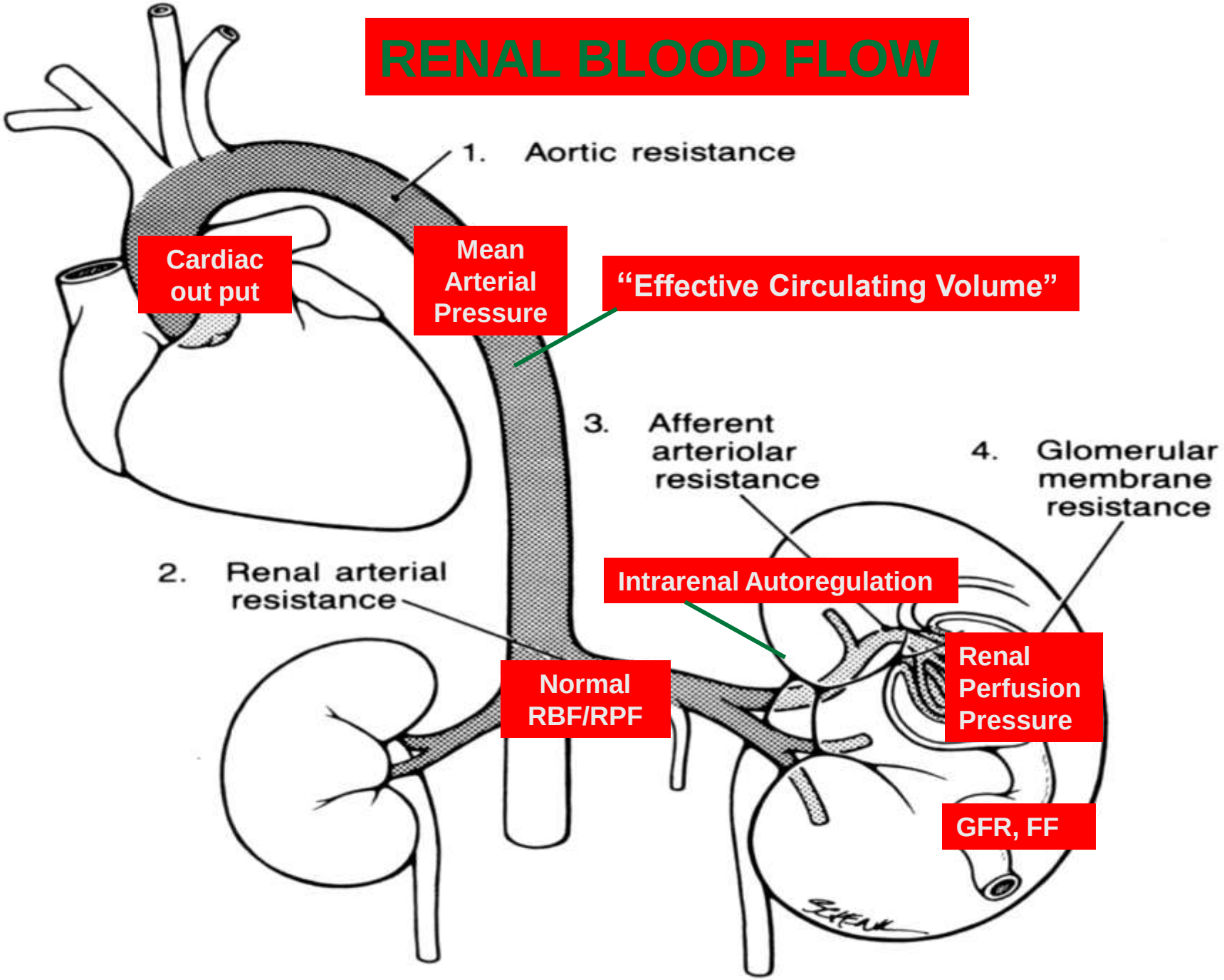
Japan 10% (?)

- Peritoneal Dialysis has disappeared.

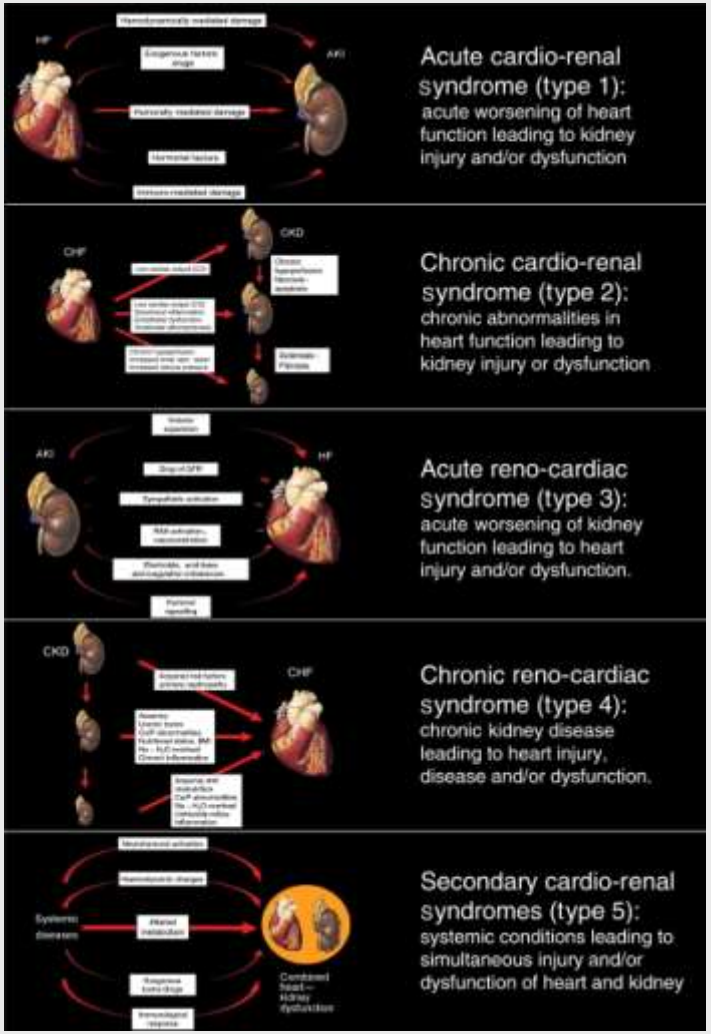
3rd Millennium

- **CRRT has become the treatment of choice for critically ill patients with Acute Renal Failure.**
- **IHD remaining only for uncomplicated ARF.**

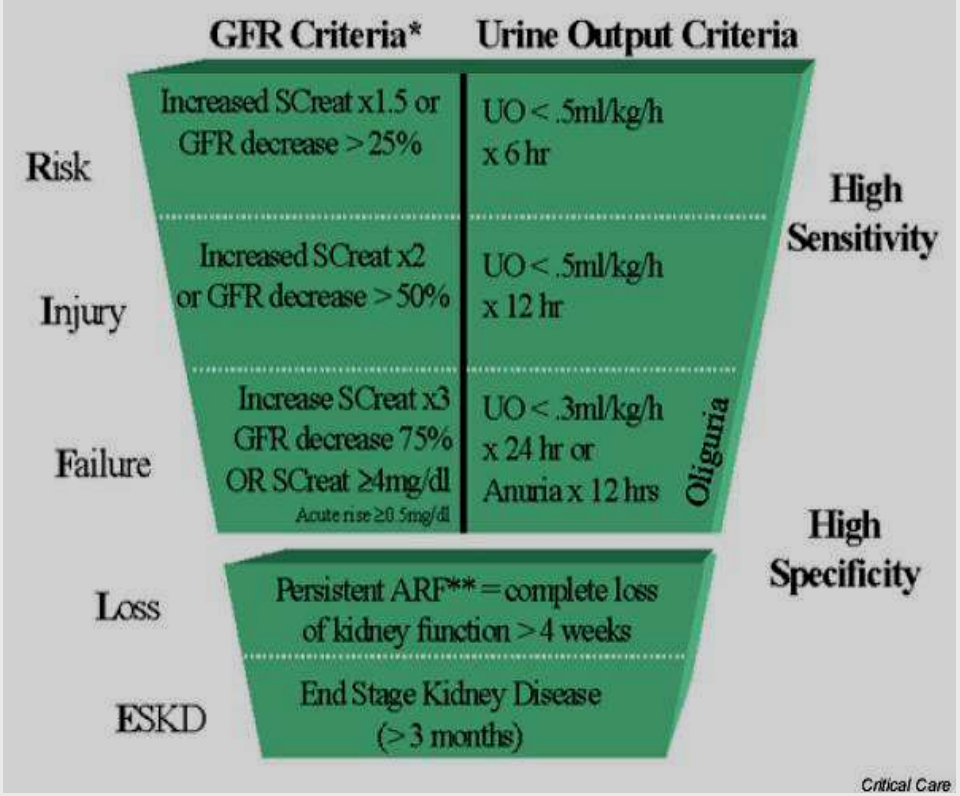
RENAL BLOOD FLOW



Pathophysiology and definitions of the five subtypes of cardio-renal syndrome
(modified by Ronco et al.105)



RIFLE criteria/staging system for RF



Ronco C et al. Eur Heart J 2010;31:703-711

Epidemiology of AKD

- The prevalence of AKD among patients in the intensive care unit is not known.
  - As many as 70% of critically ill patients experience some degree of AKD.

- Approximately 5% of patients in the ICU receive renal replacement therapy (e.g., hemofiltration, hemodialysis).
  - Hospital mortality in this group is 40-80%

Mortality

ARF is an independent predictor of a poor renal outcome

Vascular/ cardiac surgery – ARF increases mortality

Cardiac surgery patients

Matched illness severity / comorbidities

- **63% mortality dialysis**
- **4.3 % mortality intact renal function**

Predictors of mortality

Multisystem failure

Mechanical ventilation

Hypoalbuminemia

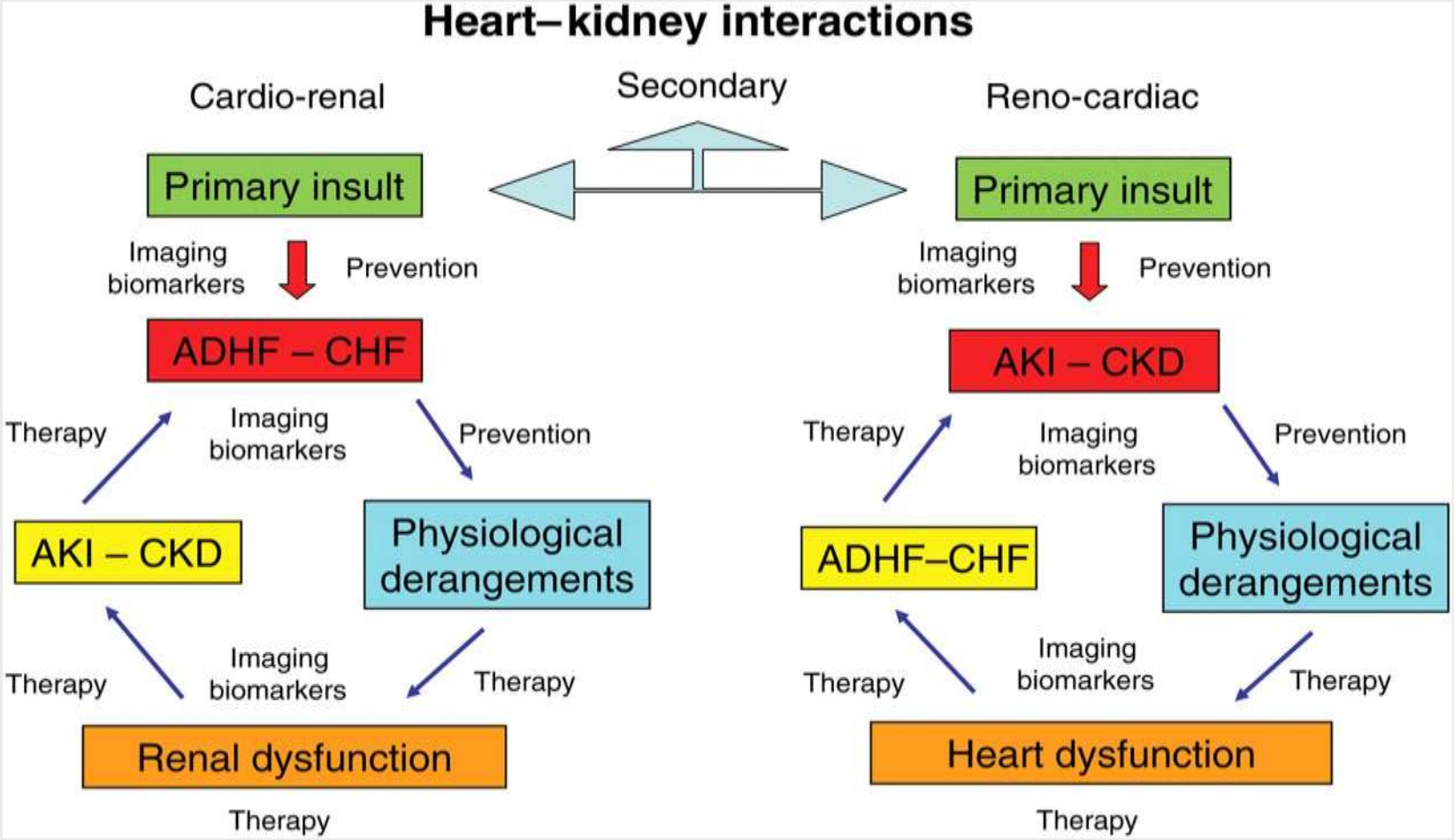
Hyperbilirubinemia

Severe Lactic acidosis

Dialysis requirement

Am J Med 1998; 104 (4) 343-348

In cardio-renal syndromes, there are two important aspects: the first is the sequence of organ involvement and the second is the bi-directionality of signalling leading to a vicious cycle.



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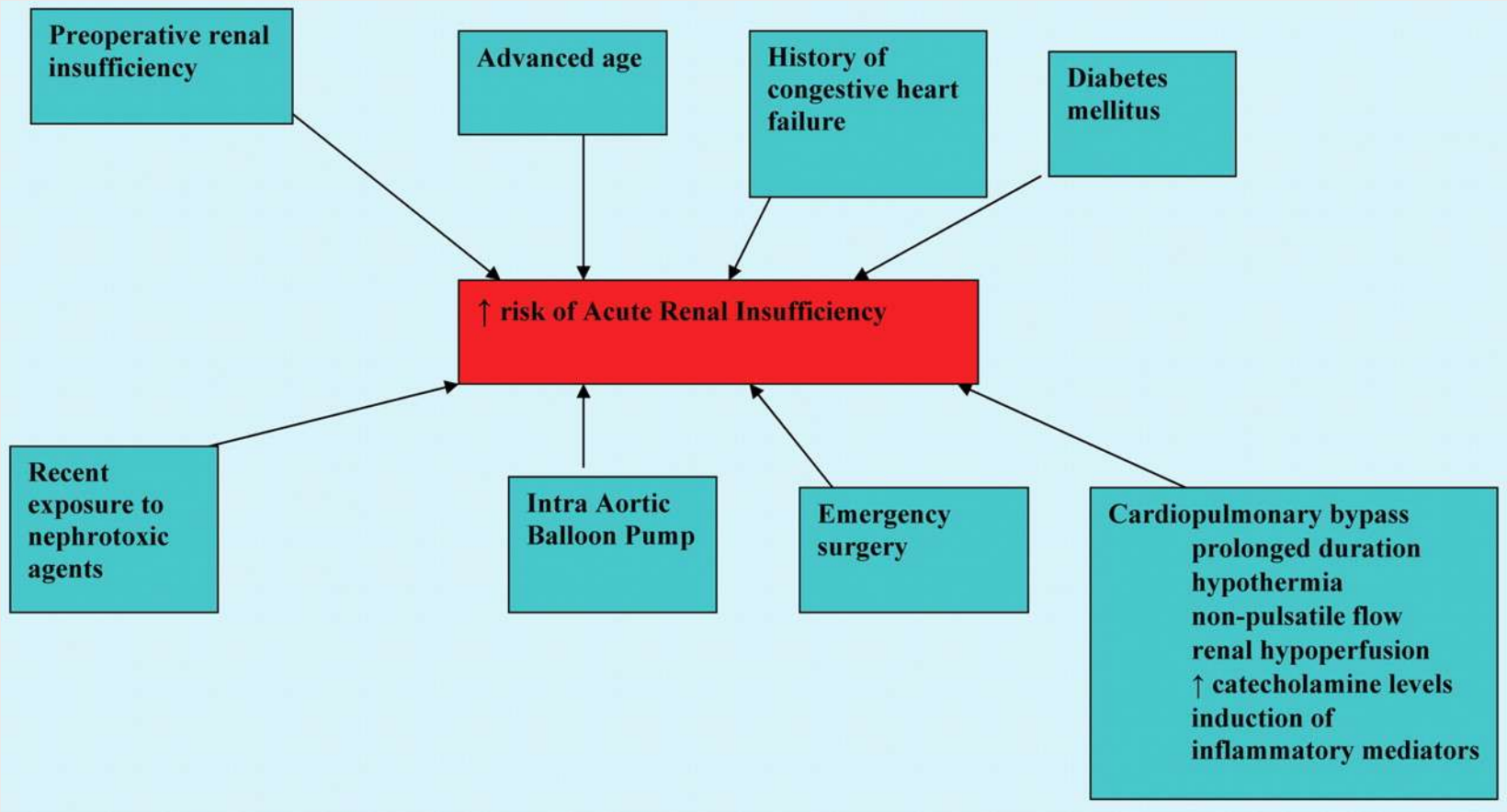
Risk factors for acute renal insufficiency after cardiac surgery.



Kolh P Eur Heart J 2009;30:1824-1827

How do we assess a patient with AKI?

- **Is this acute or chronic renal failure?**
  - **History and examination**
  - **Previous serum creatinine measurements**
  - **Small kidneys on ultrasound (except for in - Diabetes, PCKD, Urinary Tract Obstruction)**

- **Distinguishing between acute and chronic renal failure is important, as –**

  - **The approach to these patients differs greatly.**
  - **This may, save a great deal of unnecessary investigation.**

- **Factors that suggest chronicity include:**
  - **Long duration of symptoms,**
  - **Nocturia,**
  - **Absence of acute illness, anaemia, hyperphosphatemia, and hypocalcaemia,**

- **Has obstruction been excluded?**
  - **Complete anuria**
  - **Palpable bladder**
  - **Renal ultrasound**
  - **X – Ray**
  - **CT scan**

Is the patient euvolaemic?

- Pulse, JVP/CVP, postural blood pressure, daily weights, fluid balance
- Disproportional increase in urea /creatinine ratio
- Urinary sodium concentration (unless on diuretics)
- Fluid challenge

Laboratory test	Prerenal azotemia	ARF
Urine osmolality (mOsm/kg)	>500	<400
Urine sodium level (mEq/l)	<20	>40
Urine/plasma creatinine ratio	>40	<20
Fractional excretion of sodium (%)	<1	>2
Fractional excretion of urea (%)	<35	>35
Urinary sediment	Normal; occasional hyaline or fine granular casts	Renal tubular epithelial cells; granular and muddy brown casts

Management principles in ARF

- Identify and correct pre-renal and post-renal factors
- Optimise cardiac output and RBF-
- Review drugs:
  - Stop ACEI, ARBs, NSAIDs
  - Adjust doses / monitor drug concentrations (where appropriate)

Avoid

- Aminoglycosides
  - 33 % of nephrotoxicity “therapeutic levels”
- Amphotericin
  - hydration,
  - Liposomal formulation
- Radiocontrast media -
  - Hydration
  - N-acetyl cysteine

Management principles

- Accurately monitor fluid balance and daily body weight
- Identify and treat acute complications
  - Hyperkalaemia,
  - Acidosis,
  - Pulmonary oedema
- Identify and aggressively treat infection;
  - Minimise indwelling lines
  - Remove bladder catheter if anuric.
- Identify and treat bleeding tendency:
  - Prophylaxis - proton pump inhibitor or H2 antagonist, avoid aspirin
  - transfuse if required

Optimise nutritional support

- **Maintaining calories enhances patient survival**
- **Maintaining protein intake MAY enhance recovery & outcome**
- **Protein intakes of > 1.2- 1.4 g/kg/ day can dramatically increase urea production WITHOUT evidence of outcome benefit**

Treatment of AKD

Goals of therapy are to prevent death, reduce complications, hasten/permit renal recovery

Effective

- Hemodialysis
- Biocompatible membranes
- More dialysis

Unknown

- CRRT vs. IHD
- Earlier dialysis

Ineffective/harmful

Diuretics *

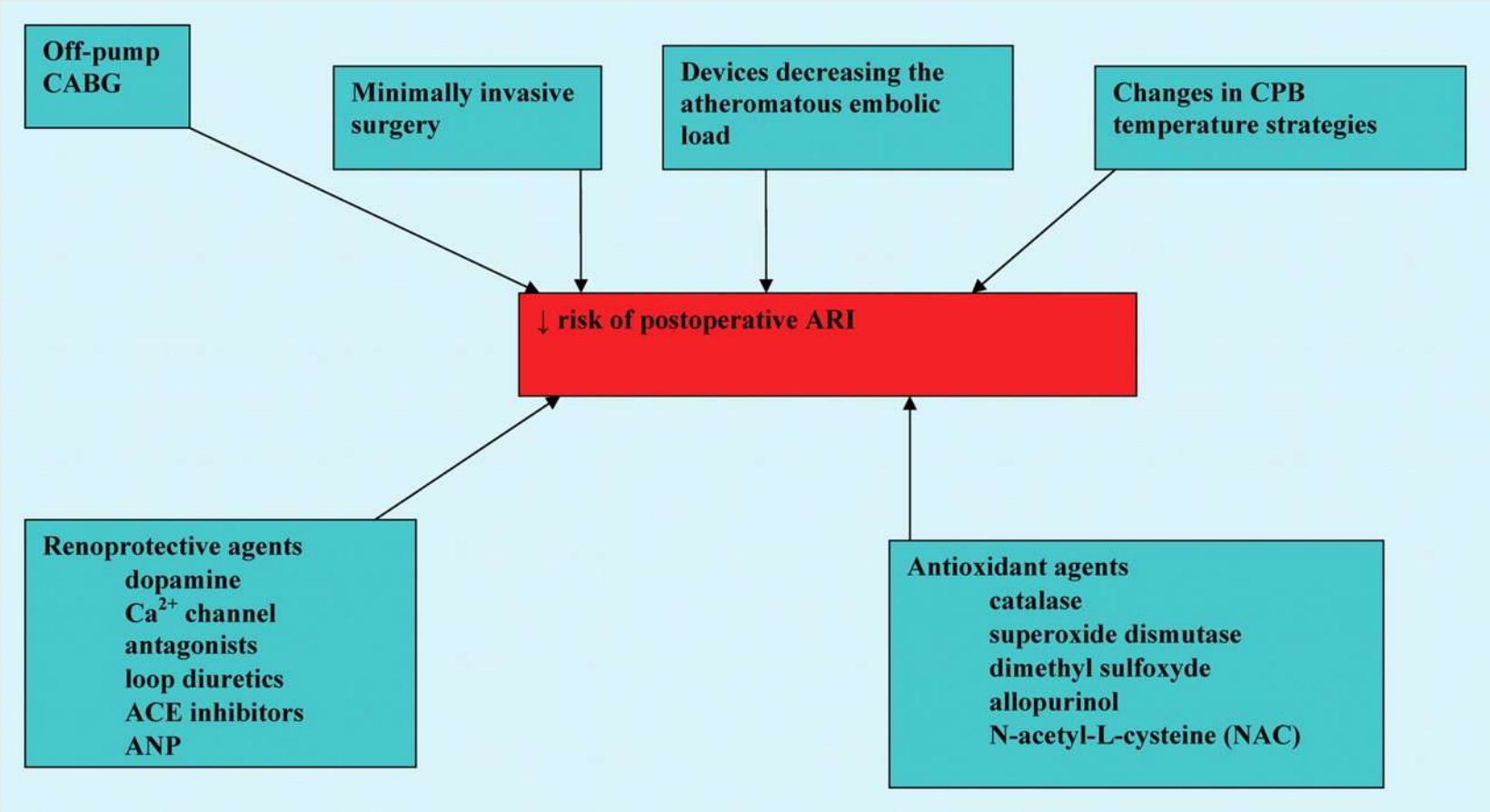
Dopamine

*** Diuretics are never a treatment for oliguria but are sometimes required for management of volume overload.**

- **Initiate dialysis before uraemic complications set in**

Kellum JA, Leblanc M, Venkatraman, R. Clinical Evidence. 2004; 11:1094-118.

Surgical techniques and pharmaceutical agents used to decrease the incidence of acute renal insufficiency (ARI) after cardiac surgery



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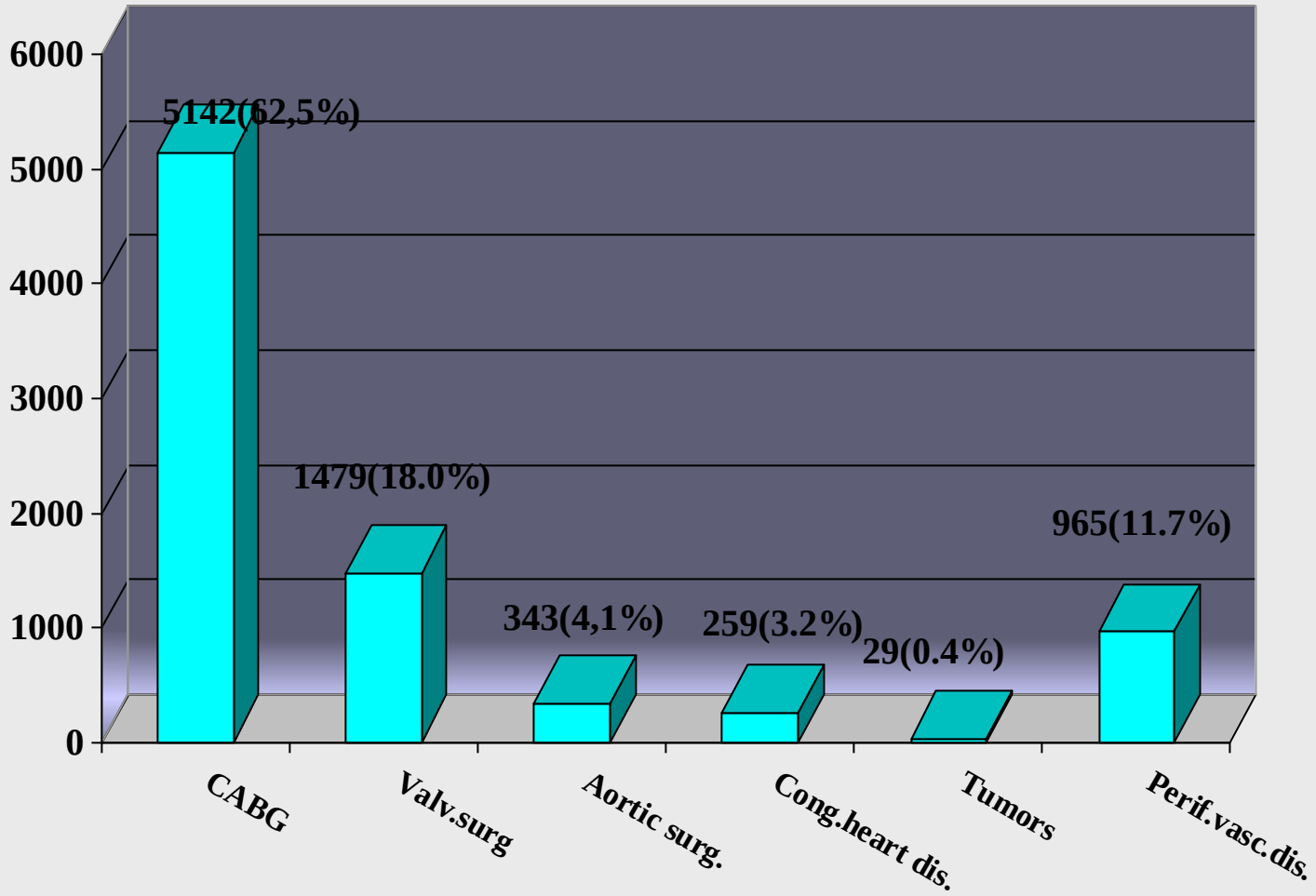
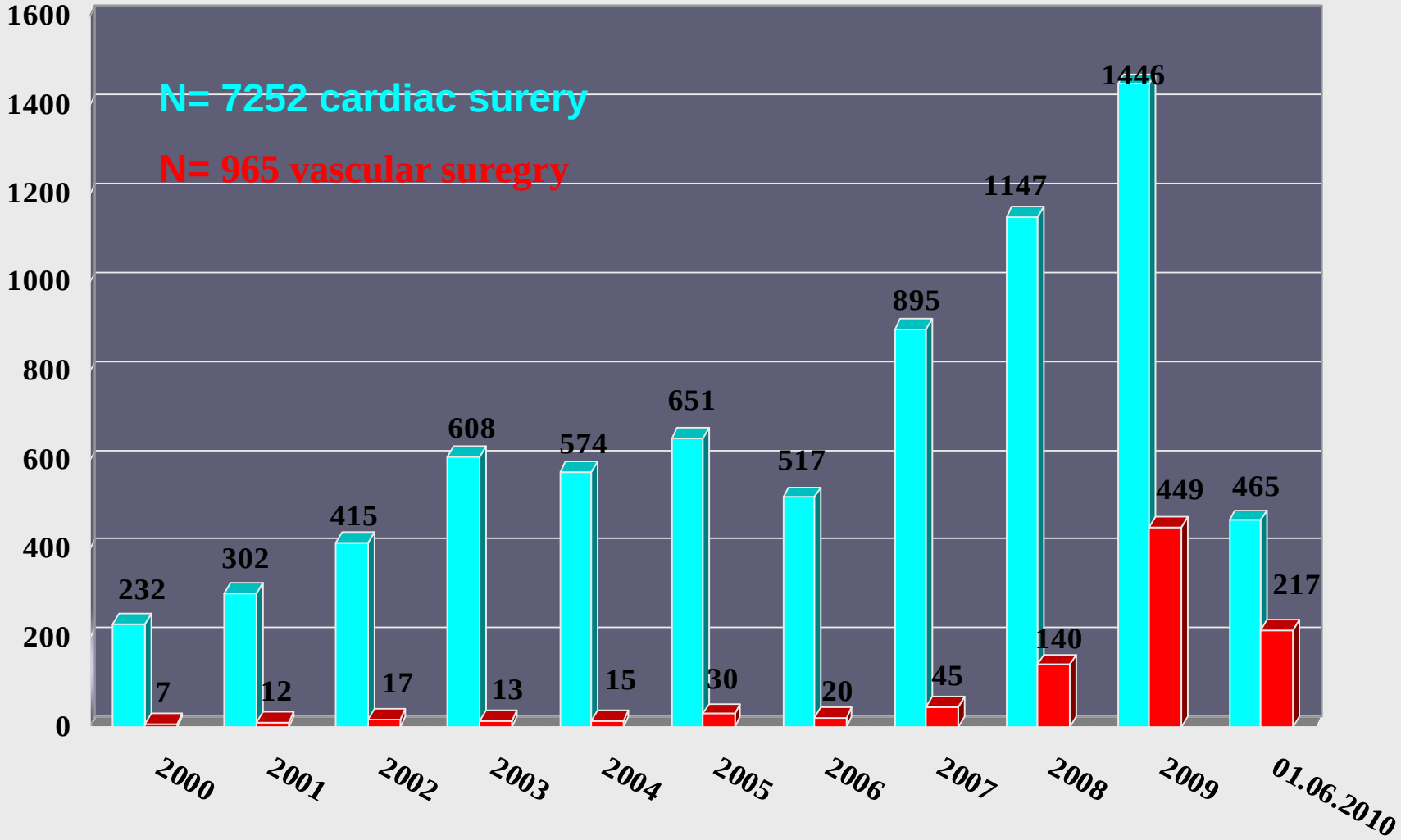
Open heart surgery procedures

(2000-01.06.2010 N=8217 pts)



Number of operations per year N=8217 pts



Renal replacement therapy on cardiac surgery intensive care unit

N=8217 pts.

n=794 (9,6%)pts.- renal insufficiency

666 (83.8%) with coronary disease

-115 (14.5%) with terminal valve disease

-3 (0.5%) congenital heart failure

-10 (1,3%) peripheral vascular disease

-625 (78,7%) conservative treatment

- 169 (21,3%) RRT

Trends and treatment possibilities

169 (21,3%) pts with RRT

(mortality rate 14,8%-25pts)

10 (5,9%) with vascular surgery

(mortality rate 0)

25 (14,8%) with valve surgery

(mortality rate 16%-4pts)

15 (8,9%) postop.sepsis

(mortality rate 40% -6pts)

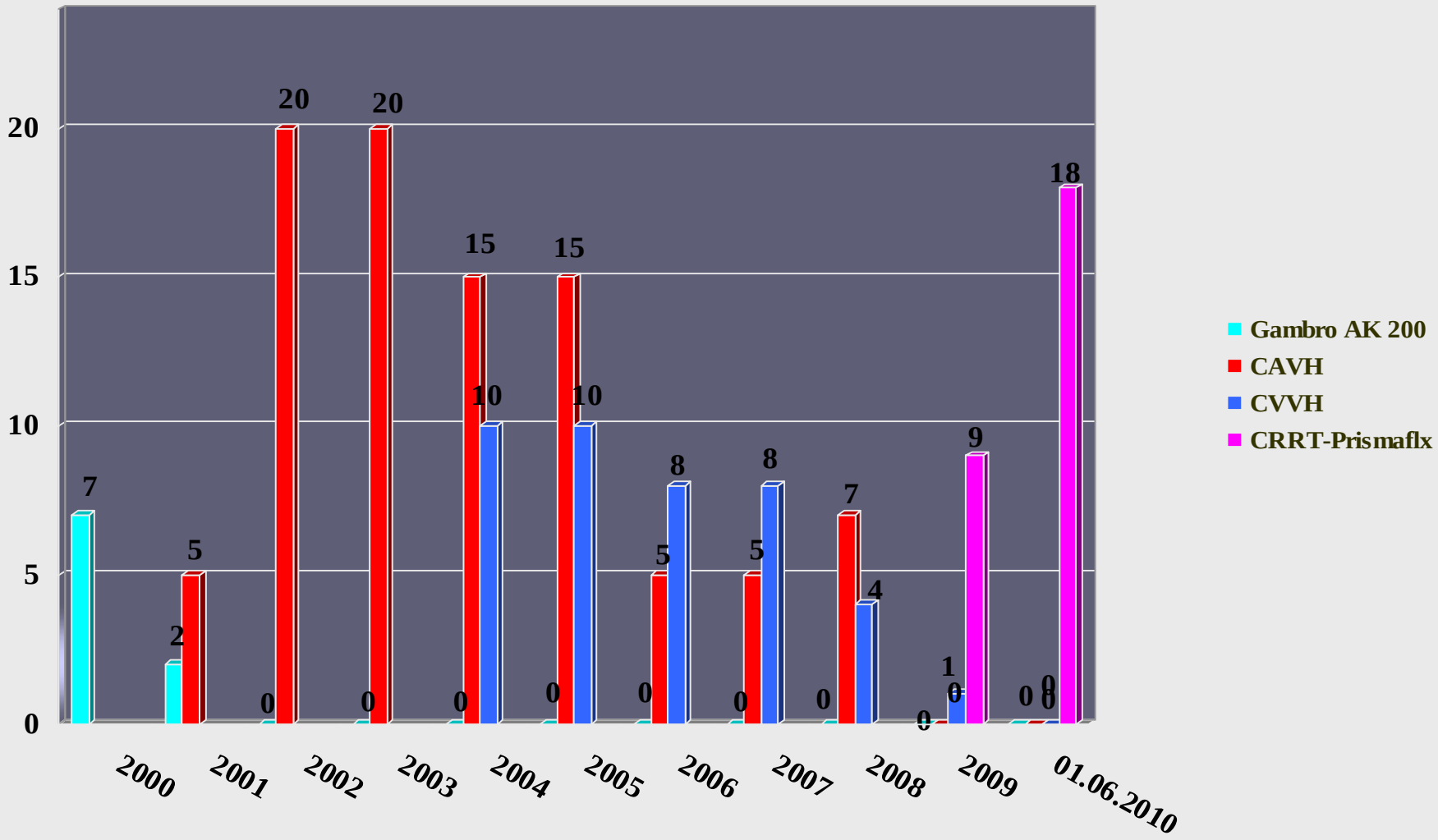
119 (70,4%) with CABG

(mortality rate 12,6%-15pts)

Prisma Flex - CRRT (treatment of ARF and CRF)

26.10.2008 first procedure

CRRT (2000-2010)



Postoperative monitoring

Prisma Flex - CRRT (treatment of ARI and CRI) 26.10.2008 first procedure

Old fashioned techniques - CAVH, CVVH

Gambro AK 200

Advantages:

Normal water balance

Electrolyte control

Coagulation control

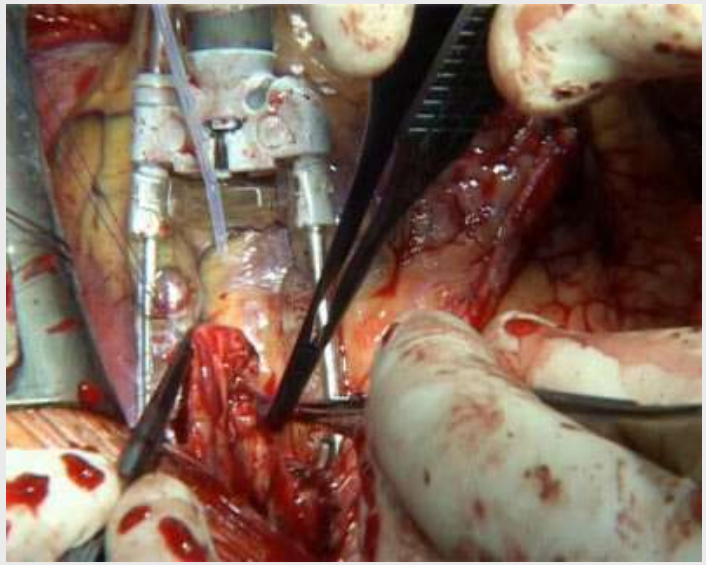
Decreasing of serum urea and creatinine level

Good patient comfort- without muscle cramps, hypoglycemia, paresthesis and vomiting

CABG - RRT

119 (70,4%) with CABG (mortality rate 12,6%-15pts)

10-pts –operated in OPCAB
0 mortality rate
No one with ARF
3- CRF – treated with Prismaflex GAMBRO



109pts operated CABG with HLM

15pts treated with CRRT – Prismaflex Gambro CVVHD

12of them with ARF (HLM elfluence and preoperative low CO Sy)

3 pts with CRF- CVVHD

10 (5,9%) with vascular surgery (mortality rate 0)

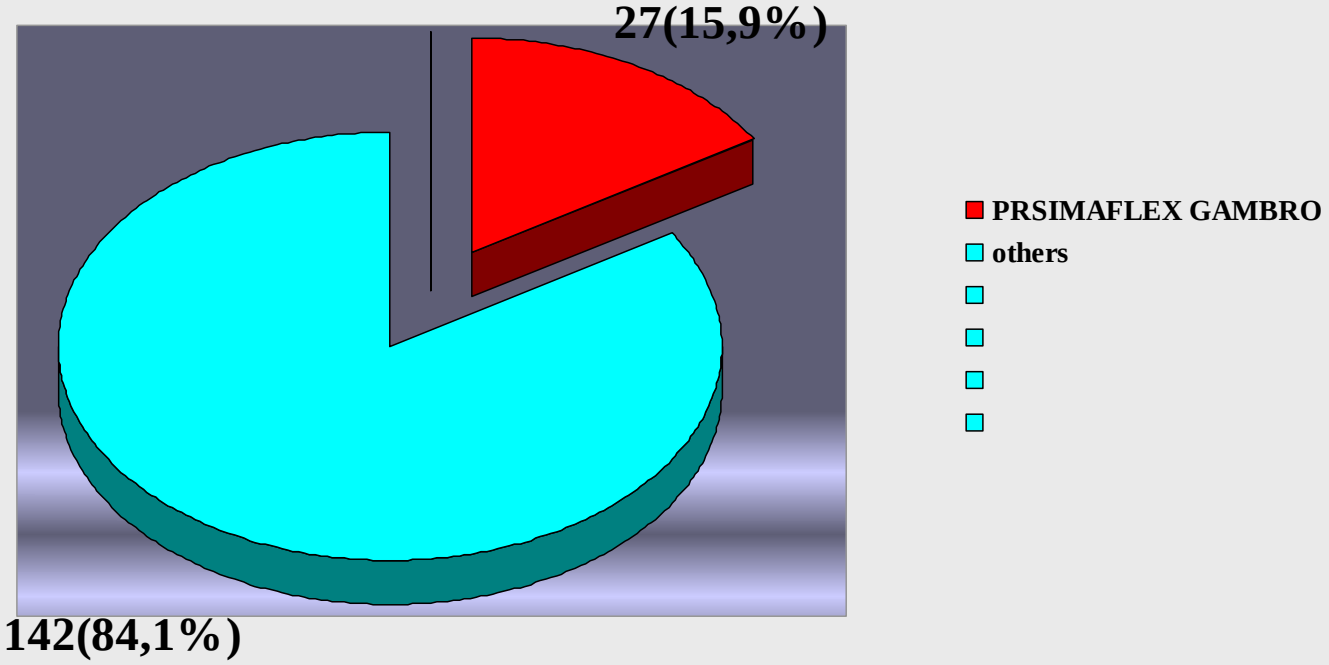
10 pts CRRT – CVVHD GAMBRO Prismaflex

10 pts CRF

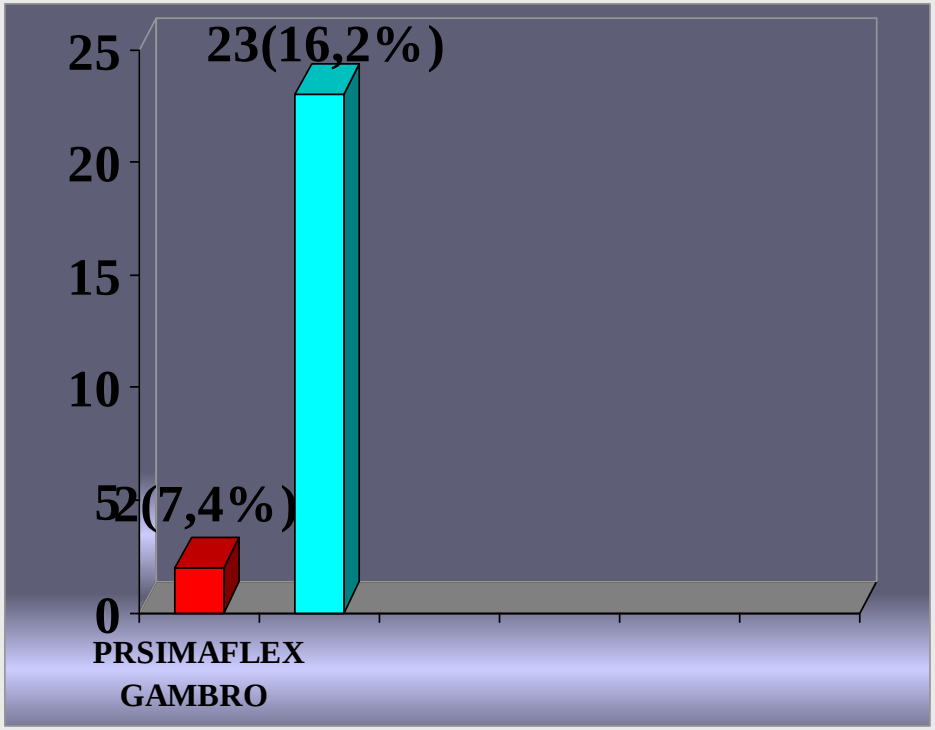
Day before op. HD

Next day continue with CVVHD

CRRT Prismaflex v.s. other types of RRT (Gambro AK200, CAVH,CVVH)



CRRT Prismaflex v.s. other types of RRT (Gambro AK200, CAVH,CVVH)



PRSIMAFLEX GAMBRO

others

CRRT – Prismaflex Gambro mortality rate 7,4% (2pts)

Other mortality rate 16,2% (23pts)

Case Report

- **B.M. 65y man**
- **09.09.2008 –CABG x3&LV aneurysmectomy & mitral reconstruction, EF 25% IABP, Sy low cardiac output**
- **21.09.2008 – discharged EF- 35%**
- **25.12.2008 re-admission pulmonary oedema,**
- **Sy low cardiac output, pO2,pCO2 inversion(pCO298,pO2 45), CVP-28mmHg, MAP-45mmHg**
- **ARF-anuria (urea 38,creat.264), cathelolamines doesn't work**
- **Severe acidosis**

Case Report

Intubation, PEEP

- **No blood gass improvement**
- **Cathecholamines – still doesn’t work**
- **PRISMAFLEX – GAMBRO –SCUF**
- **Urgent negative balance – blood gas improvement**
- **Haemodynamic stability**
- **BGA correction**
- **Normal parameters on respiratory machine**
- **Percutaneous tracheotomy**
- **Home discharge 18.01.2009**
- Follow up period 1 year 7 months