广东省医学科学院 Guangdong Academy of Medical Sciences

广东省人民医院 Guangdong General Hospital

急诊PCI围手术期急性肾损伤防治

从STEMI谈起

广东省医学科学院 广东省人民医院

华南理工大学第一临床学院

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广东省冠心病重点实验室

心内科 陈纪言

内容提要

1. STEMI行直接PCI后CIN增死亡率；
2. STEMI行直接PCI后CIN发生率高；
3. STEMI-CIN防治指南之一危险分层；
4. STEMI-CIN防治指南之二剂量限制；
5. STEMI-CIN防治指南之三水化预防。

一、造影剂急性肾损伤增加死亡风险

- 每年使用造影剂的人数为2000-3000万。
- 每年有20-100万人患上造影剂肾病。
- 造影剂肾病的总体发生率为1% - 5%.
- 造影剂的使用以每年20%的速度上升。

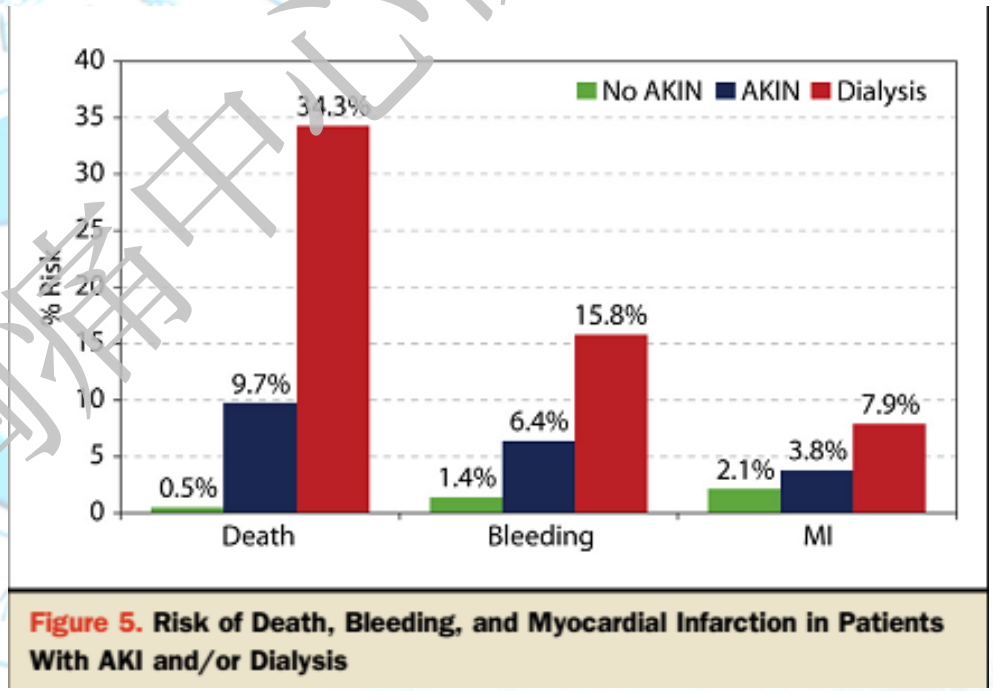
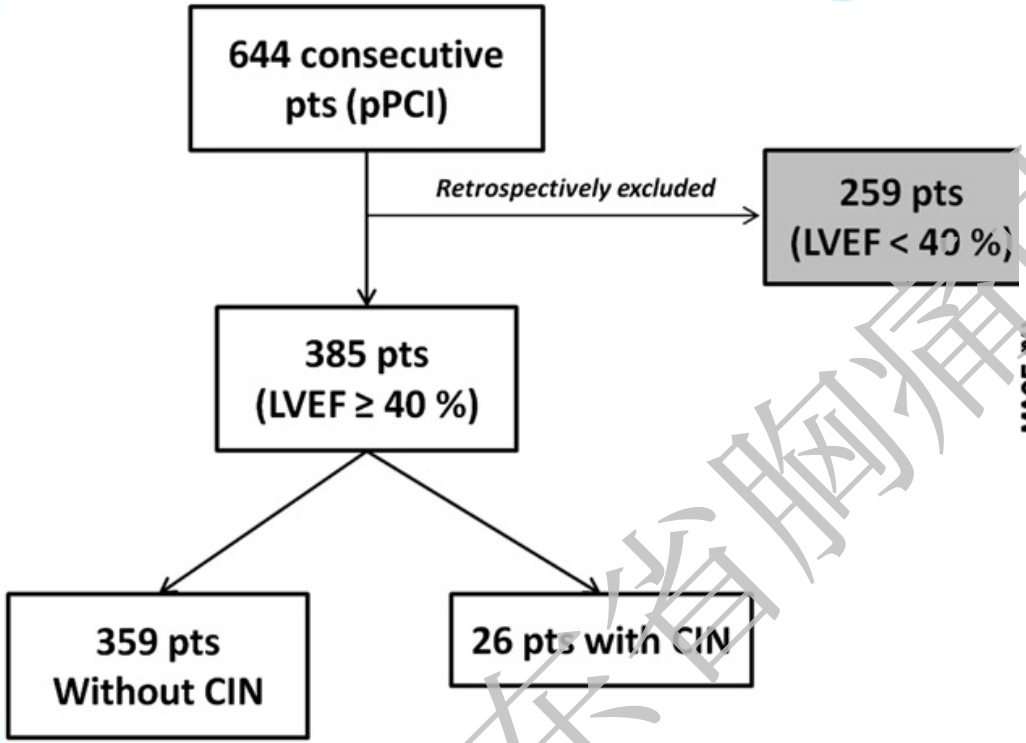
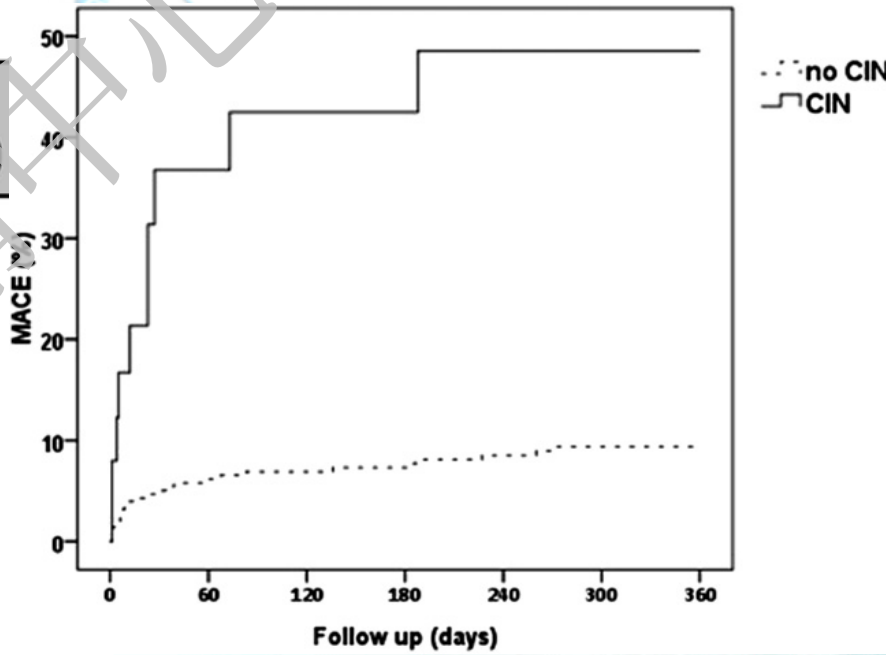


Figure 5. Risk of Death, Bleeding, and Myocardial Infarction in Patients With AKI and/or Dialysis

Tsaiet al. J Am Coll Cardiol Intv 2014;7:1–9

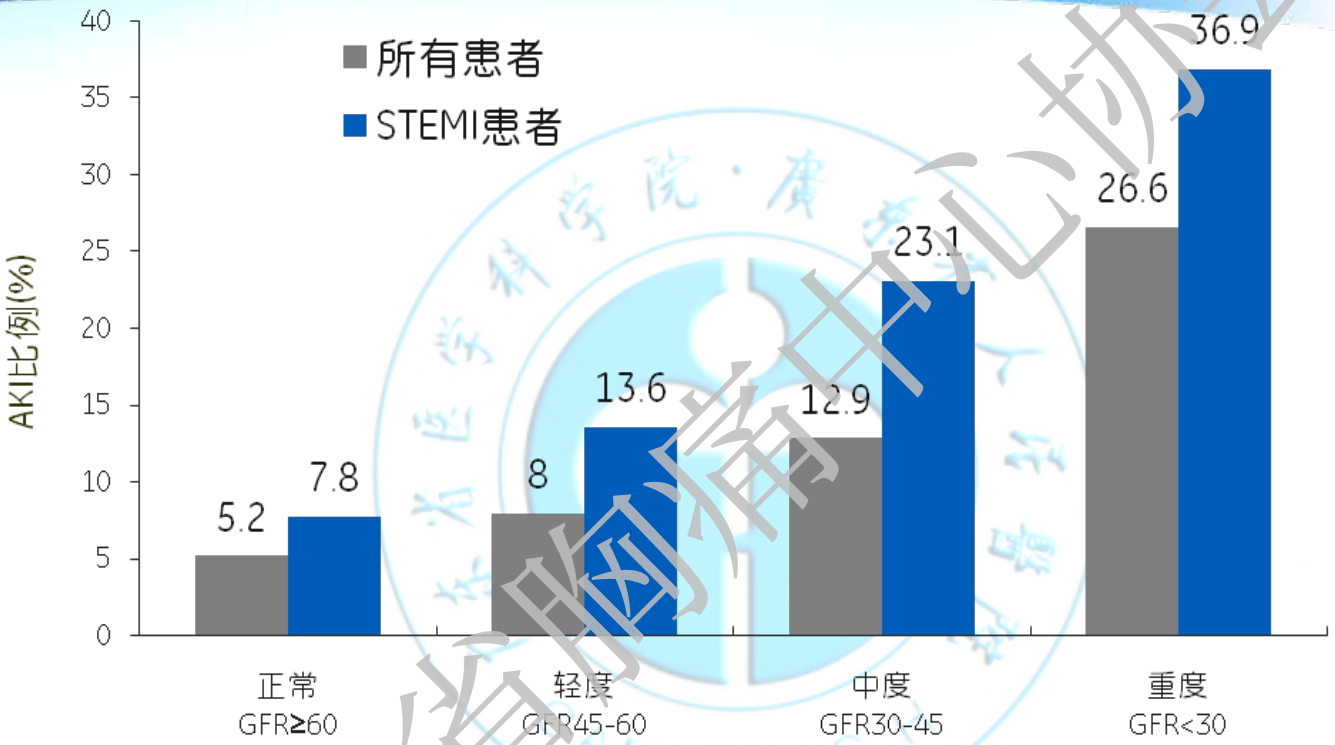
CIN增加射血分数保留STEMI（血流动力学相对稳定）直接PCI后不良心血管事件风险。





Am J Cardiol 2013;111:684e688

二、STEMI患者行PCI后发生CI-AKI率更高



* AKI：急性肾损伤。

此项研究共纳入985,737例行PCI的患者，其中共69,658例患者PCI术后出现AKI，主要独立危险因素包括基线时严重的慢性肾脏疾病(OR 3.59; 95%CI 3.47-3.71)、心源性休克(OR 2.92; 95%CI 2.80-3.04)和STEMI (OR 2.60; 95%CI 2.53-2.67) 。STEMI患者发生AKI比例高与非STEMI。

Tsai TT, Patel UD, Chang TI, et al. Contemporary incidence, predictors, and outcomes of acute kidney injury in patients undergoing percutaneous coronary interventions: insights from the NCDR Cath-PCI registry. JACC Cardiovasc Interv. 2014;7(1):1-9.

二、STEMI患者行PCI后发生CI-AKI率更高

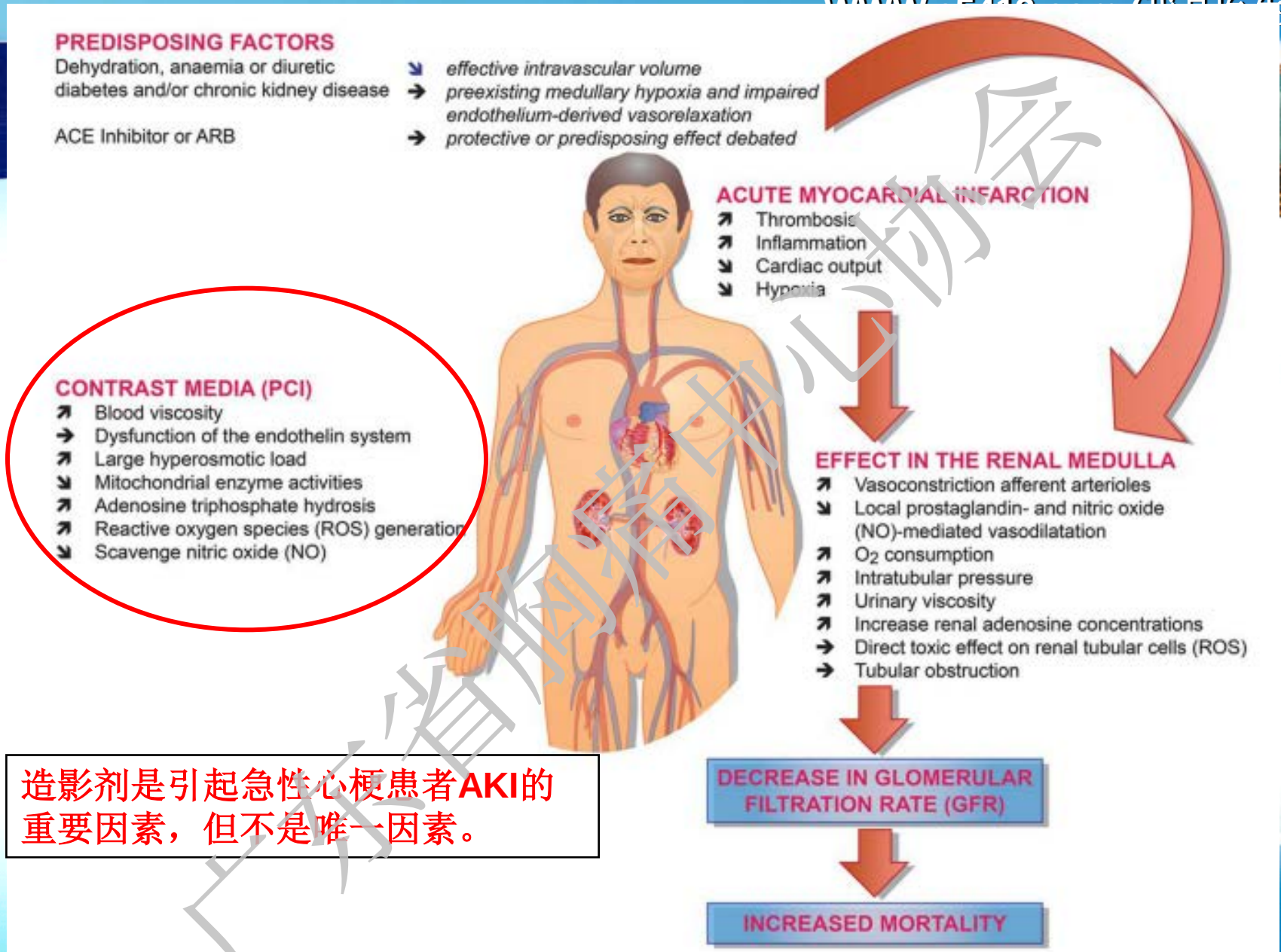
The American Journal of Cardiology

Impact of Nephropathy After Percutaneous Coronary Intervention and a Method for Risk Stratification

TABLE 2 Radiocontrast-induced Nephropathy Risk Score in the Validation Cohort

Characteristics	Odds Ratio 95% Confidence Interval	p Value	Score
Creatinine clearance <60 ml/min	5 (3.6–6.9)	<0.0001	2
Intra-aortic balloon pump use	5.1 (3.6–7.2)	<0.0001	2
Urgent/emergency procedure	4.4 (2.9–6.5)	<0.0001	2
Diabetes mellitus	3.1 (2.3–4.2)	<0.0001	1
Congestive heart failure	2.2 (1.6–2.9)	<0.0001	1
Hypertension	2.0 (1.4–2.8)	0.0001	1
Peripheral vascular disease	1.9 (1.4–2.7)	<0.0001	1
Contrast >200 ml	1.8 (1.4–2.4)	<0.0001	1

Am J Cardiol 2004;93:1515–1519



造影剂是引起急性心梗患者AKI的重要因素，但不是唯一因素。

Fig. 1 Pathophysiology of acute kidney injury in acute myocardial infarction with permission from Oxford University Press (#3654161388880)

2013-STEMI-CIN防治指南

Circulation
JOURNAL OF THE AMERICAN HEART ASSOCIATION

American Heart Association.

2013 ACCF/AHA Guideline for the Management of ST-Elevation Myocardial Infarction : A Report of the American College of Cardiology Foundation/American Heart Association Task Force on Practice Guidelines

9.8. Acute Kidney Injury

The risk of renal failure with STEMI relates to a host of factors, including patient age, prehospital renal function, medications, contrast volume, and hemodynamic status. Contrast-induced nephropathy after angiography and intervention for STEMI is always a risk, and attention to minimization of contrast volume and optimal hydration is required.[219]

CIN预防指南：

1、风险评估

2、剂量限制

3、水化预防

3、STEMI-CIN防治指南之一危险分层

Merhan评分

Risk Factors	Integer Score
Hypotension	5
IABP	5
CHF	5
Age >75 years	4
Anemia	3
Diabetes	3
Contrast media volume	1 for each 100 cc^3
Serum creatinine>1.5mg/dl	4
OR	
eGFR < 60 ml/min/1.73 m^2	2 for 40 - 60 4 for 20 - 40 6 for < 20

eGFR (ml/min/1.73 m^2) = 186 x (SCr)$^{-1.154}$ x (Age)$^{-0.203}$ x (0.742 if female) x (1.210 if African American)

Calculate

Risk Score	Risk of CIN	Risk of Dialysis
≤ 5	7.5%	0.04%
6 to 10	14.0%	0.12%
11 to 16	26.1%	1.09%
≥ 16	57.3%	12.6%

J Am Coll Cardiol . 2004;44:1393–1399.

3、STEMI-CIN防治指南之一危险分层

直接PCI的STEMI患者

造CIN的危险因素：

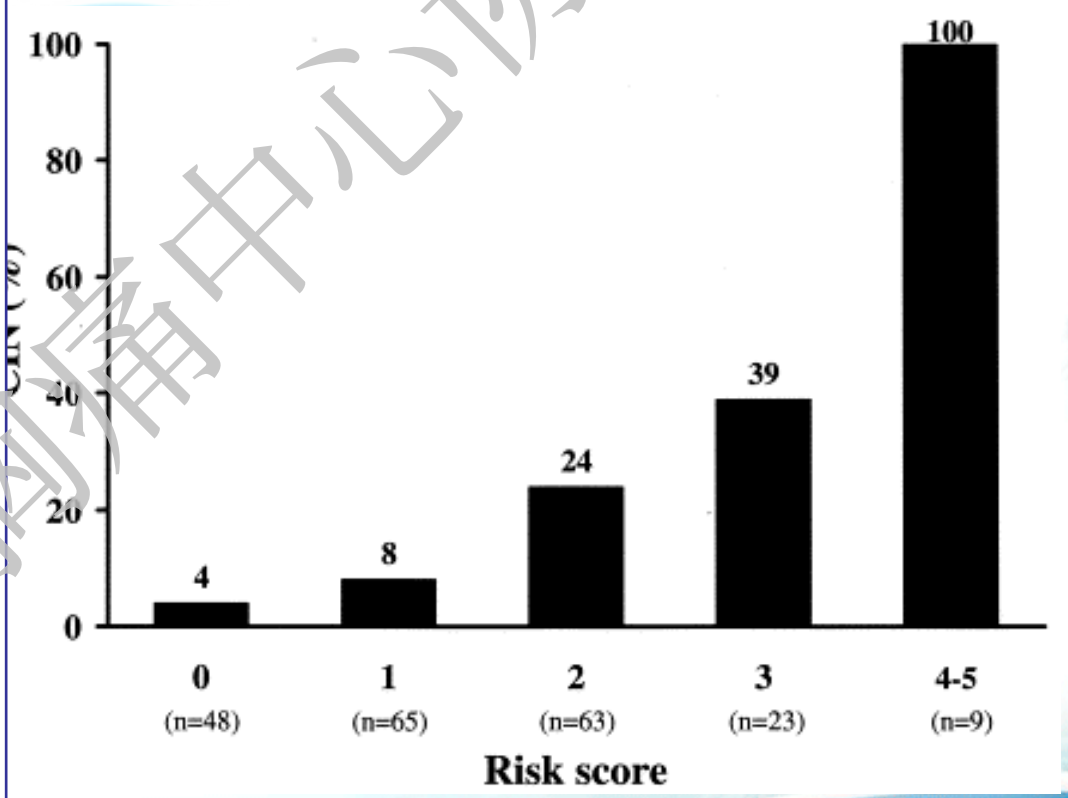
年龄 ≥75 岁，

前壁心肌梗死，

再灌注时间 ≥6 h，造

影剂剂量 ≥300 ml

使用IABP。



J Am Coll Cardiol . 2004;44:1780 –1785.

Risk Factors | **Integer Score**

Risk Factors	Integer Score
Age＞75 years	1
Hypotension	1
IABP	1
Scr＞1.5 mg/dl	1

Calculate

Risk Score	Risk CIN
0	1.0%
1-2	13.4%
≥3	90.0%

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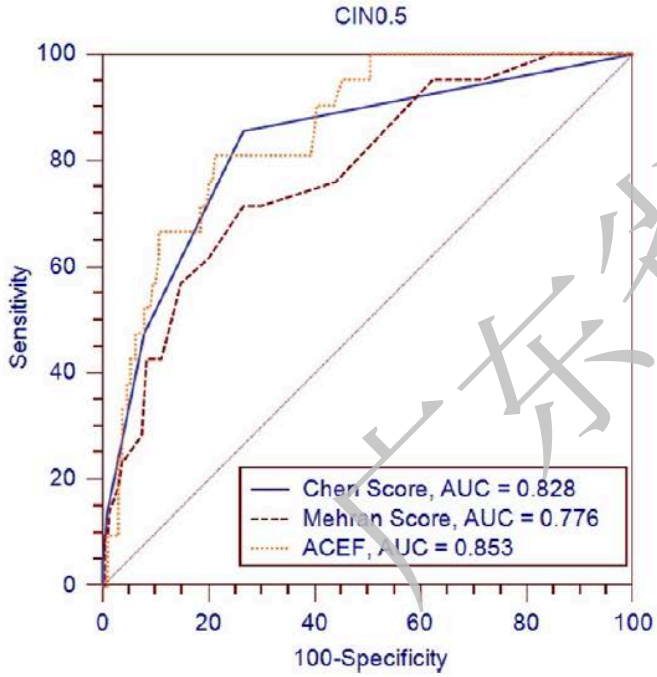
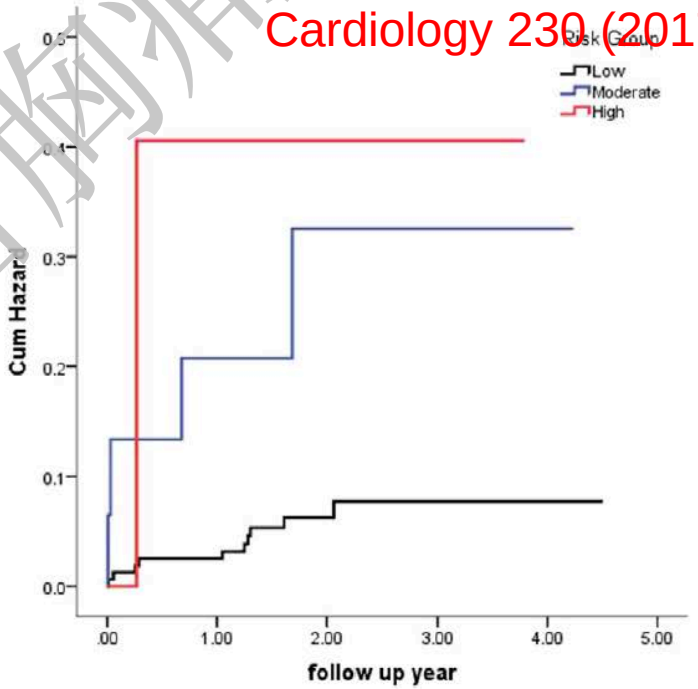
K. Lin et al. / International Journal of Cardiology 230 (2017) 402–412





4、STEMI-CIN防治指南之一剂量限制

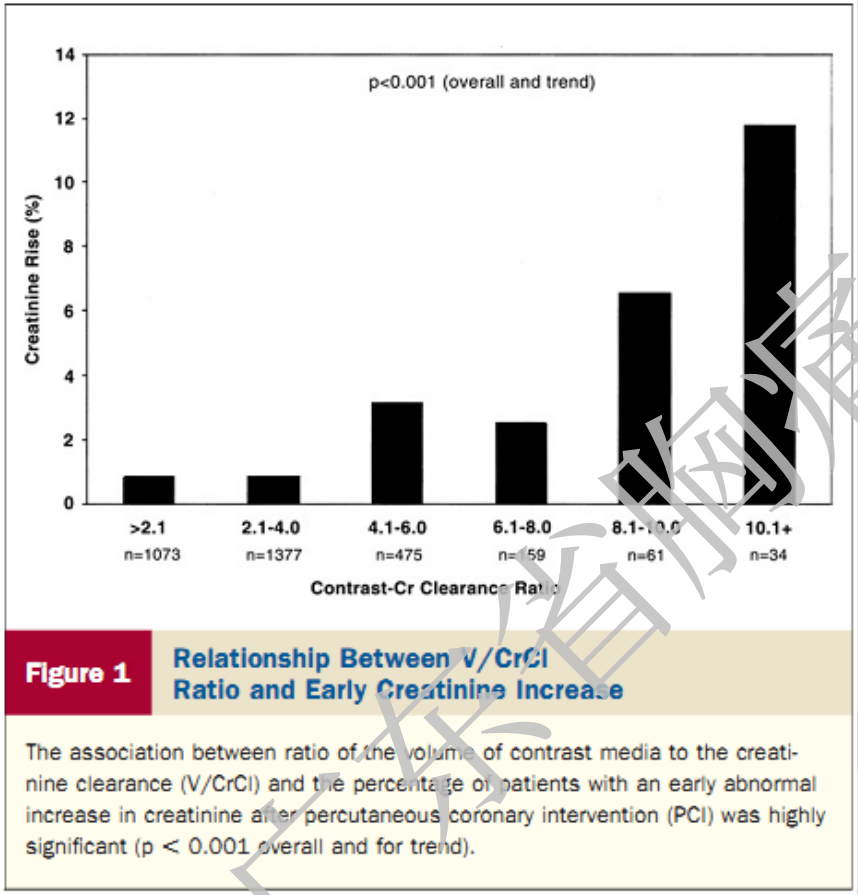


Figure 1 Relationship Between V/CrCl Ratio and Early Creatinine Increase

The association between ratio of the volume of contrast media to the creatinine clearance (V/CrCl) and the percentage of patients with an early abnormal increase in creatinine after percutaneous coronary intervention (PCI) was highly significant ($p < 0.001$ overall and for trend).

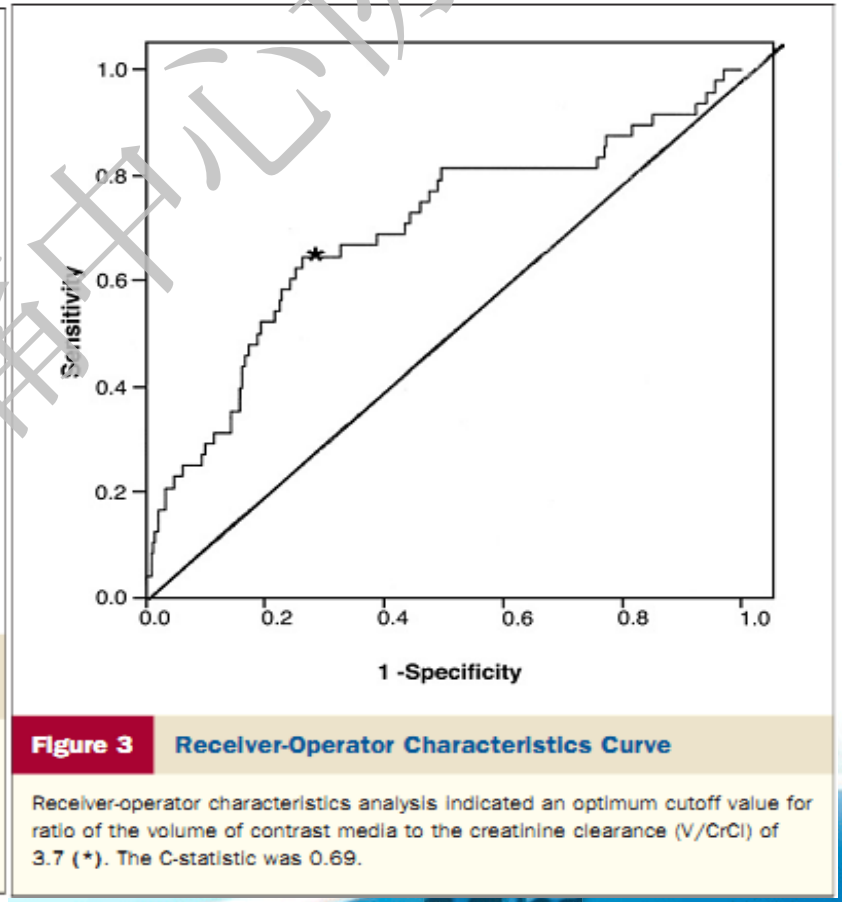


Figure 3 Receiver-Operator Characteristics Curve

Receiver-operator characteristics analysis indicated an optimum cutoff value for ratio of the volume of contrast media to the creatinine clearance (V/CrCl) of 3.7 (*). The C-statistic was 0.69.

PCI用造影剂剂量越大，CIN风险越大。

J Am Coll Cardiol 2007;50:5 84-90.

4、STEMI-CIN防治指南之一剂量限制

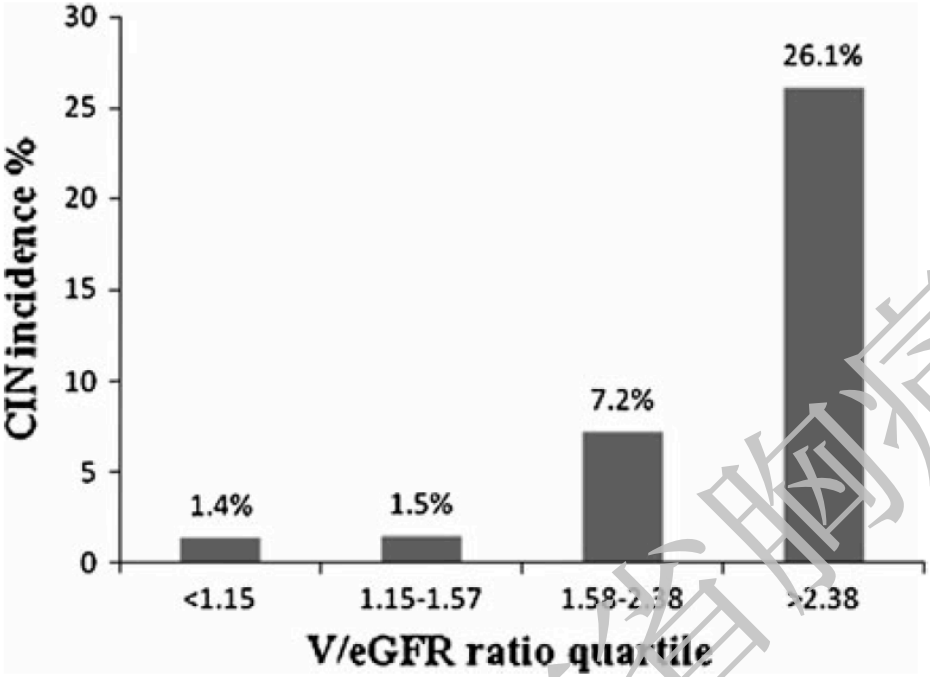


Fig. 1 Relationship between V/eGFR ratio and CIN. The association between the V/eGFR ratio and the percentage of patients with CIN after PCI was highly significant ($P < 0.001$ overall and for trend)

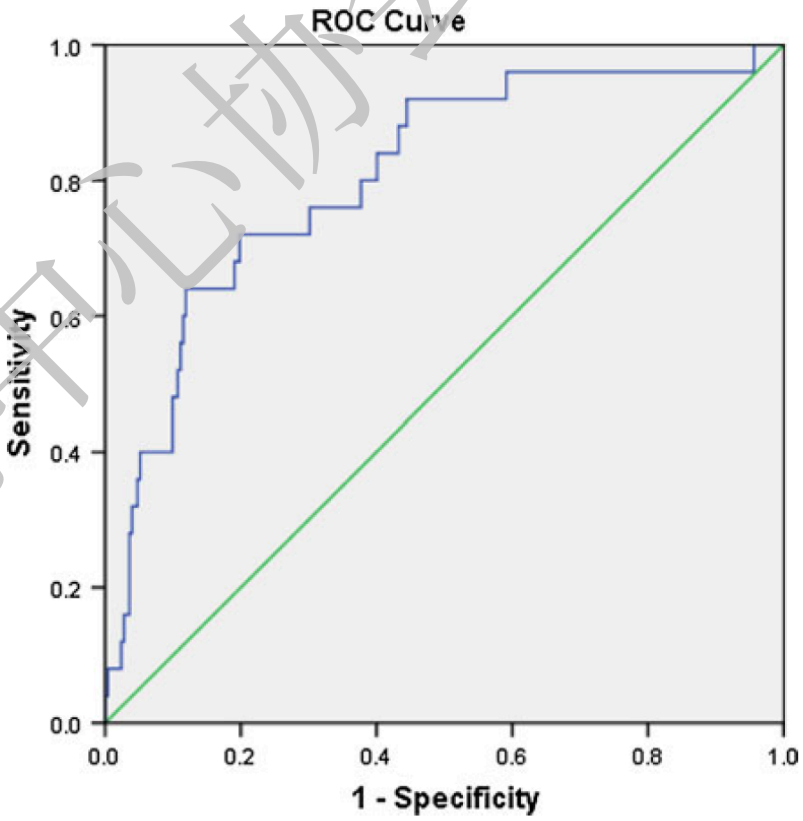


Fig. 2 ROC curve analysis. The receiver–operator characteristic curve analysis showed that at a cutoff value > 2.39, the V/eGFR ratio exhibited 72% sensitivity and 80% specificity for detecting contrast-induced nephropathy. The *C* statistic was 0.81

STEMI患者急诊PCI用造影剂剂量越大，CIN风险越大。

Int Urol Nephrol (2012) 44:221–229

5、STEMI-CIN防治指南之一水化预防

Table 17 Recommendations for prevention of contrast-induced nephropathy

Intervention	Dose	Class[a]	Level[b]	Ref.[c]
All patients with CKD				
OMT (including statins, ß-blockers, and ACE inhibitors or sartans) is recommended.	According to clinical indications.	I	A	123
Hydration with isotonic saline is recommended.	1 mL/kg/h 12 h before and continued for 24 h after the procedure (0.5 mL/kg/h if EF <35% or NYHA >2).	I	A	127–130
N-Acetylcysteine administration may be considered.	600–1200 mg 24 h before and continued for 24 h after the procedure.	IIb	A	128, 129
Infusion of sodium bicarbonate 0.84% may be considered.	1 h before: bolus = body weight in kg x 0.462 mEq i.v. infusion for 6 h after the procedure = body weight in kg x 0.154 mEq per hour.	IIb	A	127, 128, 130
Patients with mild, moderate, or severe CKD				
Use of LOCM or IOCM is recommended.	<350 mL or <4 mL/kg	I[d]	A[d]	124, 131–133
Patients with severe CKD				
Prophylactic haemofiltration 6 h before complex PCI should be considered.	Fluid replacement rate 1000 mL/h without weight loss and saline hydration, continued for 24 h after the procedure.	IIa	B	134, 135
Elective haemodialysis is not recommended as a preventive measure.		III	B	136

PCI的临床指南也推荐择期PCI的慢性肾病（CKD）患者中，术前充分生理盐水水化，但对于行直接PCI的STEMI患者术前无法获知基础肾功能情况。

RESCIND –STEMI NCT02067195

5、STEMI-CIN防治指南之一水化预防

Closed-loop fluid management system

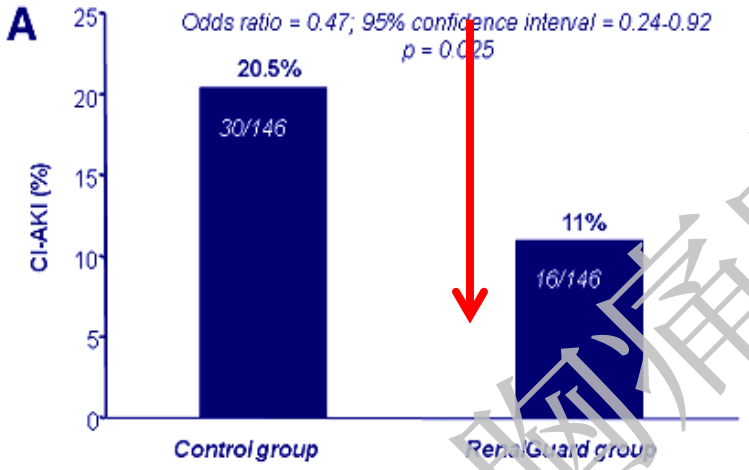
A high-volume fluid pump
A high-accuracy dual weight measuring system
A single-use intravenous set
A urine collection system

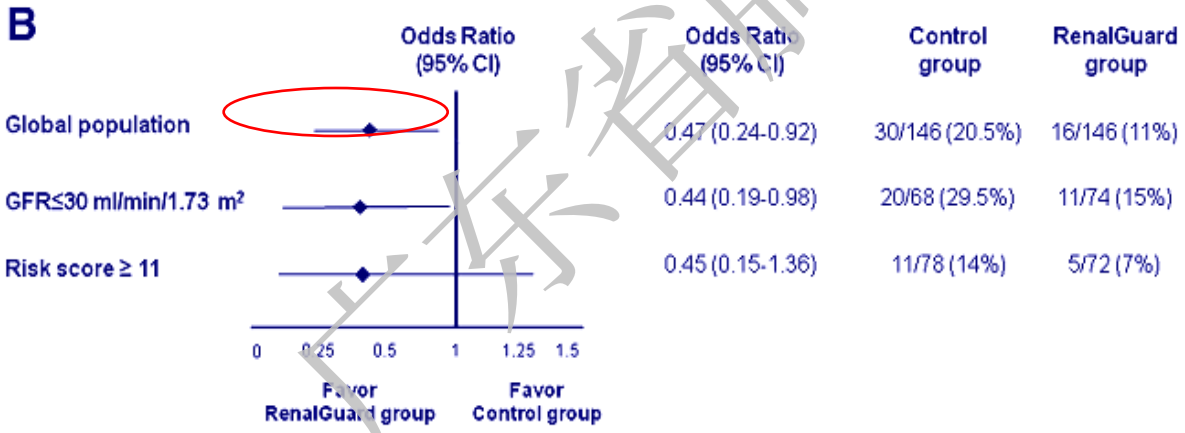
肾脏保护装置预防**CIN**

Circulation. 2011,13;124(11):1260-9.

5、STEMI-CIN防治指南之一水化预防

肾脏保护装置组现在降低了CIN发生率。





A. A lower concentration of CM in the kidneys
B. A more rapid transit of CM through the kidneys
C. Less overall exposure to toxic CM
D. A potential reduction of oxygen consumption in the medulla
E. Maintenance of flow in the renal tubules and collecting ducts

Circulation. 2011,13;124(11):1260-9.

5、STEMI-CIN防治指南之一水化预防

肾脏保护装置预防CIN同时，并没有增加急性肺水肿发生率。

Table 3. Characteristics of Patients Who Developed Acute Pulmonary Edema

Patient	Group	Age, y	Sex	LVEF, %	LVEDP, mm Hg	GFR, mL[·]min^{-1}·1.73 m^{-2}	SBP, mm Hg	Risk Score	Contrast Volume, mL	CI-AKI
1	Control	61	M	42	14	40	110	12	200	Yes
2	RenalGuard	80	F	55	12	35	120	15	250	No
3	RenalGuard	86	F	45	12	36	130	12	150	No
4	RenalGuard	81	F	43	13	35	120	13	250	No

Table 5. Major Adverse Events at 1 Month in the 2 Groups

	Control Group (n=146), n (%)	RenalGuard Group (n=146), n (%)	*P*
Cumulative major adverse events	14 (9.6)	10 (6.8)	0.52
Death	6 (4.1)	6 (4.1)	1.00
Dialysis	7 (4.8)	1 (0.7)	0.031
Acute pulmonary edema	1 (0.7)	3 (2.1)	0.62

Circulation. 2011,13;124(11):1260-9.

5、STEMI-CIN防治指南之一水化预防

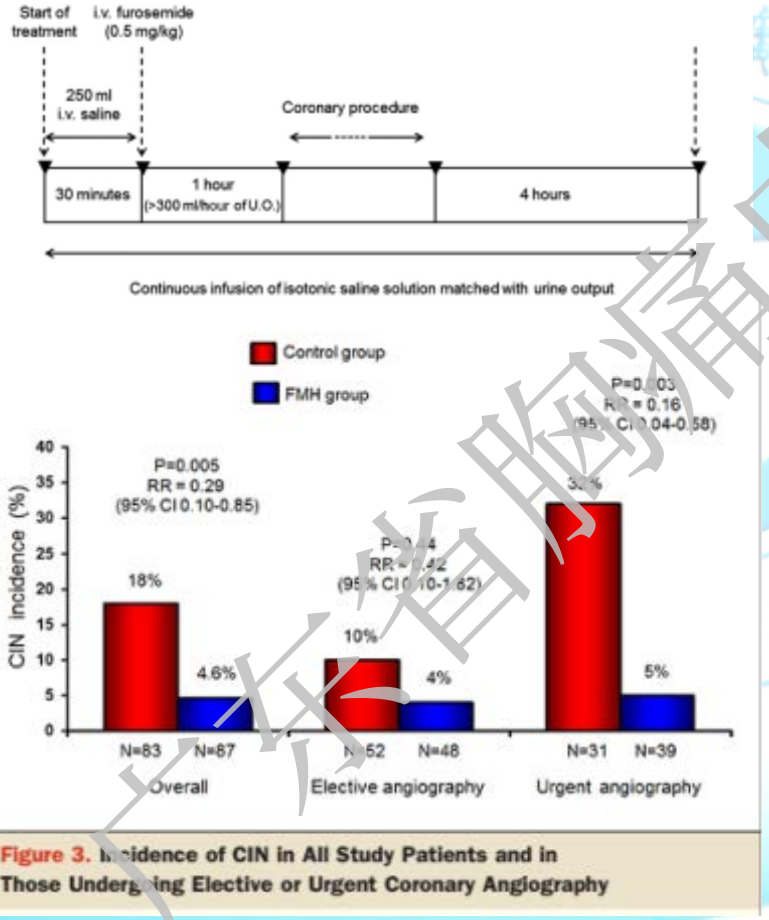


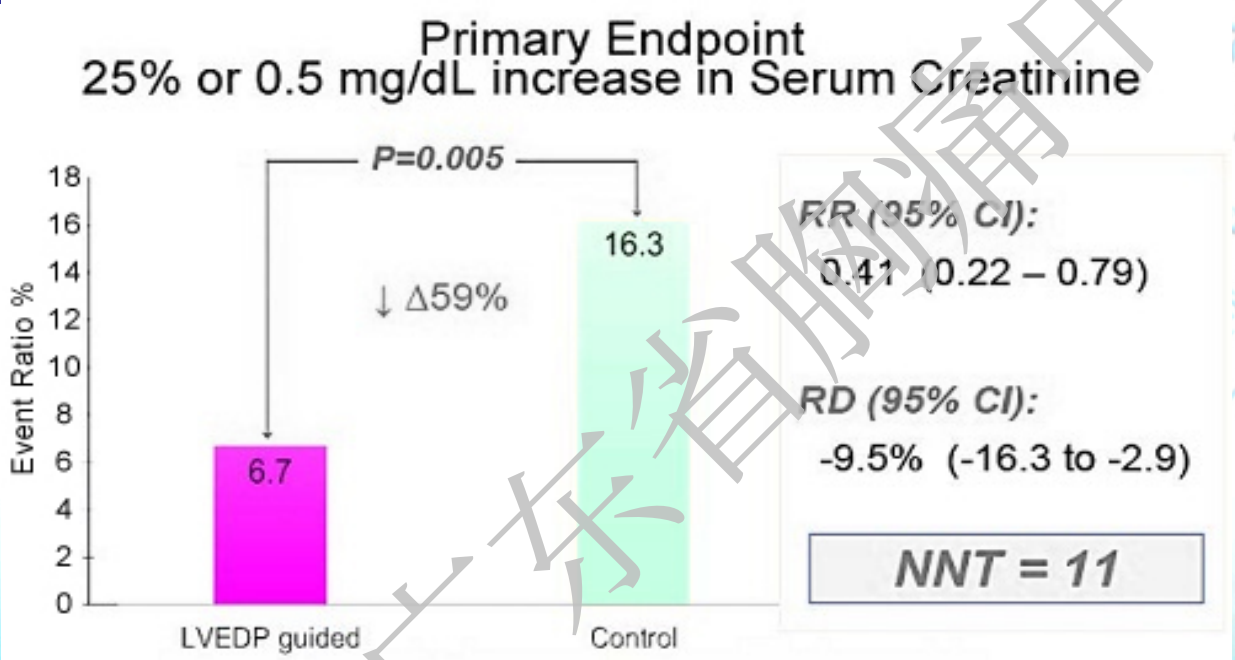
Figure 3. Incidence of CIN in All Study Patients and in Those Undergoing Elective or Urgent Coronary Angiography

Marenzi等人对冠脉介入诊疗术患者高尿量（≥300ml/h）导向的肾保护装置研究中发现，实验组水化量明显增加（3,995±1,401 ml比1,742±290 ml），时间更短（6±1 h比25 ±2 h），而显著减低急诊介入术后CIN发生风险（5%比32%，*P*=0.003）。

J Am Coll Cardiol Intv 2012;5:90 – 7

5、STEMI-CIN防治指南之一水化预防

Table:	Median NS volume
LVEDP-guided hydration arm	1,711 ml
Standard Hydration	807 ml



柳叶刀发表的左室舒张末压（LVEDP）引导CKD患者充分水化研究结果引起了极大关注，所有患者术前1小时开始大剂量水化（3 ml/kg/h），此后常规水化剂量组的水化速度为1.5 ml/kg/h，而实验组若LVEDP<13 mmHg，水化速度调至5 ml/kg/h，LVEDP 13-18 mmHg 调为 3 ml/kg/h，LVEDP >18 mmHg调为>1.5 ml/kg/h，术后均维持4小时。

Lancet. 2014 May 24;383(9931):1814-23

5、STEMI-CIN防治指南之一水化预防

Circulation
Cardiovascular Interventions
JOURNAL OF THE AMERICAN HEART ASSOCIATION
American Heart Association
Learn and Live

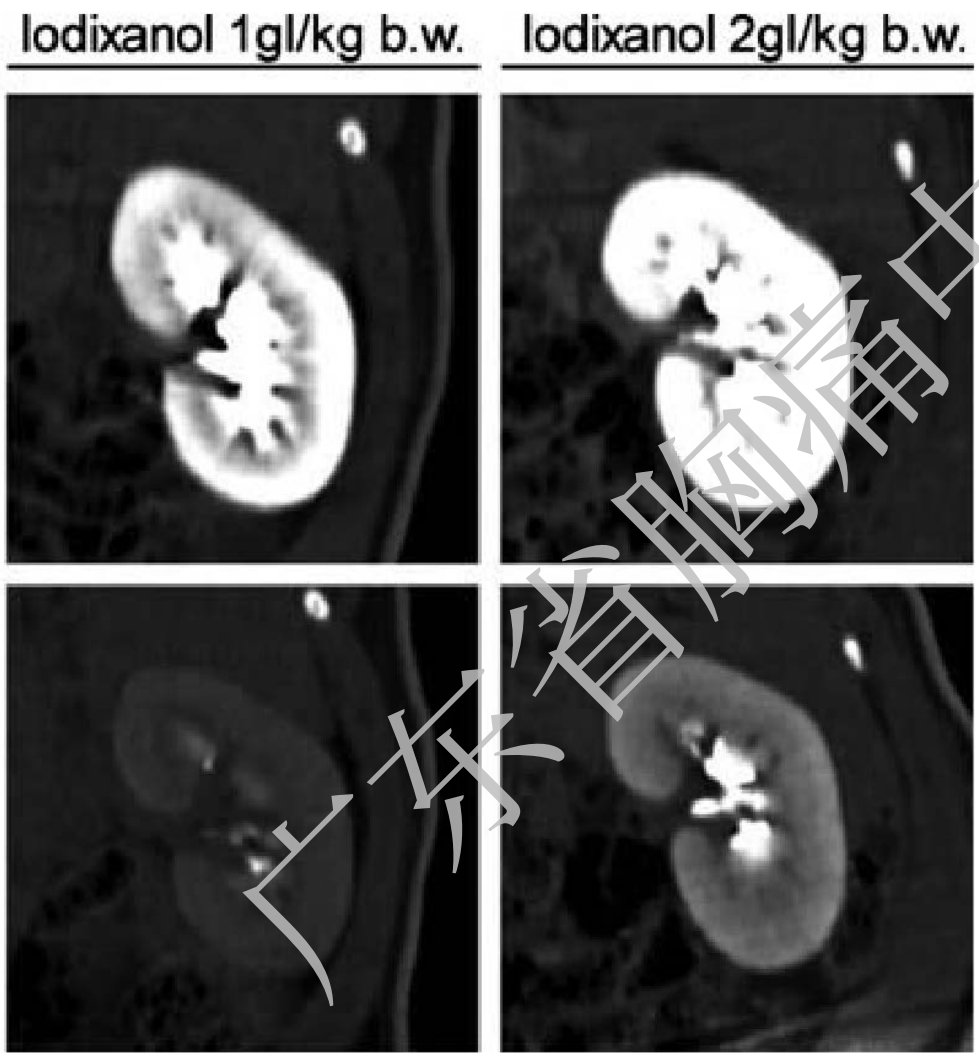
Effects of Hydration in Contrast-Induced Acute Kidney Injury After Primary Angioplasty
A Randomized, Controlled Trial

Table 2. End Points of the Study, Incidence of CI-AKI in High-Risk Patients, and In-Hospital Outcomes in the 3 Study Groups

	Control Group (n=150)	Late Hydration Group (n=150)	Early Hydration Group (n=150)	*P* Value for Trend
Primary and secondary end points				
Serum creatinine increase by ≥0.5 mg/dL and/or by ≥25% within 72 h, n (%)	41 (27.3)*	34 (22.7)†	18 (12.0)*†	0.001
eGFR decrease by >25% at 72 h, n (%)	23 (15.6)	15 (10.3)	9 (6.0)	0.007

研究表明早期充分水化显著降低CIN发生风险，且并没有急性肺水肿发生，多因素分析表明总的水化量小于960ml可能是CIN的发生独立预测因子，但该研究两组使用的水化液种类存在差异（碳酸氢钠与生理盐水）。因此对于直接PCI患者，最佳的水化时间、总量和速度尚未明确，值得进一步研究。

5、STEMI-CIN防治指南之一水化预防



比剂肾脏高浓度聚集损害再术后4-6小时最为显著，也是我们CIN防治黄金期。

5、STEMI-CIN防治指南之一水化预防

ATTEMPT研究

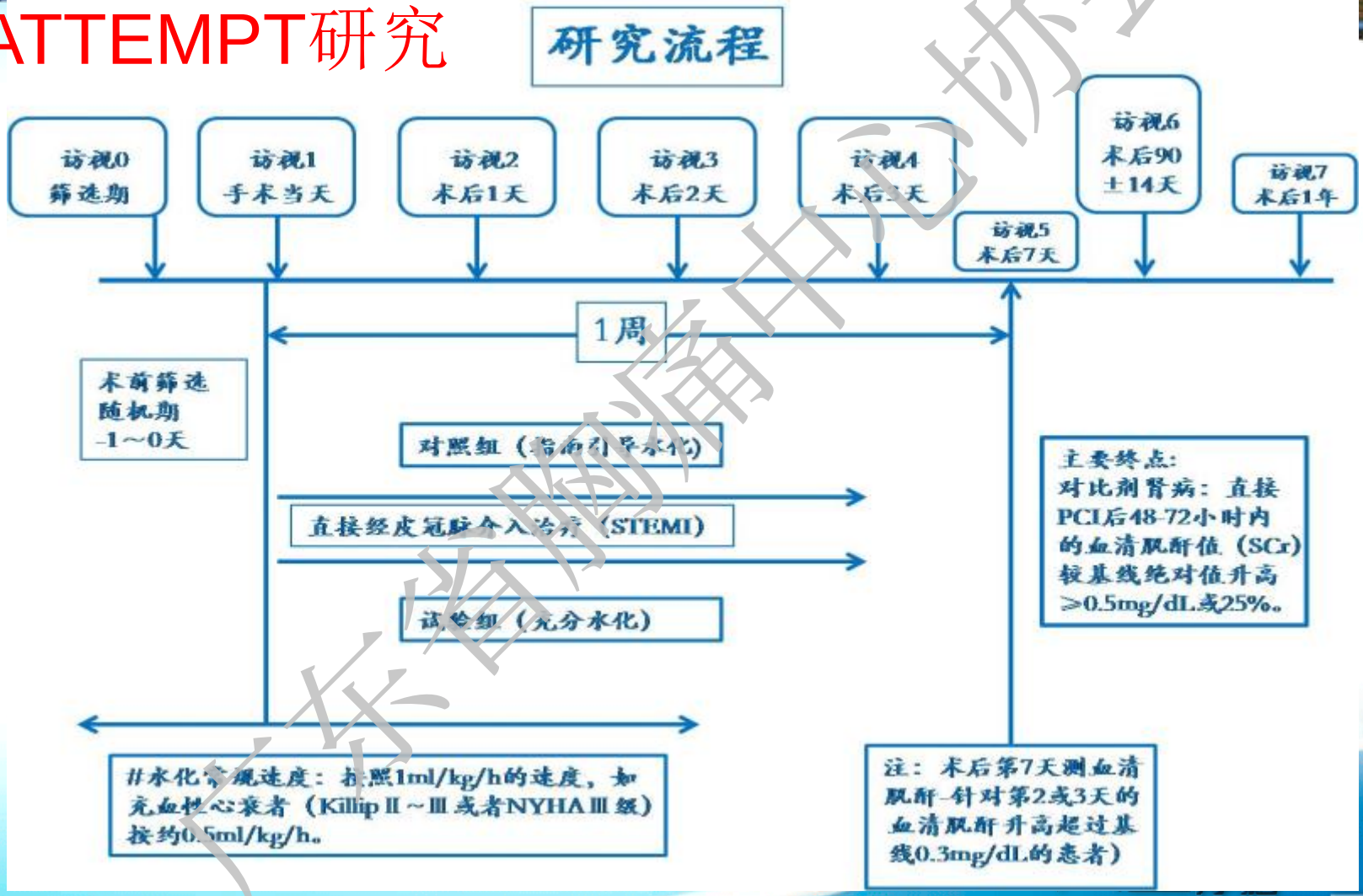
Aggressive hydraTion in patients with ST-Elevation Myocardial infarction undergoing Primary percutaneous coronary intervention to prevenT contrast-induced nephropathy (ATTEMPT): Study design and protocol for the randomized, controlled trial, the ATTEMPT, RESCIND 1 (First study for REduction of contraSt-induCed nephropathy followINg carDiac catheterization) trial

Yong Liu, MD,[a] Ji-yan Chen, MD, FACC, FESC,[a] Yong Huo, MD, FACC, FESC,[b] Jun-bo Ge, MD, FACC, FESC,[c] Ying Xian, MD,[d] Chong-yang Duan, MS,[e] Shi-qun Chen, MS,[a,e,f] Wei Jiang, MD,[d] Ping-yan Chen, MS,[e] and Ning Tan, MD[a], RESCIND group *Guangzhou, Beijing, Shanghai, China; and Durham, NC*

广东省人民医院陈纪言教授牵头，葛均波、霍勇联合负责人开展ATTEMP，研究方案已经发表美国心脏杂志（AHJ)，研究已完成入选。

5、STEMI-CIN防治指南之一水化预防

ATTEMPT研究



急诊PCI围手术期CIN防治建议

- 造影剂使用前风险评估和干预可控危险因素。
- 基于肾功能个体化的造影剂剂量估算与限制。
- 早期充分、经济、安全的等渗水化预防。

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Thank you!

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