31 GIORNATE CARDIOLOGICHE TORINESI

TURIN
October
24th-26th
2019

HOW TO REDUCE TIME, CONTRAST MEDIA AND RADIATION DOSE IN CARDIOVASCULAR IMAGING AND PROCEDURES

HEART FAILURE AND RENAL FAILURE

Federico Ronco

Interventional Cardiology - Department of Cardiac, Thoracic and Vascular Sciences
AZIENDA ULSS 3 SERENISSIMA – MESTRE - VENEZIA - ITALY

OSPEDALE DELL'ANGELO

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I HAVE NO CONFLICT OF INTEREST FOR THIS PRESENTATION

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HEART FAILURE AND RENAL FAILURE
THE SIZE OF THE PROBLEM

Heart failure (HF) and chronic kidney disease (CKD) have increasing incidence and prevalence owing in part to the aging population and increasing rates of hypertension, diabetes, and other cardiovascular and kidney disease risk factors. **HF and CKD often coexist**

Prevalence of CKD in HF patients

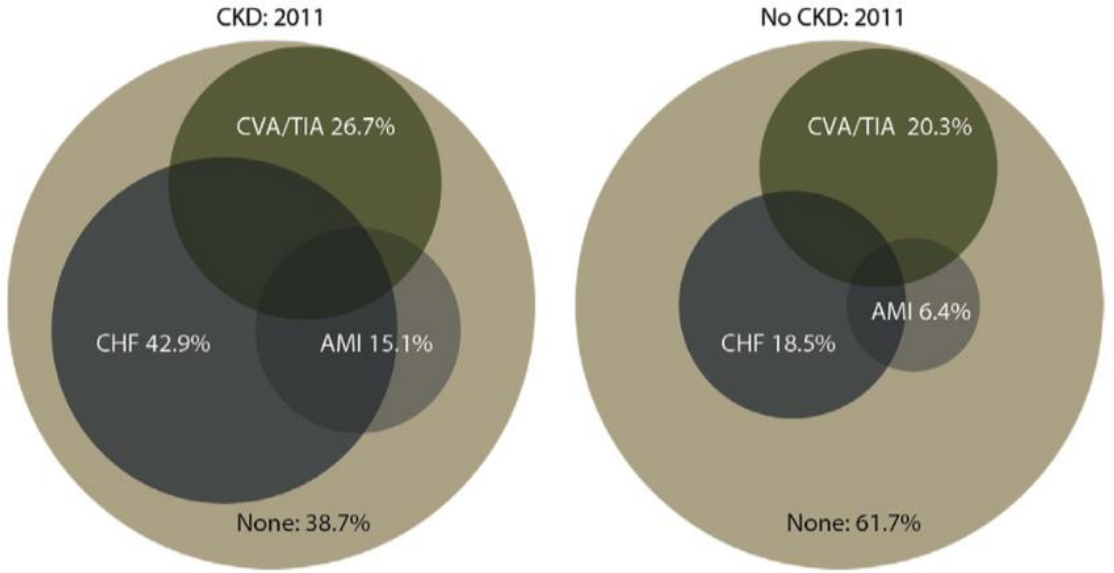
Table 4 Prevalence and hazard of chronic kidney disease in patients with chronic heart failure.

Ref. no.	Study	Year	No. of pts	NYHA	Age, years	Male, %	EF, %	BP or HTN	DM, %	RASi, %	eGFR < 60, %	Follow-up	Outcome	Adjusted hazard comparing with pts without CKD for the outcome
17	SOLVD-T	2000	2,161	I–IV	60.7	81.5	24.7	40.4%	24.9	50.3				1.41 for eGFR <60[a]
18	PRIME-II	2000	1,906	III–IV	64.7	80.4	26.2	121.6/						1.91 for eGFR 4–58
19	DIG	2002	585	II/III: 85%										85 for eGFR <44 for eGFR 64[a]
20														for eGFR 8[a]
21														t 1-year ity[b] in each 10 μmol/l increase of creatinine
22												54.4 months	CV death + HF hospitalization	1.54 for eGFR 45–59.9 1.86 for eGFR <45
23	ANI									24	39.2	2.07 years (median)	All-cause mortality + HF hospitalization	1.39 for eGFR 30–44
24	CHART				68.3	65.1	49.3[c]	39.2%[c]	19.3[c]	69.1[c]	42.7	3.45 years	All-cause mortality + HF hospitalization	2.28 for eGFR 15–29 1.31 for eGFR 30–59
25	JCARE-CARD	2009	2,013	1.8 (mean)	71.5	58.7	44.8	54.5%	30.7	ACEi: 36.7 ARB: 46.1	70.3	2.4 years	All-cause mortality	1.56 for eGFR <30 1.26 for eGFR 30–59 2.48 for eGFR <30

CKD was present in 35—70% of HF patients evaluated in cohort studies or subanalyses of randomized controlled trials

Shiba N, J Cardiol 2010

Prevalence of HF in CKD vs non-CKD patients (age > 66yo)



House A.A. Am J Kidney Disease 2017

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THE CARDIORENAL SYNDROME

OSPEDALE DELL'ANGELO

Definition of CRS

Journal of the American College of Cardiology
© 2008 by the American College of Cardiology Foundation
Published by Elsevier Inc.
Vol. 52, No. 19, 2008
ISSN 0735-1097/08/$34.00
doi:10.1016/j.jacc.2008.07.051

STATE-OF-THE-ART PAPER

Cardiorenal Syndrome

Claudio Ronco, MD,* Mikko Haapio, MD,† Andrew A. House, MSc, MD,‡ Nagesh Anavekar, MD,§ Rinaldo Bellomo, MD¶
Vicenza, Italy; Helsinki, Finland; London, Ontario, Canada; and Melbourne, Australia

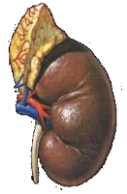
"A complex pathophysiologic disorder of the heart and kidneys whereby acute or chronic dysfunction in one organ may induce acute or chronic dysfunction in the other organ"

Acute Heart Disease → **TYPE 1** → **Acute** Kidney Injury

Chronic Heart Disease → **TYPE 2** → **Progressive** Kidney Injury

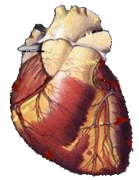
Acute Kidney Injury → **TYPE 3** → **Acute** Heart Disease

Chronic Kidney Disease → **TYPE 4** → **Progressive** Heart Disease



TYPE 5

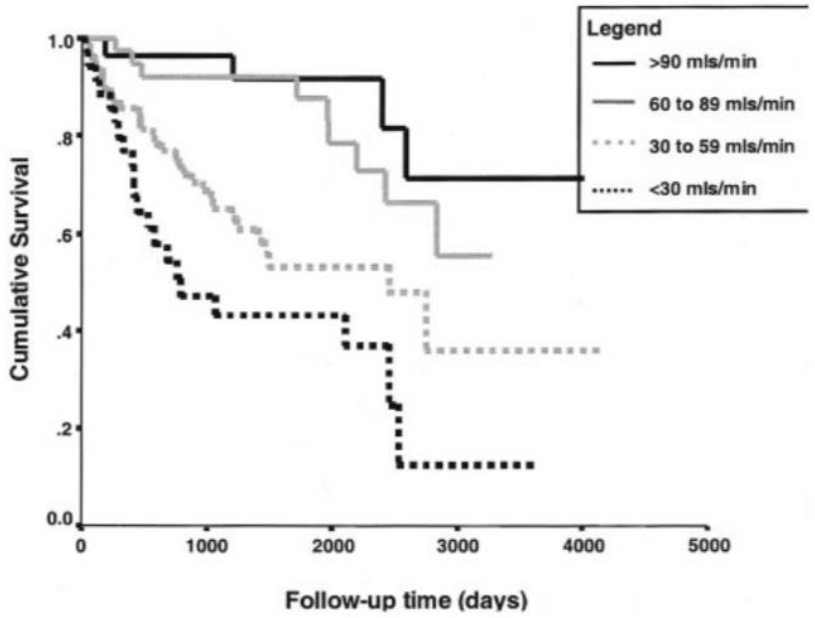
combined cardiac and renal dysfunction due to acute or chronic systemic disorders



HEART FAILURE AND RENAL FAILURE
THE SIZE OF THE PROBLEM

The presence of one condition has a strong influence on the other, leading to greater risks for hospitalization, morbidity, and death, as well as very high health care costs.

CKD is a powerful independent prognostic factor in HF

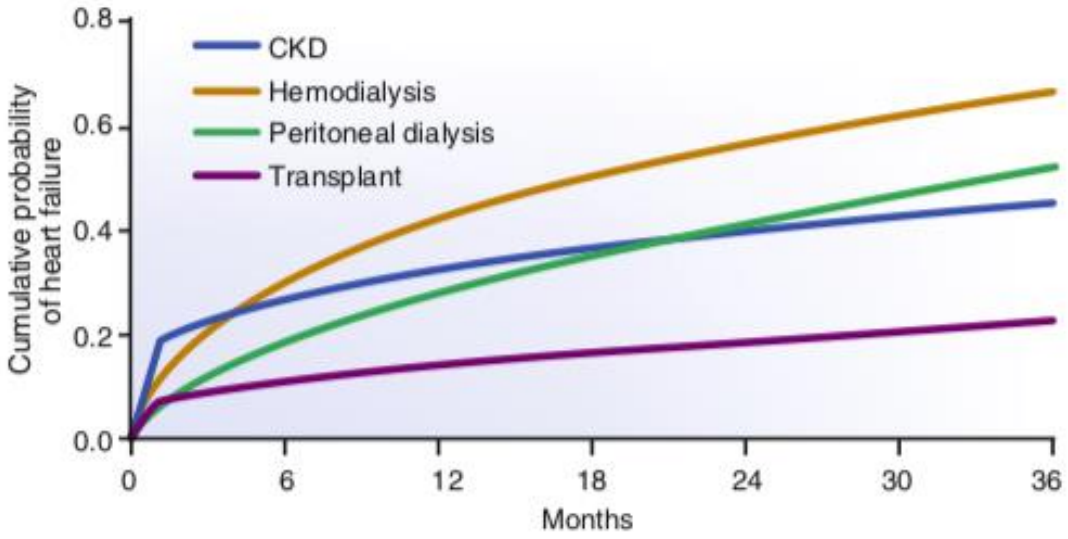


Survival stratified by baseline creatinine clearance. Log-rank statistic=27.98 ($P<0.0001$).

McAlistar FA, Circ 2004

HF is a powerful indipendent prognostic factor in CKD

The mortality rate after HF was 83% at 3 years



Am J Kidney Disease 2003, 2008

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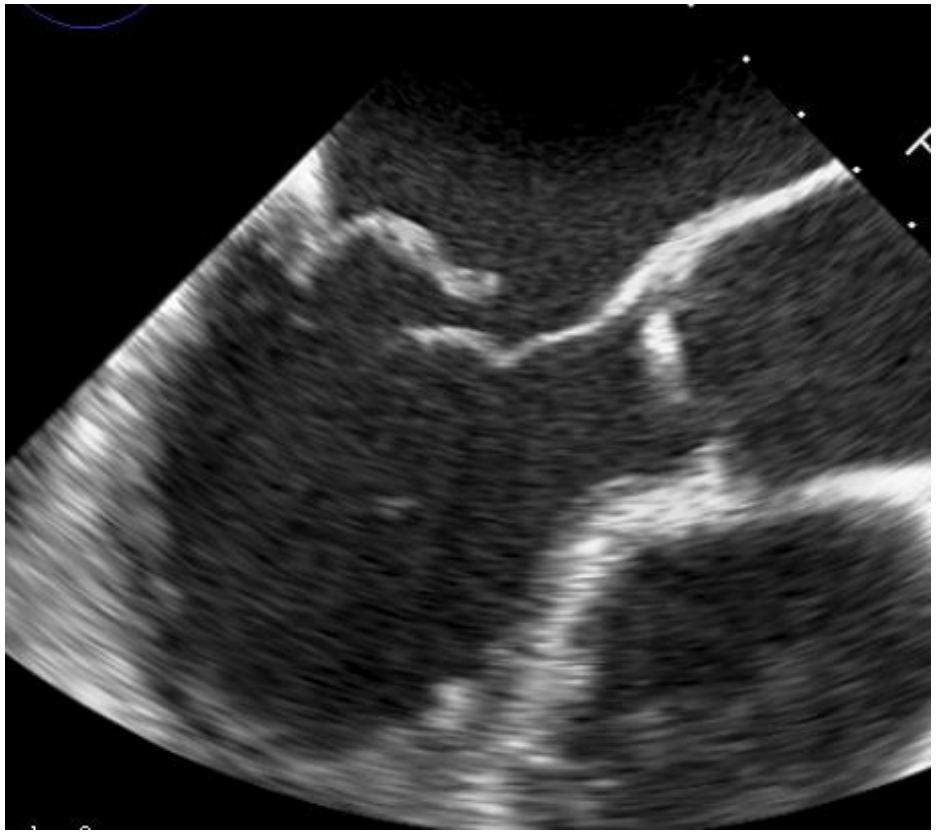
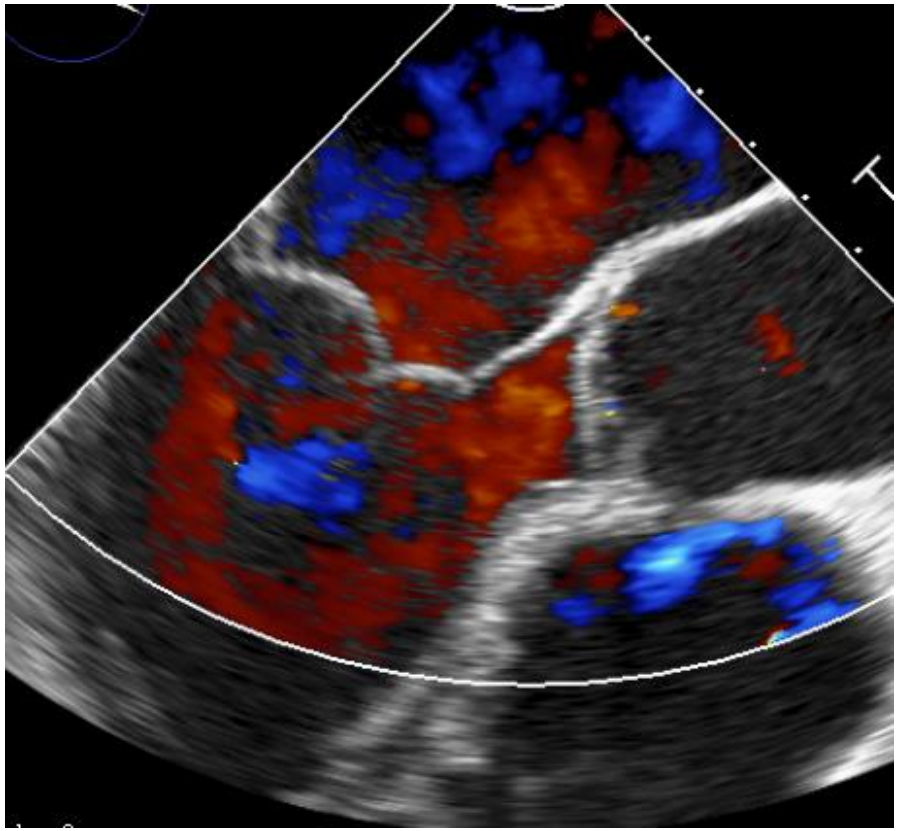
CLINICAL CASE

89 yo Male **admitted for ADHF**
Complicated by AKI
Massive degenerative MR
Flail of posterior leaflet

HEART TEAM decision:

PMVR with MitraClip





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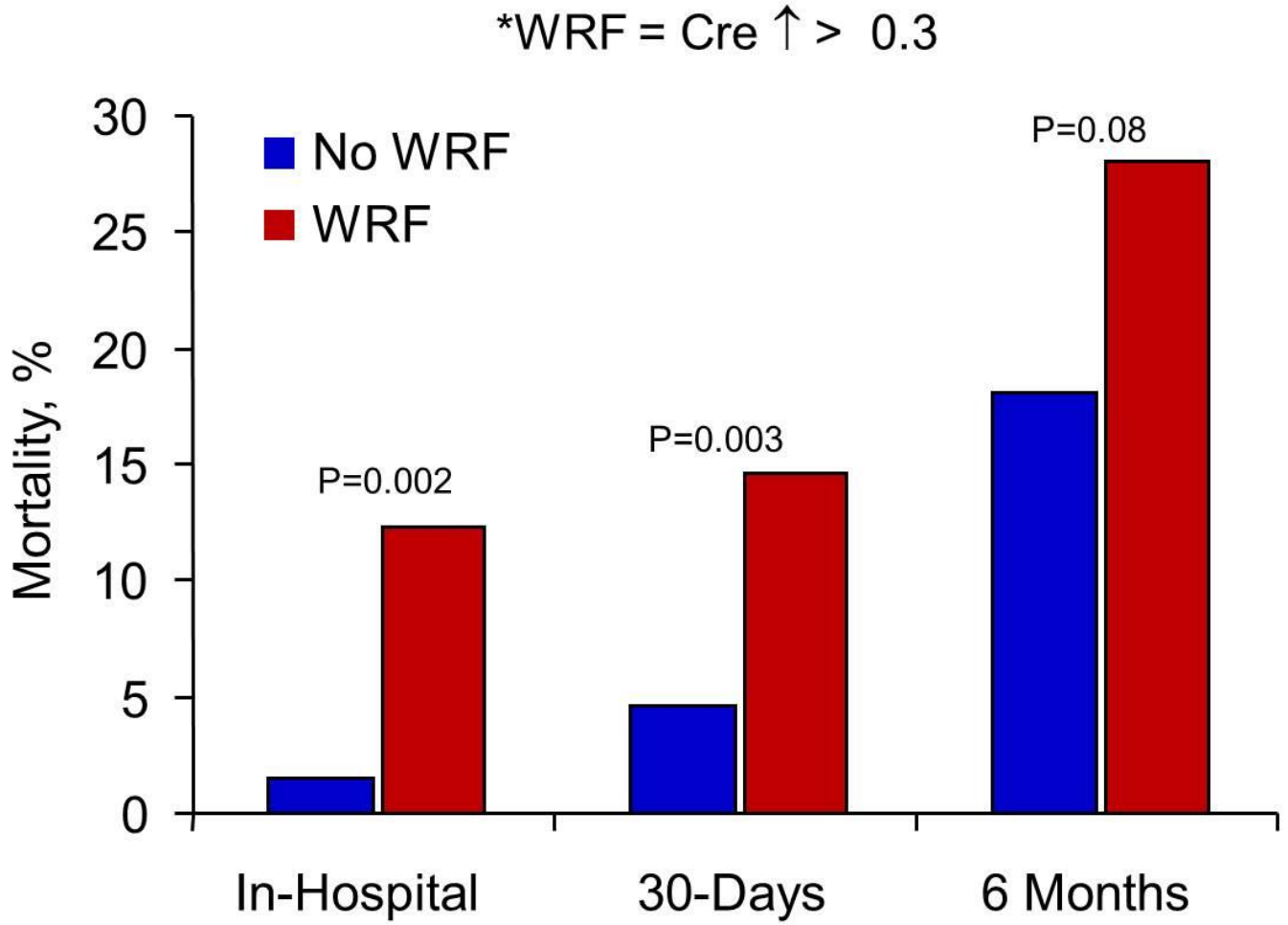
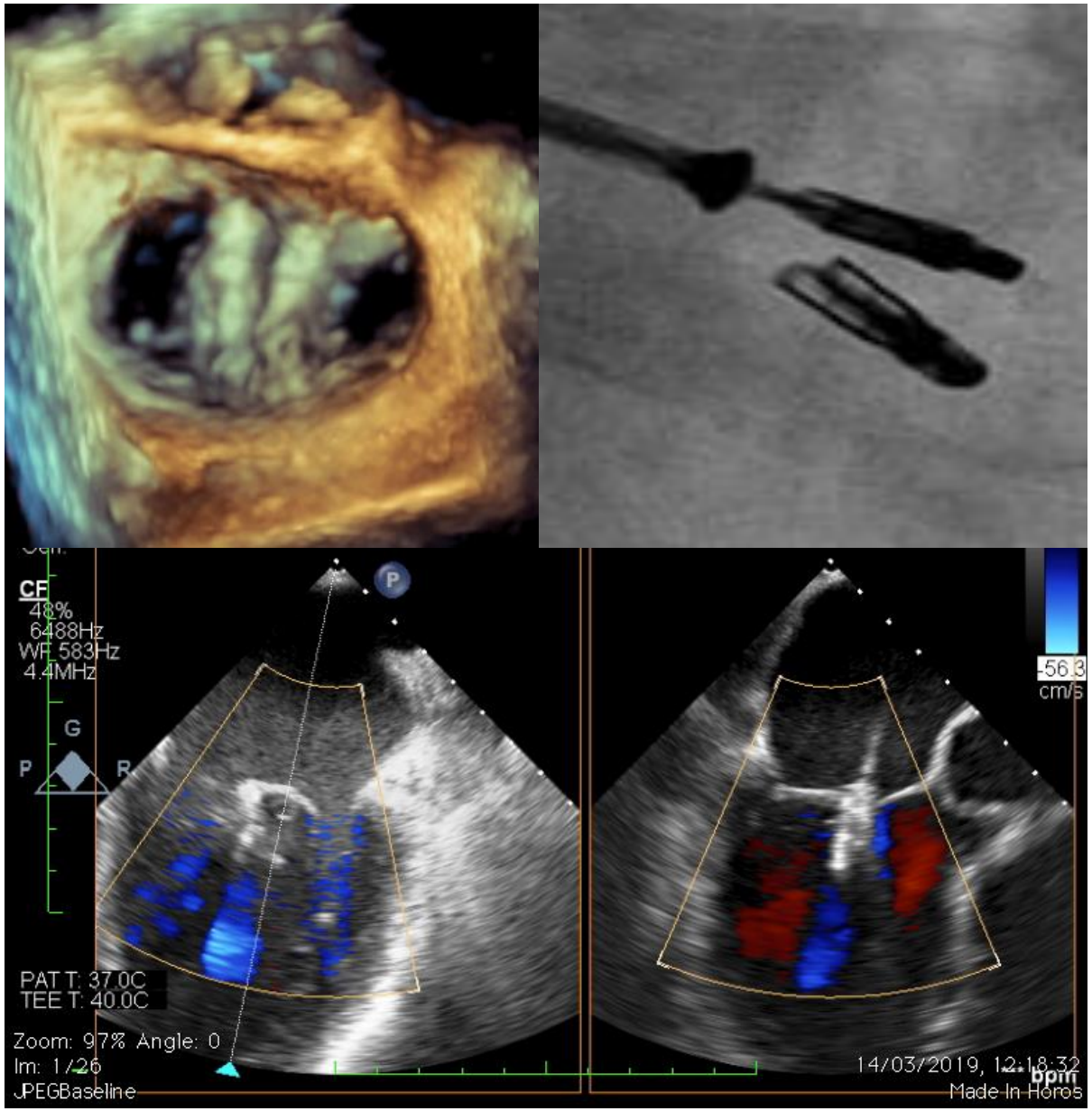
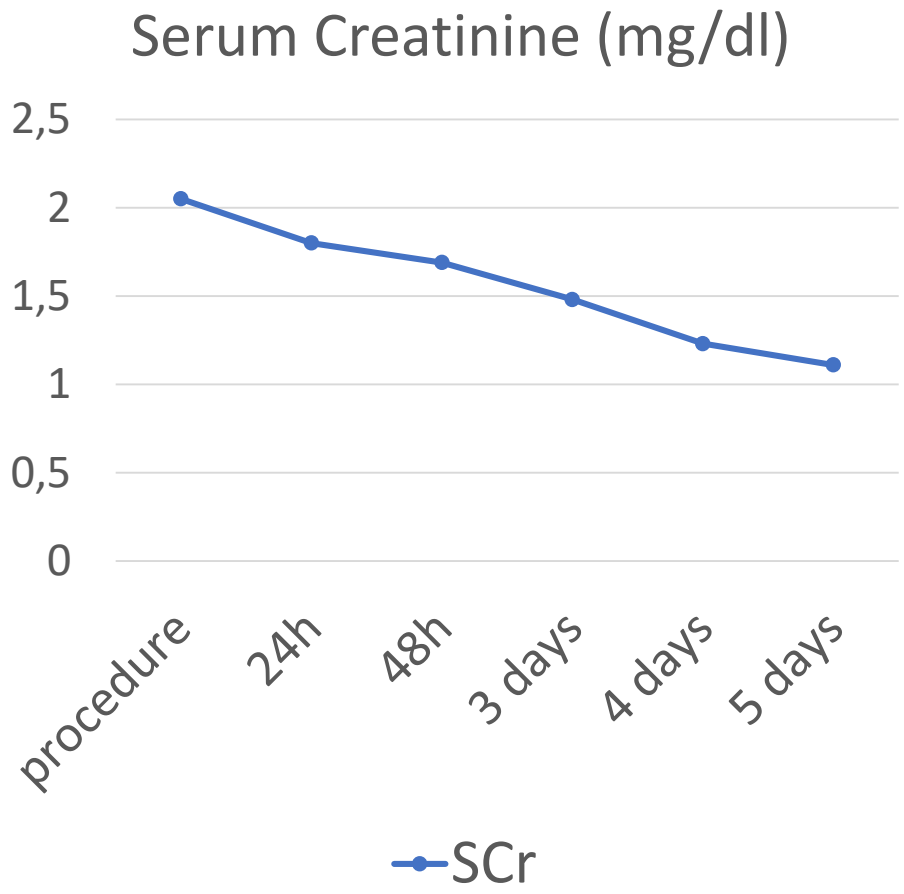
DEVELOPMENT OF WORSENING RENAL FUNCTION DURING ADHF



Cowle et al., Eur Heart J 2006;27:1216

CLINICAL CASE





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EFFECT OF PMVR ON RENAL FUNCTION

Reduction in MR severity by the MitraClip device is associated with improvement in renal function at 1 year in patients with baseline renal dysfunction.

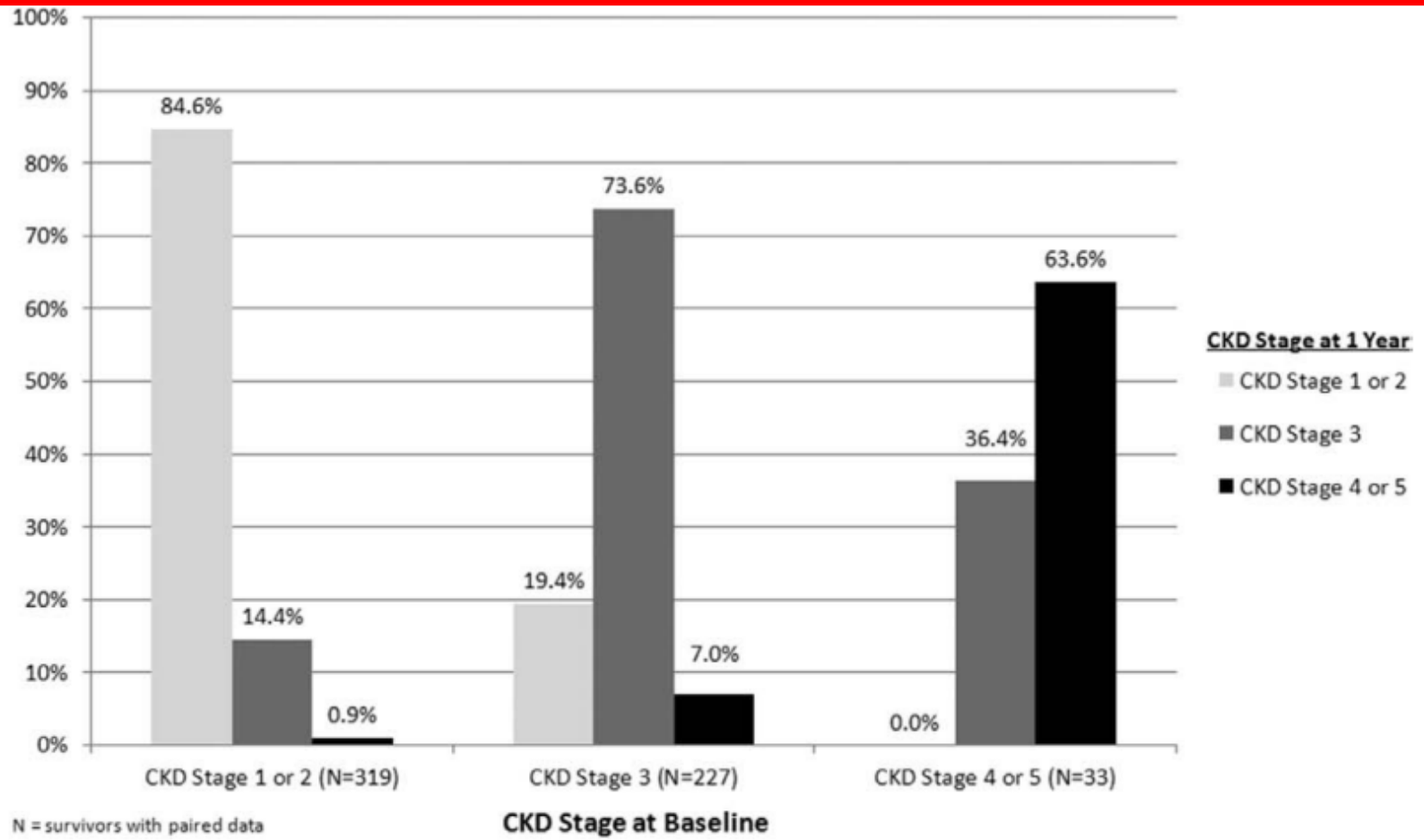

Figure 2. Paired comparisons of chronic kidney disease (CKD) severity across subgroups from baseline to 1 year.

Wang et al. Circ Cardiovasc Int 2015

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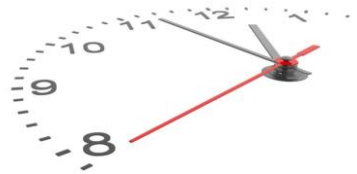
DIFFERENT CAUSES FOR RENAL FUNCTION DETERIORATION IN ''CATH-LAB PATIENTS''

- **LOW CARDIAC OUTPUT**
- **PRE-EXISTING CKD**
- DRUGS
- COMORBIDITIES
- AGE
- EMBOLIC RENAL DAMAGE

CONTRAST ADMINISTRATION

Biomarker

Time Frame



CONTRAST INDUCED ACUTE KIDNEY INJURY

CI-AKI

Differential Diagnosis

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CI-AKI DEFINITION

In interventional cardiology

- An increase in serum creatinine by more than **0.5 mg/dl** **(44 µmol/l**) or **25% relative increase**
- Within **72 hours** of the intravascular administration of contrast medium

Old definition

- An increase in serum creatinine by more than **0.3 mg/dl** **(26.5 µmol/l)** or **1.5–1.9 times baseline**
- Within **48 hours** of the intravascular administration of contrast medium
- **Urine output < 0,5ml/Kg/h for 6-12 h**
- **No alternative aetiology**

Current KDIGO 2012

- An increase in ***novel biomarkers*** (NGAL…CyC…Cyr 61… IL18…)
- Within ***few hours*** of the intravascular administration of contrast medium

Future definition?

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CI-AKI CONSENSUS PROJECT

GISE
Società Italiana di Cardiologia Interventistica

SIN reni
Società Italiana Nefrologia

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Marina Di Luca
Chiara Venturelli

Documento di consenso SICI-GISE/SIN: Danno renale acuto da mezzo di contrasto in cardiologia interventistica

Federico Ronco[1], Lorenzo Azzalini[2], Carlo Briguori[3], Laura Cosmai[4], Maurizio D'Amico[5], Marina Di Luca[6], Giovanni Esposito[7], Antonino Granatelli[8], Nicola Maddestra[9], Federico De Marco[10], Alessio La Manna[11], Mauro Maioli[12], Giuseppe Musumeci[13], Fabio Tarantino[14], Chiara Venturelli[15], Giuliano Brunori[15], Giuseppe Tarantini[16]

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Contrast-induced acute kidney injury (CI-AKI) is a serious complication that can affect outcome and prognosis of patients undergoing percutaneous diagnostic and interventional procedures. The Italian Society of Interventional Cardiology (SICI-GISE) has promoted a consensus project on the subject of CI-AKI in order to disseminate and implement nephroprotection strategies in interventional cardiology. The initiative was conducted in partnership with the Italian Society of Nephrology (SIN).

Key words. Acute kidney injury; Contrast dye; Contrast-induced acute kidney injury; Contrast-induced nephropathy; Interventional cardiology; Nephroprotection.

G Ital Cardiol 2019;20(9 Suppl 1):295-435

CI-AKI IN DIFFERENT PROCEDURES

PROCEDURE	PCI	PPCI	CTO	TAVI	TEVAR	EVAR	R	AAO
INCIDENCE CI-AKI	3.3-10.2%	10.5%-18.3%	9.4%	22%				
CLINICAL RELEVANCE	Increased risk of **death** (9.5% at 1y and	Increas	In hospital Increase of **ations** (5.2%, p<0,001)	**dialysis** (OR 14.35), **lifethreating bleeding** (OR 2.9)	**spitalizatio n** (p=0.008) higher **mortality** (29%, p<0,001)	**pital death** (14.3% p=0.013), **ICU stays** (p=0,029), 1y **mortality** (21.4%, p=0.005)	Increased risk oh in **hospital death** (OR 18.1), **MI** (OR 16.2), **TIA-stroke** (OR 5.5%) **bleeding** with transfusion (OR 7)	**Mortality** 23% (2 fold increase) at 1 y
REF	rdiol 2009 Lindsay CCI 2003	Silvain Heart 2017	Demir Am J Cardiol 2018 Azzalini Can J Card 202018)	Gargiulo CCI 2015	Piiffaretti J Vas Surg 2012	Kawatani J Med Inv 2018	Prasad CCI 2016 Pucciarelli Euroint 2018 Grossman J int C 2017	Nombela-Franco JACC Int 2018

CI-AKI is associated with worse procedural outcomes

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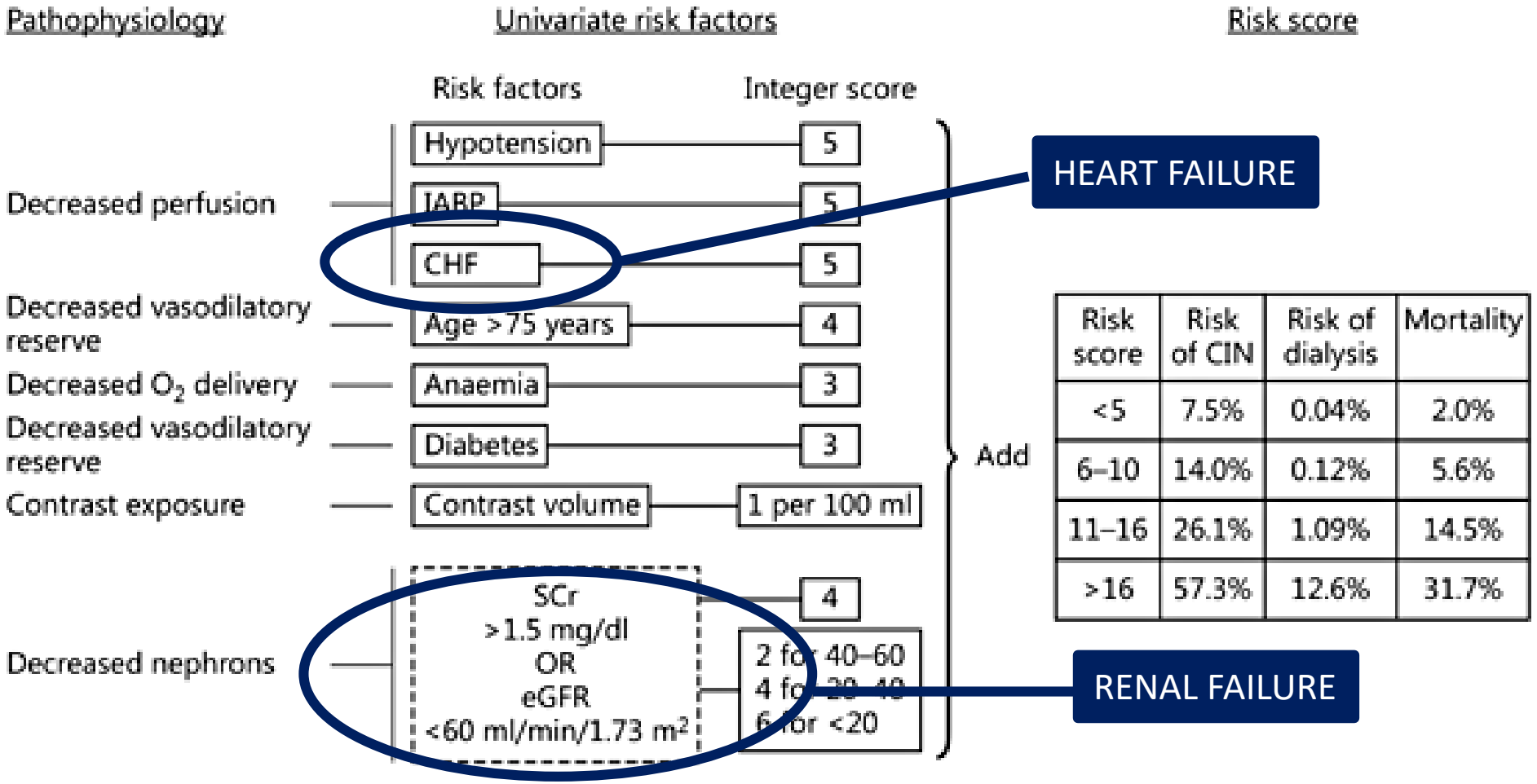
RISK SCORE FOR CI-AKI



Risk score	Risk of CIN	Risk of dialysis	Mortality
<5	7.5%	0.04%	2.0%
6–10	14.0%	0.12%	5.6%
11–16	26.1%	1.09%	14.5%
>16	57.3%	12.6%	31.7%

Mehran JACC 2004

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STRATEGIES TO REDUCE RISK OF CI-AKI

Pre- and post-hydration with isotonic saline should be considered if the expected contrast volume is >100 mL.	1 mL/kg/h 12 h before and continued for 24 h after the procedure (0.5 mL/kg/h if LVEF ≤35% or NYHA >2).	IIa	C
As an alternative to the pre- and post- hydration regimen, tailored hydration regimens[d] may be considered.[295–297]		IIb	B

ent

STRATEGIES TO REDUCE RISK OF CI-AKI
Tailored Hydration

Haemodynamic-guided fluid administration for the prevention of contrast-induced acute kidney injury: the POSEIDON randomised controlled trial

Lancet 2014

Somjot S Brar, Vicken Aharonian, Prakash Mansukhani, Naing Moore, Albert Y-J Shen, Michael Jorgensen, Aman Dua, Lindsay Short, Kevin Kane

fluid protocol based on the left ventricular end-diastolic pressure

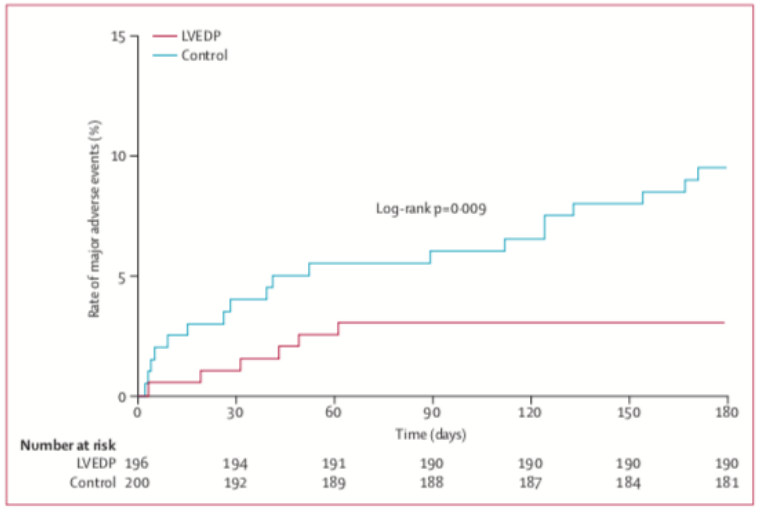


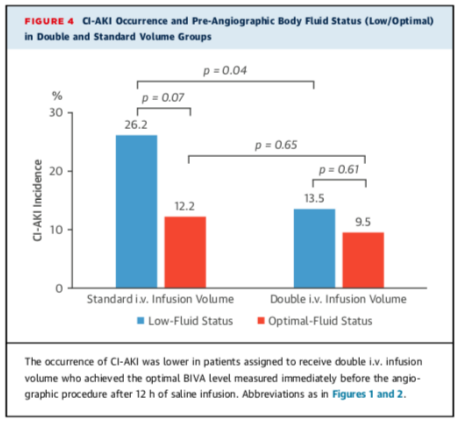
Figure 3: **Rate of major adverse events in each group**
The graph shows the 6-month rate of major adverse events, defined as a composite of all-cause mortality, myocardial infarction, or dialysis. LVEDP=left ventricular end-diastolic pressure.

Bioimpedance-Guided Hydration for the Prevention of Contrast-Induced Kidney Injury

The HYDRA Study

JACC 2018

Mauro Maioli, MD,[a] Anna Toso, MD,[a] Mario Leoncini, MD,[a] Nicola Musilli, MD,[a] Gabriele Grippo, MD,[a] Claudio Ronco, MD,[b] Peter A. McCullough, MD, MPH,[c,d,e,f] Francesco Bellandi, MD[a]



Evaluation of BIVA levels on admission in patients with stable coronary artery disease allows adjustment of intravascular volume expansion, resulting in lower CI-AKI occurrence after angiographic procedures.

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STRATEGIES TO REDUCE RISK OF CI-AKI
Tailored Hydration

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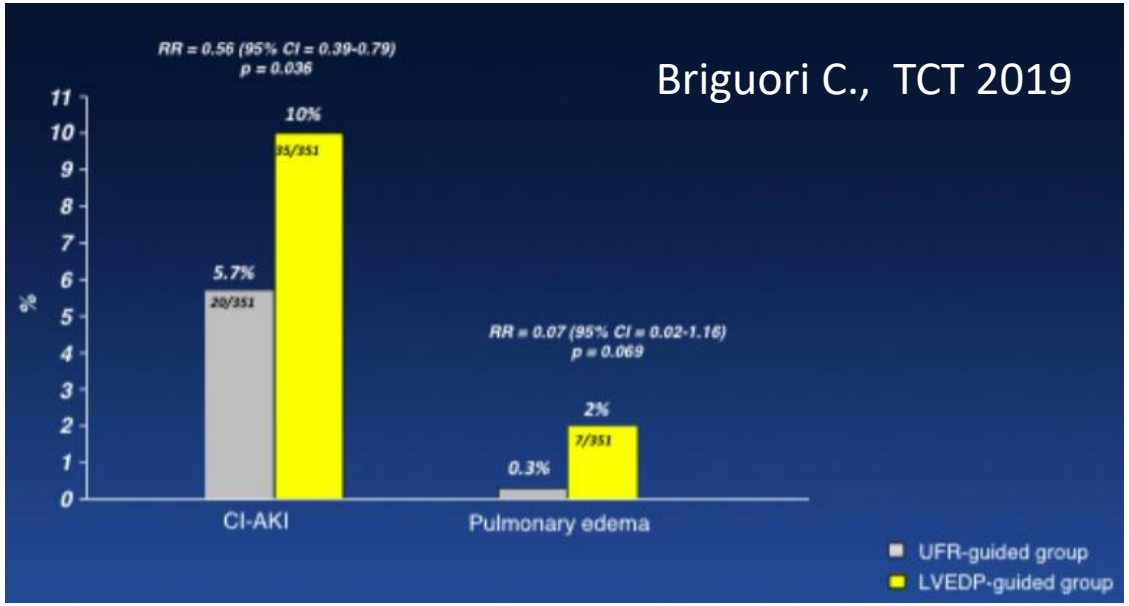
RenalGuard

The RenalGuard system (RenalGuard Solutions, Milford, Massachusetts) is a device that allows the **maximization of intravenous hydration by matching the infused volume to the patient's urine output.**

REMEDIAL III

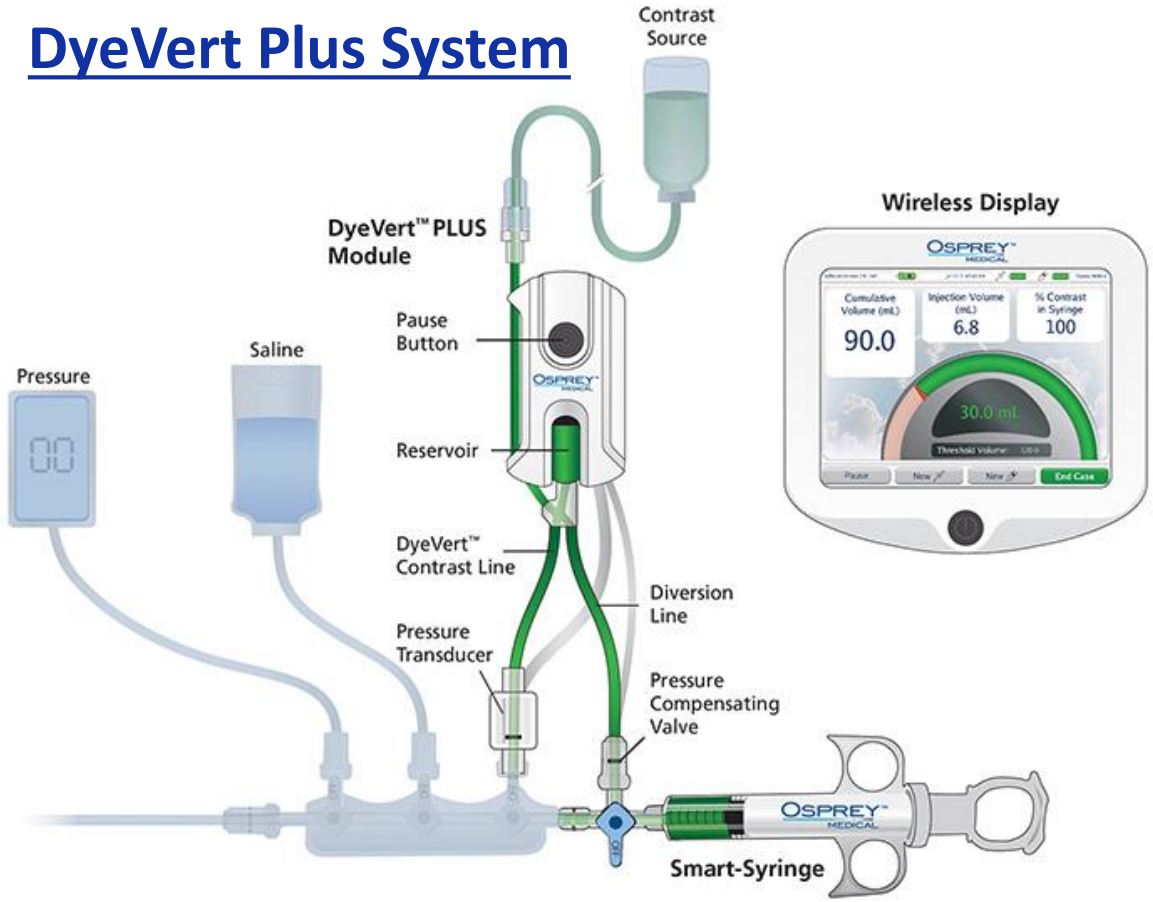
Multicenter , randomized, single-blind, phase 3, investigator-initiated trial comparing 2 tailored-hydration regimens:

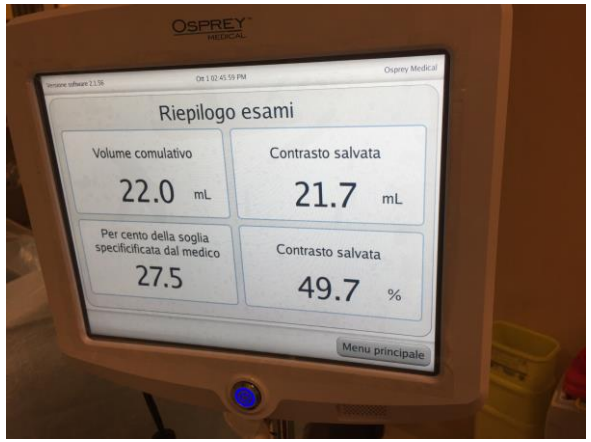
- **LVEDP-guided hydration**
- **UFR-guided hydration**



AMOUNT OF CONTRAST MEDIUM
LESS IS MORE

DyeVert Plus System





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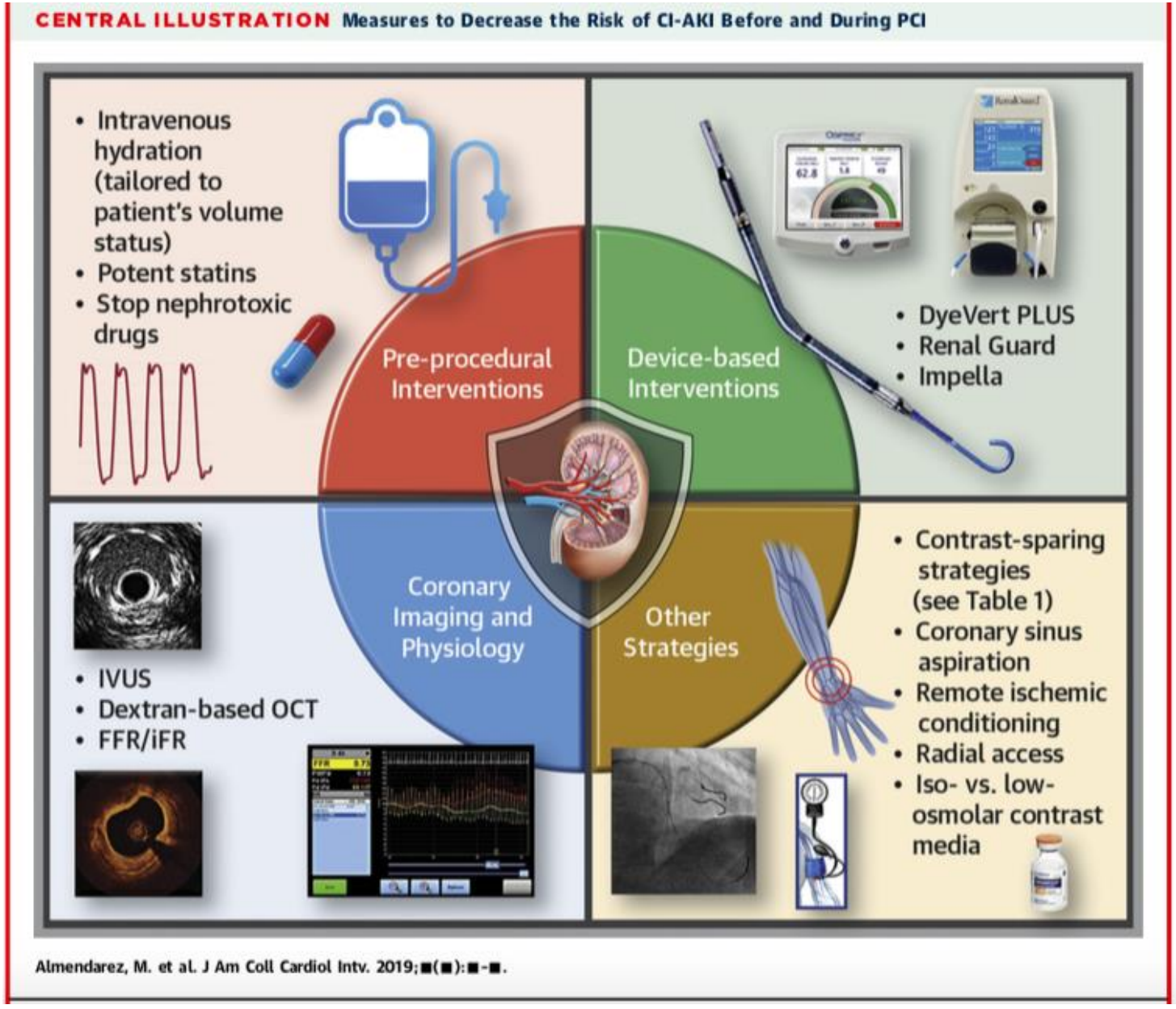
STRATEGIES TO REDUCE RISK OF AKI IN THE CATH LAB



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IMPELLA

The Impella is a heart pump that pulls blood from the left ventricle through an inlet area near the tip and expels blood from the catheter into the ascending aorta.

INDICATIONS

- *High risk PCI*
- *ADHF, Cardiogenic Shock*
- *Coronary artery bypass surgery without ECC.*

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IMPELLA

452 symptomatic patients with complex coronary artery disease and severely depressed left ventricular function randomly assigned to IABP (n226) or Impella 2.5 (n226) support during nonemergent high-risk percutaneous coronary intervention

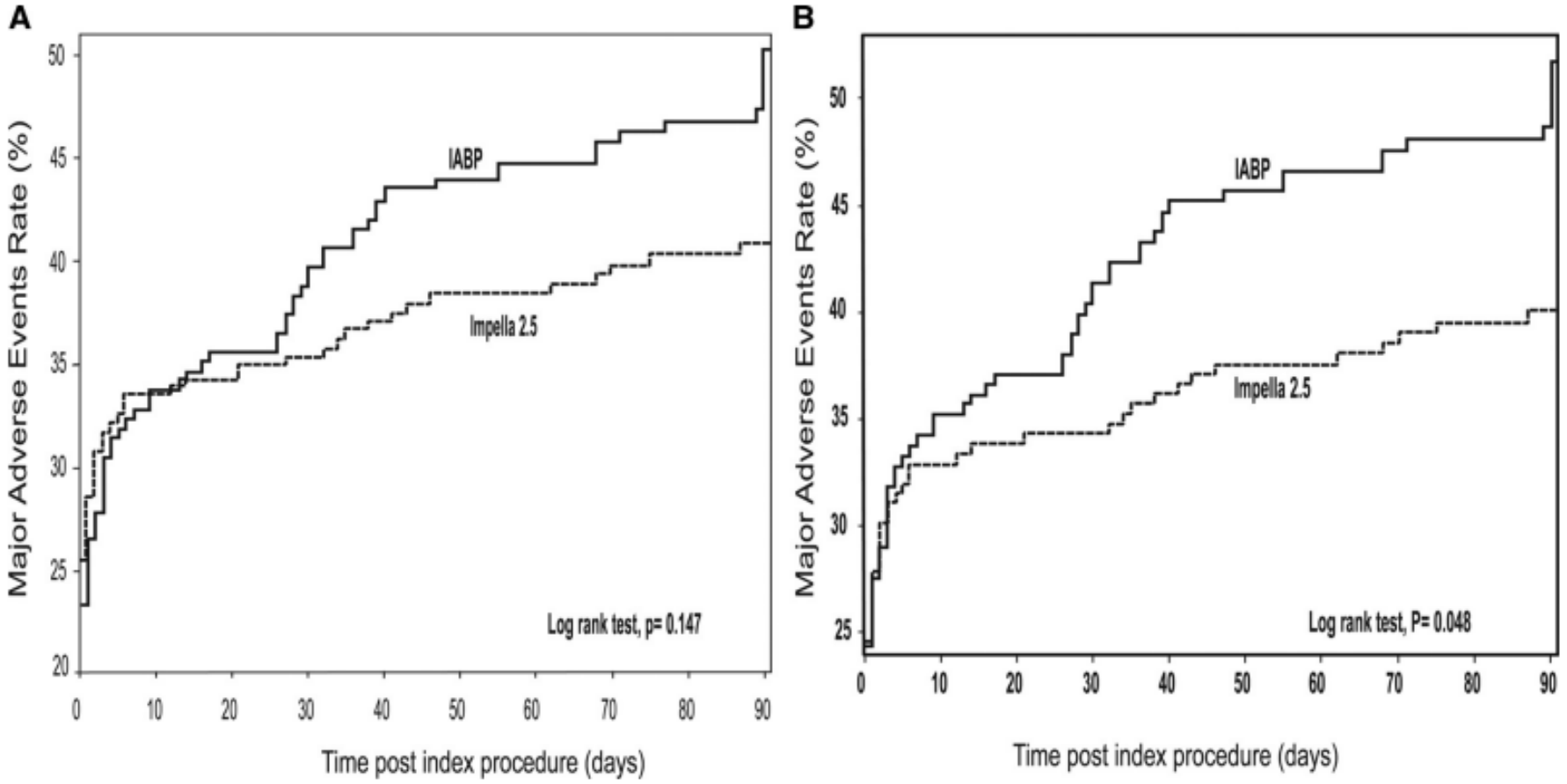


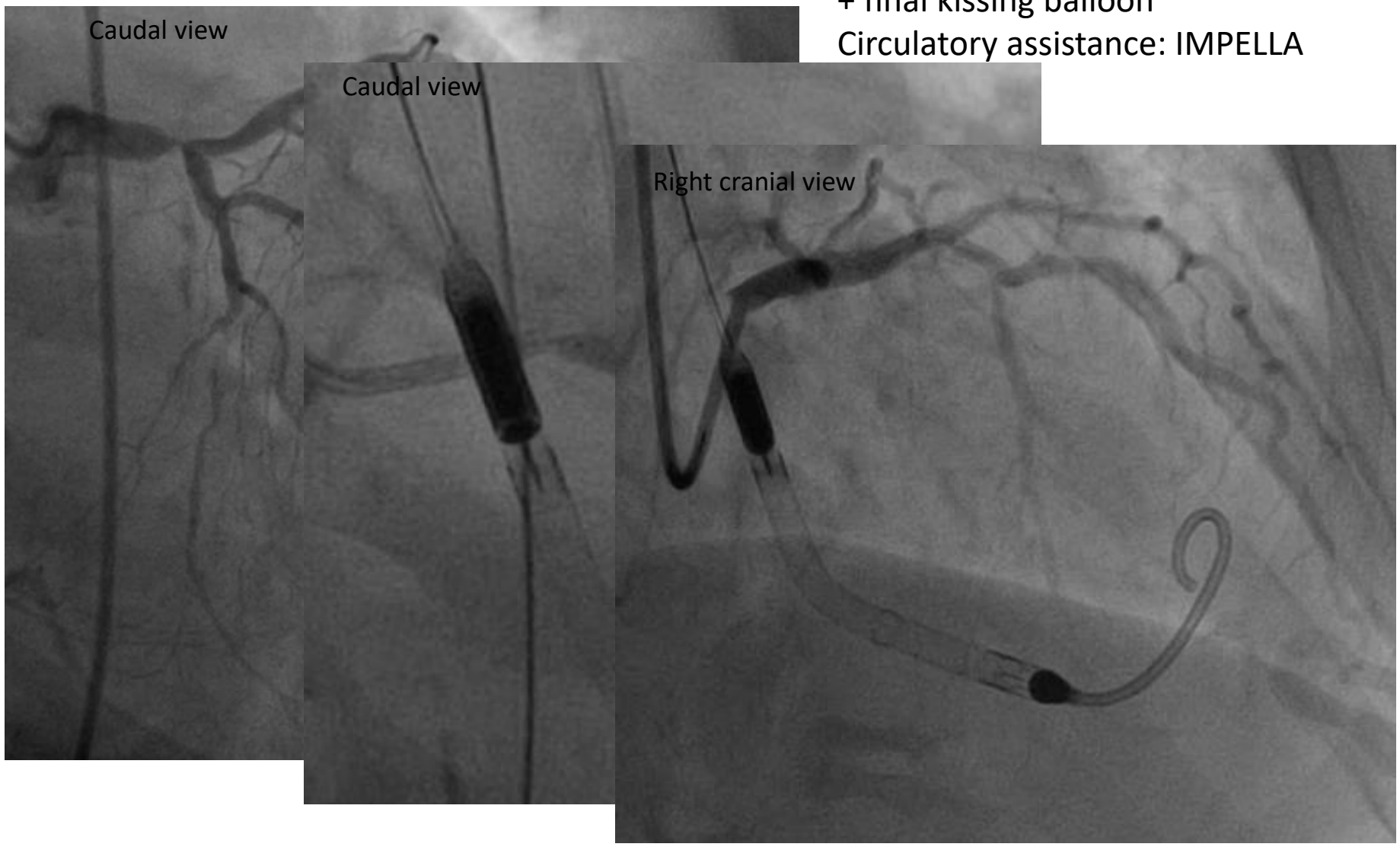
Figure 2. Kaplan–Meier curves of major adverse events to 90 days. **A**, intent-to-treat population. **B**, per protocol population. IABP indicates intra-aortic balloon pump.

O'Neill W.W. et al, PROTECT II, Circulation 2012

IMPELLA

Male 75 yo admitted for cardiogenic shock
ECG: SR, LBBB

PCI with 2 DES LM-LAD-Circ
+ final kissing balloon
Circulatory assistance: IMPELLA



MECHANICAL CIRCULATORY SUPPORT

Blood Purification

Blood Purif 2013;35:119–126
DOI: 10.1159/000346096

Published online: January 22, 2013

Effect of Percutaneous Ventricular Assist Devices on Renal Function

Huijuan Mao[a, b, e] Anna Giuliani[a–c] Lourdes Blanca-Martos[a, b, f]
Jeong Chul Kim[a, b] Akash Nayak[b, d] Grazia Virzi[a, b] Alessandra Brocca[a, b]
Elisa Scalzotto[a, b] Mauro Neri[a, b] Nevin Katz[g] Claudio Ronco[a, b]

pVAD insertion with hemodynamic improvement **should improve kidney function** as a result of the restoration of perfusion.

However, there are only a **few studies reporting the effect of pVADs on kidney function**, and the patient numbers studied are small.

Nevertheless, the **available clinical data support pVAD as a means to reverse and prevent renal failure** in patients with marked hemodynamic compromise.

In that kidney function is one of the most reliable predictors of outcome in the setting of acute heart disease, the pVAD should be chosen depending on its expected renal effects.

IMPELLA

OSPEDALE DELL'ANGELO

Impella support and acute kidney injury during high-risk percutaneous coronary intervention: The Global cVAD Renal Protection Study

CCI 2019

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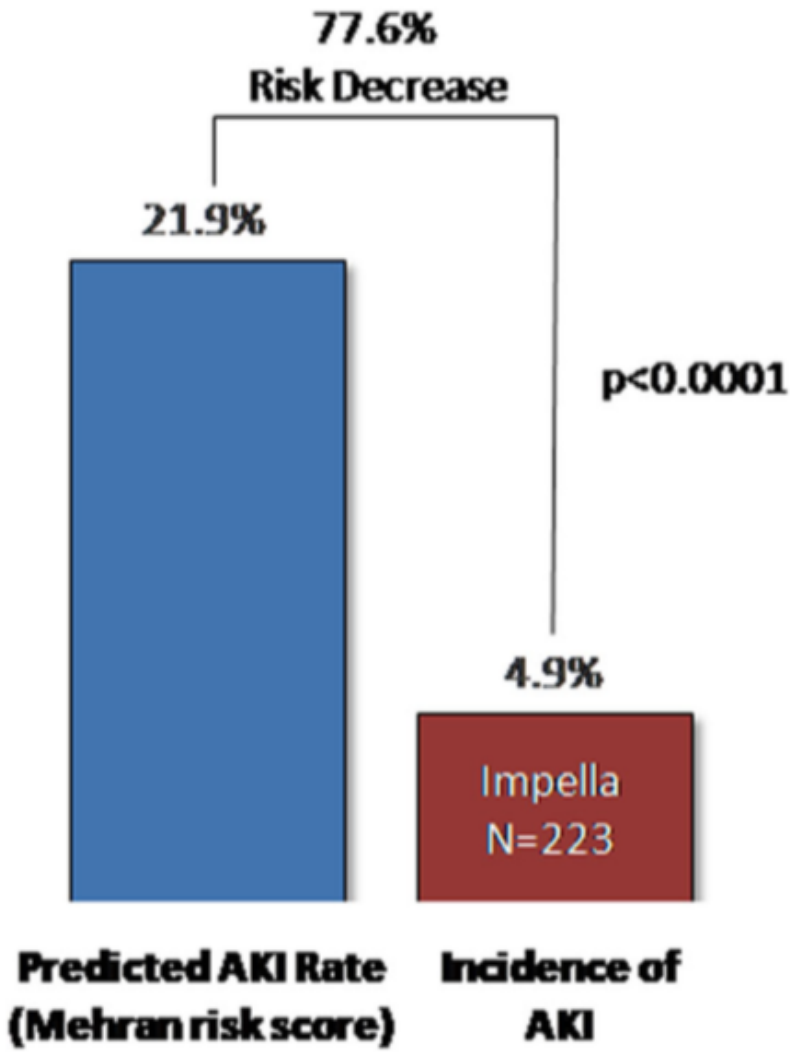
Igor Palacios MD[4] | William W. O'Neill MD[5] | Theodore L. Schreiber MD[6] |
Michael J. Lim MD[7] | Amir Kaki MD[8] | Ioana Ghiu MD[9] | Roxanna Mehran MD[10]

Conclusion: The incidence of AKI was lower during HR-PCI than expected from current risk models. Although further exploration of this finding is warranted, these data support a **new protective strategy against AKI during HR-PCI**.



CONTRAST DYES: IOCM vs LOCMs

RCTs

LOCMs safer	Neutral	IOCM safer
	ICON (Mehran JACC 2009)	NEPHRIC (Aspelin NEJM 2013)
	VALOR (Rudnik AHJ 2008)	Recover (Jo JACC 2006)
	CARE (Solomon Circ 2007)	Nie CCI 2009
	Feldkamp (Clin Nephr 2006)	Song Int J Cardiol 2017

Metanalysis

LOCMs safer	Neutral	IOCM safer
	Reed (JACC 2009)	McCollough (CRM 2011)
	Heinrich (Radiology 2009)	Dong (JNephr 2012)
	Biondi-Zoccai (IJC 2014)	Mc Collough (JACC 2006)
	Pandya IJC 2016	

IOCM or LOCMs?

Documento di consenso SICI-GISE/SIN: Danno renale acuto da mezzo di contrasto in cardiologia interventistica

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Il Panel non ritiene vi siano evidenze per raccomandare l'utilizzo di IOCM vs LOCM nella popolazione generale dei pazienti sottoposti a procedure diagnostiche o interventistiche endovascolari. Tuttavia, nei pazienti giudicati clinicamente ad alto rischio di CI-AKI (Tabella 1), considerando che i dati esprimono l'equivalenza o comunque la superiorità dello IOCM vs LOCM in termini di riduzione del rischio di CI-AKI, il Panel accoglie il riportato trend di maggior sicurezza a favore del MCI iso-osmolare.

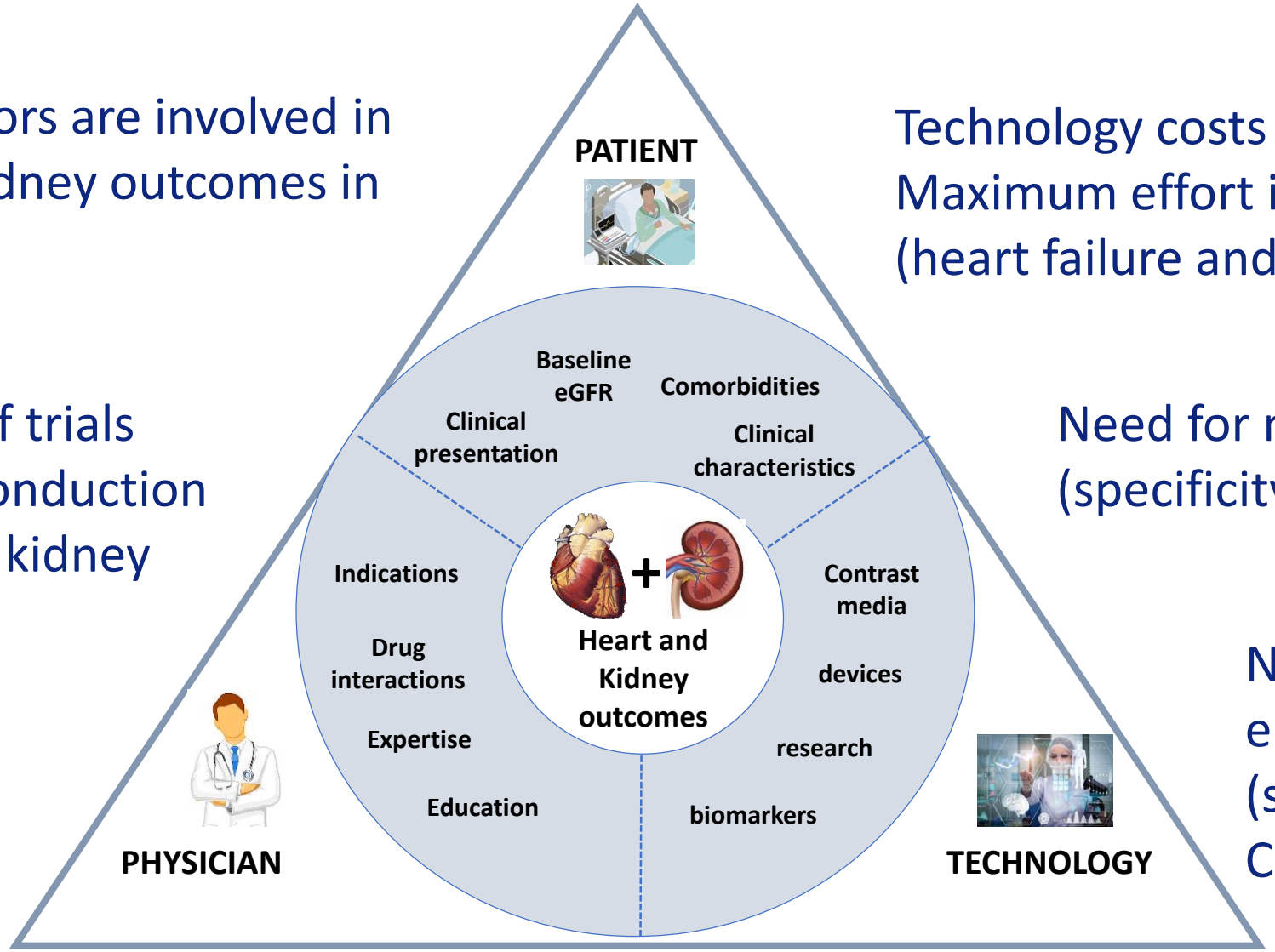
Tabella 1. Principali fattori di rischio per danno renale acuto da mezzo di contrasto.

Dati anamnestici
Età avanzata
Insufficienza renale cronica
Diabete
Anemia
Scompenso cardiaco
Ridotta FEVS
Presentazione clinica
Urgenza/emergenza
Shock
Concomitante insufficienza renale acuta da altre cause
Ipovolemia
Concomitante utilizzo di farmaci nefrotossici
Aspetti procedurali
Volume di MCI
Tipo di MCI
IABP
Accesso arterioso femorale

HEART AND KIDNEY OUTCOMES IN CATH-LAB

Multiple actors are involved in heart and kidney outcomes in the cath lab

Complexity of trials design and conduction on heart and kidney outcomes



Technology costs effectiveness: Maximum effort in high risk patients (heart failure and renal failure)

Need for novel biomarkers (specificity)

New combined end points (subclinical AKI and CI-AKI, MARCE)

Modified from Ronco F et al GIC 2019

OSPEDALE DELL'ANGELO

31 GIORNATE CARDIOLOGICHE TORINESI

TURIN
October
24th-26th
2019

THANK YOU

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