Kontrastinducerad nefropati – sanning eller myt?

Robert Frithiof, MD, PhD

Professor Barnanestesi och Intensivvård

The NEW ENGLAND JOURNAL of MEDICINE

CLINICAL PRACTICE

Preventing Nephropathy Induced by Contrast Medium

Brendan J. Barrett, M.B., and Patrick S. Parfrey, M.D.

This Journal feature begins with a case vignette highlighting a common clinical problem. Evidence supporting various strategies is then presented, followed by a review of formal guidelines, when they exist. The article end with the authors' clinical recommendations.

A 71-year-old man with type 2 diabetes and hypertension is referred for coronary angiography. His medications include metformin and a thiazide. Before the angiogram, his serum creatinine level is 1.8 mg per deciliter (160 μmol per liter), yielding an estimated glomerular filtration rate of 40 ml per minute per 1.73 m² of body-surface area. What can be done to reduce the risk that an angiographic contrast medium will worsen his kidney function?

THE CLINICAL PROBLEM

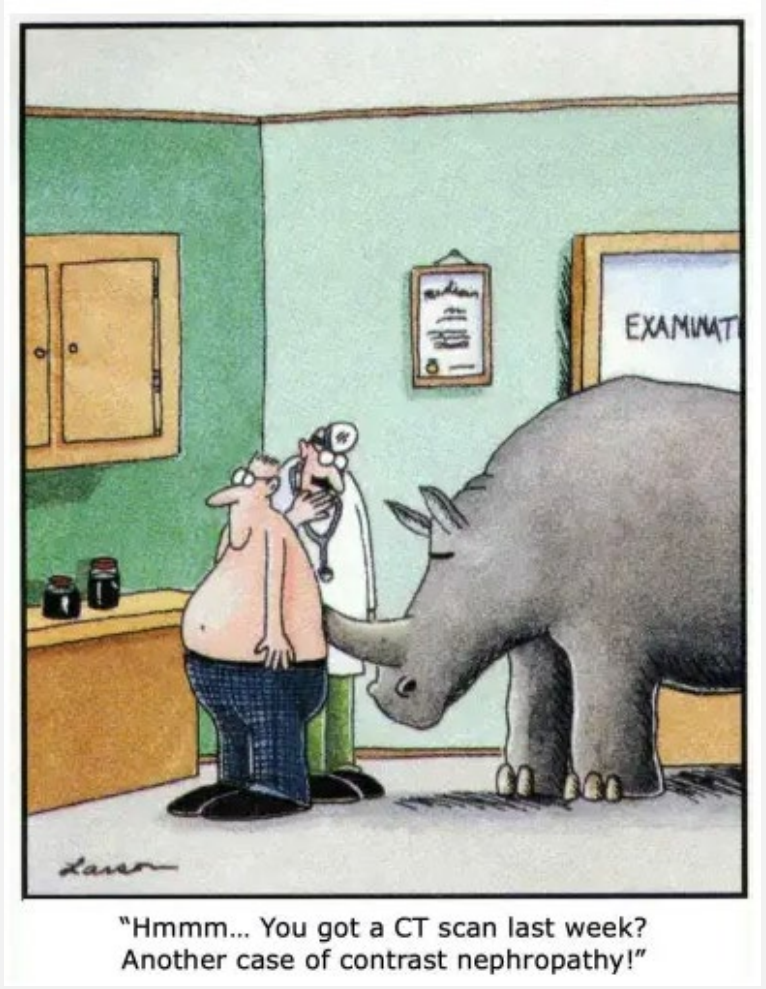
Sensitive tests of kidney function identify mild, transient changes in most patients who have been exposed to intravascular iodinated contrast mediums.[1] Clinically important injury (often called contrast-medium–induced nephropathy) is much less common. Cases of contrast-medium–induced nephropathy are usually defined by a fixed (0.5 mg per deciliter [44 μmol per liter]) or proportionate (25 percent) rise in serum creatinine levels after exposure to the contrast medium. However, the clinical importance of such changes, if they are transient, is uncertain. A serum creatinine level itself is a relatively poor measure of kidney function and is influenced by age, sex, and body composition.

In a study by Nash et al.,[2] contrast-medium–induced nephropathy was reported to be the third most common cause of acute renal failure in hospitalized patients.

N Engl J Med 2006;354:379-86.

Acute Kidney Injury (AKI) och jodbaserad kontrast

- Renal vasokonstriktion och mikrocirkulationsstörning
- Medullär hypoxi
- Direkt tubulär och endotelial toxicitet, vid tillräcklig exponering, apoptos eller nekros.



"Hmmm... You got a CT scan last week?
Another case of contrast nephropathy!"

Heyman et al. CJASN 2008;3:288–296 och **Seeliger et al. Eur Heart J 2012;33:2007–2015**.

Från högosmolärt till modernt kontrastmedel

Utvecklingen av intravaskulära jodkontrastmedel



1950-talet

Högosmolära

Joniska monomerer

Exempel: diatrizoat

≈1 500–2 100

mOsm/kg vatten

≈5–7 × plasma

1980-talet

Lågosmolära

Icke-joniska monomerer

Exempel: iohexol, iopamidol

≈500–900

mOsm/kg vatten

≈2–3 × plasma

1990-talet

Isoosmolära

Icke-joniska dimerer

Exempel: iodixanol

≈290

mOsm/kg vatten

≈plasma

Moderna kontrastmedel

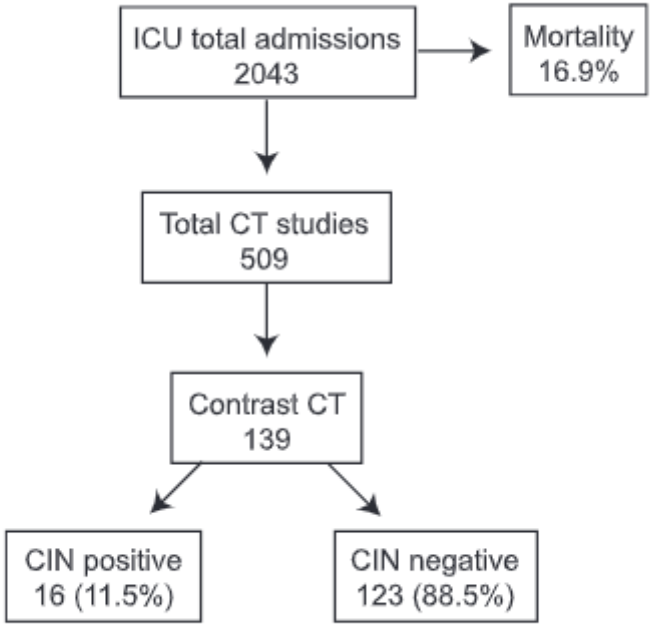
Nyman et al. Acta Radiol 2016;57:1072–1078. Eivindvik & Sjögren. Acta Radiol Suppl 1995;399:32–38.

Acute Kidney Injury (AKI) och jodbaserad kontrast

Begrepp	Betydelse	Kriterier/tidsfönster
CIN – Contrast-induced nephropathy	Äldre benämning på kontrastinducerad njurskada. Antyder kausalitet.	Historiskt ofta kreatininökning ≥44 µmol/L eller ≥25 % inom 48–72 timmar. Definitionerna varierar mellan studier.
CA-AKI – Contrast-associated acute kidney injury	AKI i tidsmässigt samband med kontrastadministrering, oavsett orsak.	Enligt ACR/NKF: AKI inom 48 timmar efter kontrast. AKI bedöms med KDIGO-kriterier.*
PC-AKI – Post-contrast acute kidney injury	Principiellt synonymt med CA-AKI. Innebär inte kausalitet.	Enligt ESUR: kreatininökning >26,5 µmol/L eller >1,5 × utgångsvärdet inom 48–72 timmar efter intravaskulär kontrast.
CI-AKI – Contrast-induced acute kidney injury	AKI som orsakas av kontrastmedlet. En undergrupp av CA-AKI.	AKI-kriterier och tidsmässigt samband enligt ovan, plus ett kausalt samband.

*ACR = American College of Radiology; NKF = National Kidney Foundation; ESUR = European Society of Urogenital Radiology; *KDIGO = Kidney Disease: Improving Global Outcomes; AKI = acute kidney injury (akut njurskada).*

CIN på IVA



Anaesth Intensive Care 2009; 37: 968-975

Incidence of contrast-induced nephropathy in intensive care patients undergoing computerised tomography and prevalence of risk factors

A. H. RASHID*, J. L. BRIEVA†, B. STOKES‡

Intensive Care Unit, John Hunter and Calvary Mater Hospital, Hunter New England Area Health, Newcastle, New South Wales Australia

Journal of Critical Care (2011) **26**, 593–599

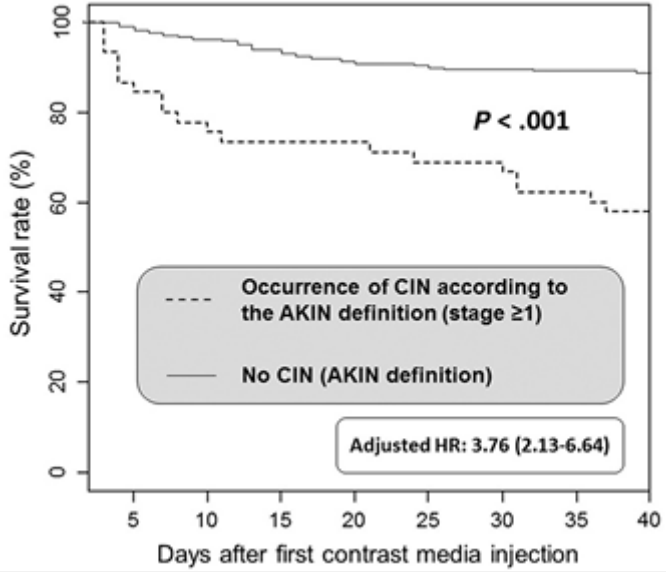
ELSEVIER

Journal of Critical Care

Acute Kidney Injury Network definition of contrast-induced nephropathy in the critically ill: Incidence and outcome☆,☆☆,★

Karim Lakhal MD[a,*], Stephan Ehrmann MD[b], Anis Chaari MD[a], Jean-Pierre Laissy MD, PhD[c], Bernard Régnier MD, PhD[a], Michel Wolff MD, PhD[a], Olivier Pajot MD[a]

In our mostly medical population, we observed a CIN incidence of about 10% to 20%, depending on the definition. Furthermore, CIN was strongly associated with implementation of RRT and was independently associated with ICU mortality.



CA-AKI på IVA

Intensive Care Med (2011) 37:1921–1931
DOI 10.1007/s00134-011-2389-8

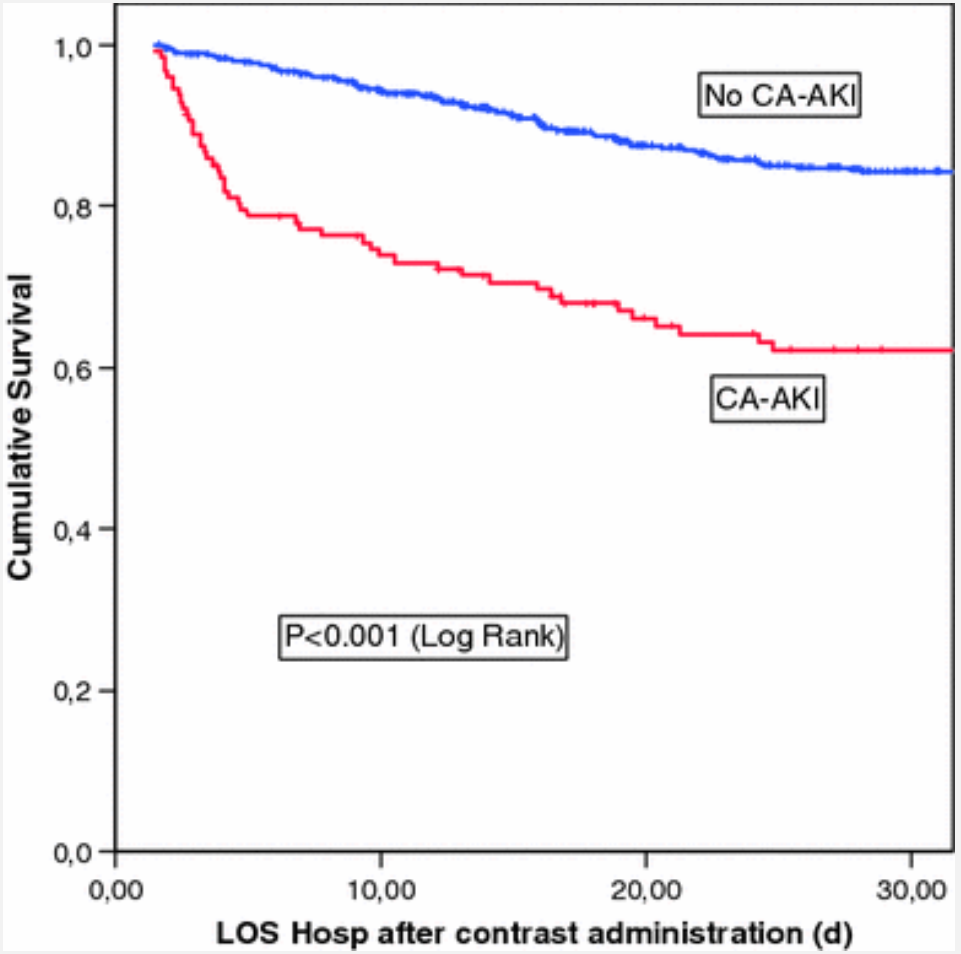
ORIGINAL

Eric A. J. Hoste
Severine Doom
Jan De Waele
Louke J. Delrue
Luc Defreyne
Dominique D. Benoit
Johan Decruyenaere

Epidemiology of contrast-associated acute kidney injury in ICU patients: a retrospective cohort analysis

CA-AKI occurred in 128 patients (16.3%).

creatinine after contrast administration. Patients who developed CA-AKI were older, had a worse baseline kidney function, were more severely ill on admission, and



Vad har dessa och liknande studier haft för effekt i Sverige?



- Vid risk för KMN – använd helst metoder som inte påverkar njurfunktionen (DT utan KM, ultraljud eller MRT)

Bilaga 1. Datortomografi – försiktighetsåtgärder och teknik vid risk

- Isotona kristalloider som t.ex. Ringeracetat eller Plasmalyte; 1-1,5 mL/kg per timme (eller c:a 100 mL/timme eller 1000 mL) under 3-4 timmar före och 4-6 timmar efter undersökningen
- Akuta situationer: t.ex. Ringeracetat eller Plasmalyte; 3 mL/kg under en timme före och 1 mL/kg per timme under 6 timmar efter undersökningen

vetenskapliga rön. Gruppens målsättning har genomgående varit att anamma försiktighetsprincipen, dvs. om vetenskaplig konsensus saknas om huruvida en åtgärd är farlig faller bevisbördan på dem som hävdar dess ofarlighet. Observera att i det individuella fallet är det alltid viktigt att göra en adekvat avvägning mellan risken för en kontrastmedelskomplikation och den nytta undersökningen kan ha för den enskilde patienten. Viktigt är att patienten inte i onödan undanhålls en kontrastmedelsundersökning som är essentiell för patientens diagnos och behandling.

*KMN – Kontrastmedels-nefropati

Läkartidningen

makulaödem och ska användas med försiktighet och lämplig övervakning till dessa patienter.
KLICKA HÄR FÖR MER INFORMATION

NYA RÖN

Jodkontrastmedel och akuta njurskador vid datortomografi

18 sep 08.33

Dela artikeln

Ulf Nyman, docent, institutionen för translationell medicin, divisionen för medicinsk radiologi, Lunds universitet

Torkel Brismar, professor, enheten för radiologi, Clintec, Karolinska institutet; ME radiologi, Medicinsk diagnostik, Karolinska universitetssjukhuset, Stockholm

Således ska man vid låg njurfunktion, i synnerhet vid GFR <30 ml/min/1,73 m², vara medveten om att det kan finnas en icke obetydlig risk för njurskada som måste vägas mot nyttan med undersökningen.


RÖNTGEN
Måste vi verkligen ge kontrast? Han har ju AKI!
Kreatinin 240
IVA
Frågan är vad vi riskerar att missa utan den...
78
97/54 (68)
98
14
0,05
2,00
1,50
5,00

Hur bör vi förhålla oss till risken för kontrastinducerad nefropati?

- Patienter som får kontrast kan utveckla AKI
- En teoretisk rational (?) för att kontrastmedel kan orsaka njurskada
- Betydande förekomst av anekdotisk bevisföring

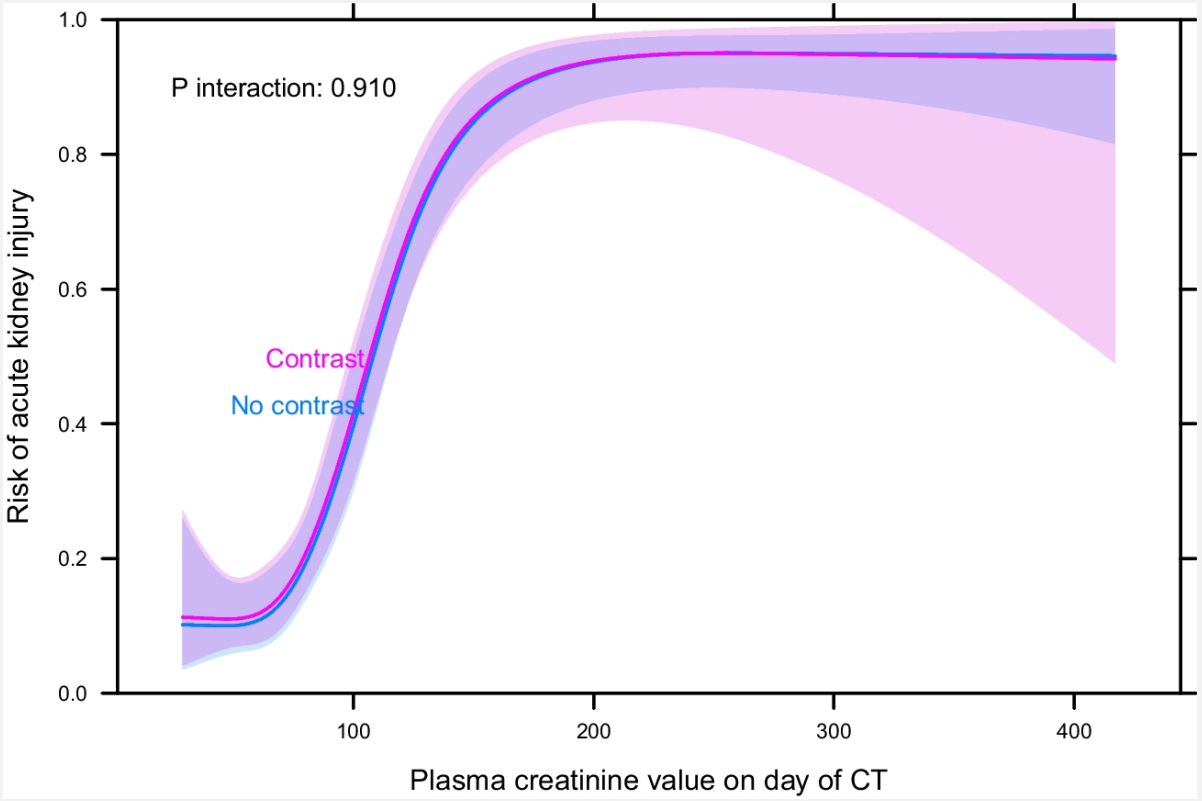
Ger kontrastmedel de facto en ökning av krea hos IVA-patienter?

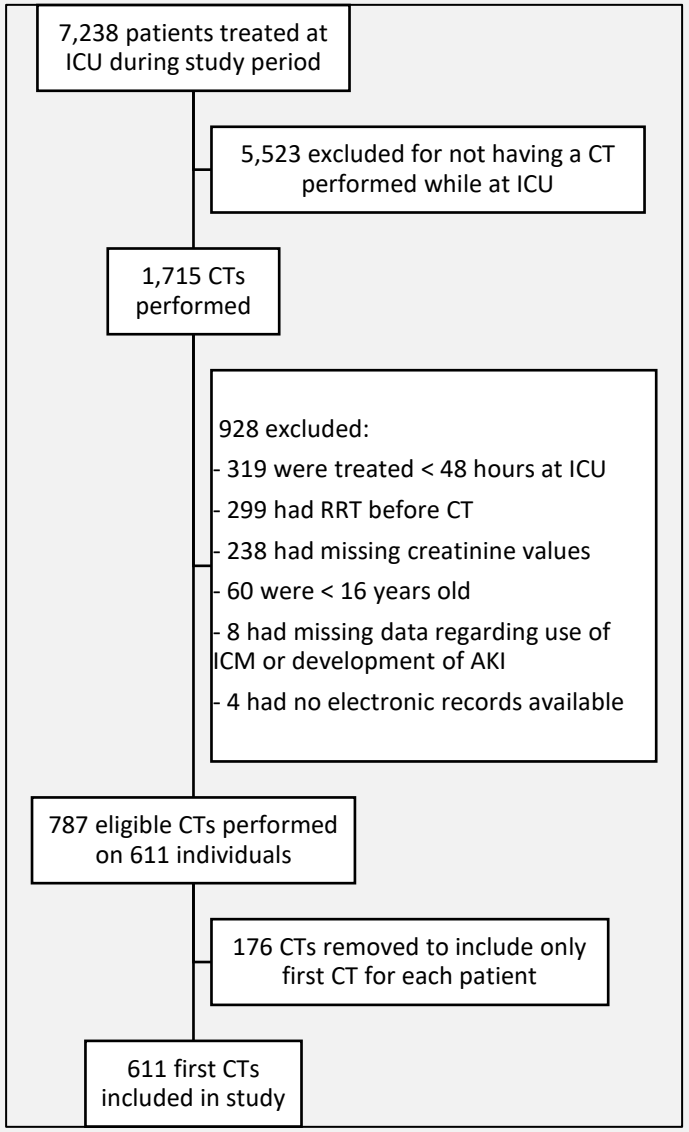
Betyder det i så fall att njuren är skadad?

Bildar patienter som fått kontrast kö till njurmottagningen?

Påverkar risken för AKI hur vi behandlar våra patienter?

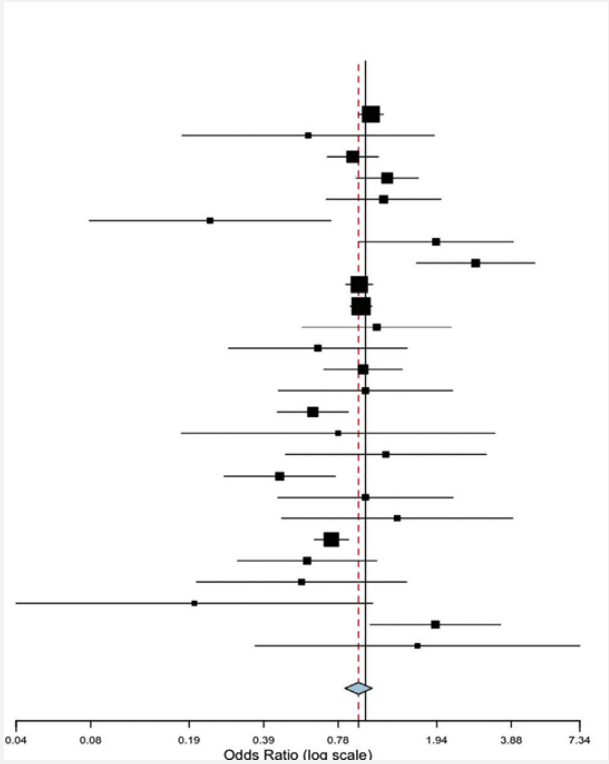
Ger kontrastmedel de facto en ökning av krea hos IVA-patienter?





Berglund F, Eilertz E, Nimmersjö F, Wolf A, Nordlander C, Palm F, Parenmark F, Westerbergh J, Liss P, Frithiof R. Acute and long-term renal effects after iodine contrast media-enhanced computerised tomography in the critically ill - a retrospective bi-centre cohort study. Eur Radiol. 2024 Mar;34(3):1736-1745.

Ger kontrastmedel de facto en ökning av krea hos IVA-patienter?



Aycock RD et al. Acute Kidney Injury After Computed Tomography: A Meta-analysis. Ann Emerg Med. 2018

pharmaceuticals

MDPI

Review

The Crucial Question About Contrast-Induced Nephropathy (CIN): Should It Affect Clinical Practice?

Damian Krzyżak, Marcin Basiak *, Adrianna Dec, Marcin Hachuła and Bogusław Okopień

In conclusion, the above studies demonstrate that there is no association between contrast administration and the occurrence of AKI

JIM Review

doi: 10.1111/joim.70095

Contrast-enhanced CT—Nephrotoxic or not? A critical review of propensity-score-adjusted studies

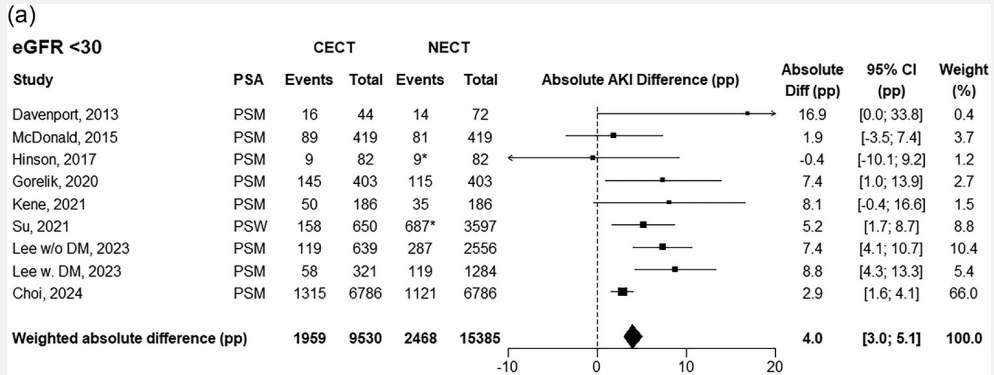
Ulf Nyman[1], Jonas Björk[2,3], Mikael Hellström[4,5], Peter Leander[1], Per Liss[6], Gunnar Sterner[7] & Torkel B. Brismar[8,9]

From the [1]Department of Translational Medicine, Division of Medical Radiology, University of Lund, Malmö, Sweden; [2]Division of Occupational and Environmental Medicine, Lund University, Lund, Sweden; [3]Clinical Studies Sweden, Forum South, Skåne University Hospital, Lund, Sweden; [4]Department of Radiology, Sahlgrenska University Hospital, Gothenburg, Sweden; [5]Department of Radiology, Sahlgrenska Academy at Gothenburg University, Gothenburg, Sweden; [6]Department of Surgical Sciences, Section of Radiology, Uppsala University, Uppsala, Sweden; [7]Department of Nephrology, Skåne University Hospital, Malmö, Sweden; [8]Unit of Radiology, Department of Clinical Science, Intervention and Technology (CLINTEC), Karolinska Institutet, Stockholm, Sweden; and [9]Department of Radiology, Karolinska University Hospital in Huddinge, Stockholm, Sweden

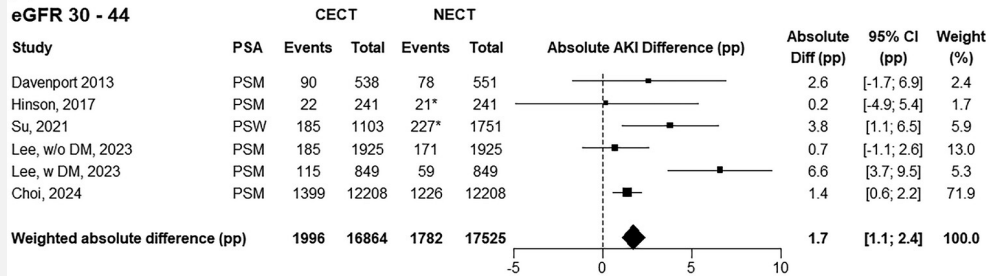
Abstract. Nyman U, Björk J, Hellström M, Leander P, Liss P, Sterner G, et al. Contrast-enhanced CT—Nephrotoxic or not? A critical review of propensity-score-adjusted studies. *J Intern Med.* 2026;**300**: 5–25.

tions between individual contrast medium (CM) doses and AKI/dialysis were generally lacking. Marked selection bias was evident in one cohort. Thus, the analyses support an association between CECT and AKI in emergency-/inpatients, includ-

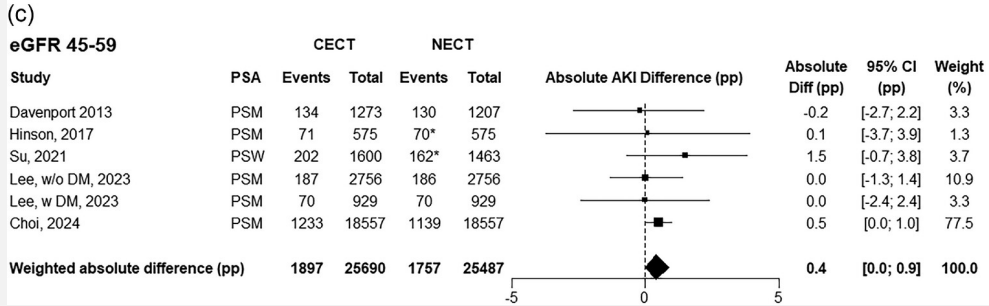
(a)



(b)



(c)



AKADEMISKA SJUKHUSET | Region Uppsala | UPPSALA UNIVERSITET

Betyder det i så fall att njuren är skadad?

Eur Radiol (2015) 25:1926–1934
DOI 10.1007/s00330-015-3624-4

CONTRAST MEDIA

No increase in Kidney Injury Molecule-1 and Neutrophil Gelatinase-Associated Lipocalin excretion following intravenous contrast enhanced-CT

Judith Kooiman · Wilke R. van de Peppel · Yvo W. J. Sijpkens · Harald F. H. Brulez · P. M. de Vries · Mioara A. Nicolaie · H. Putter · Menno V. Huisman · W. van der Kooij · Cees van Kooten · Ton J. Rabelink

Intensive Care Med (2017) 43:774–784
DOI 10.1007/s00134-017-4699-y

ORIGINAL

Post-contrast acute kidney injury in intensive care unit patients: a propensity score-adjusted study

Jennifer S. McDonald[1*], Robert J. McDonald[1], Eric E. Williamson[1], David F. Kallmes[2] and Kianoush Kashani[3]

Conclusions: Intravenous contrast material administration was not associated with an increased risk of AKI, emergent dialysis, and short-term mortality in ICU patients with pre-CT eGFR > 45. An increased risk of dialysis was observed in patients with pre-CT eGFR ≤ 45.

Bildar patienter som fått kontrast kö till njurmottagningen?

	N	Combined N=611	Contrast at CT: No contrast N=6347	Contrast at CT: Contrast N=264
Creatinine				
Baseline creatinine	609	84.0 (70.0 -- 94.5) [2]	86.8 (70.9 -- 97.5) [1]	78.0 (69.4 -- 92.5) [1]
Creatinine at day of CT	611	85.0 (62.0 -- 132.0)	100.0 (66.0 -- 166.5)	77.0 (59.0 -- 109.0)
Creatinine follow-up	298	71.5 (58.0 -- 90.0) [313]	76.0 (63.0 -- 96.0) [169]	67.0 (53.8 -- 82.0) [144]
Baseline creatinine estimated	611	228 (37.3%)	130 (37.5%)	98 (37.1%)

3 -6 månader efter CT

Berglund F, Eilertz E, Nimmersjö F, Wolf A, Nordlander C, Palm F, Parenmark F, Westerbergh J, Liss P, Frithiof R. Acute and long-term renal effects after iodine contrast media-enhanced computerised tomography in the critically ill - a retrospective bi-centre cohort study. Eur Radiol. 2024 Mar;34(3):1736-1745.

Bildar patienter som fått kontrast kö till njurmottagningen?

Intensive Care Med (2023) 49:205–215
https://doi.org/10.1007/s00134-022-06966-w

ORIGINAL

Renal outcomes following intravenous contrast administration in patients with acute kidney injury: a multi-site retrospective propensity-adjusted analysis

Michael R. Ehmann[1*], Jonathon Mitchell[1], Scott Levin[1], Aria Smith[1], Steven Menez[2], Jeremiah S. Hinson[1] and Eili Y. Klein[1,3]

Conclusion

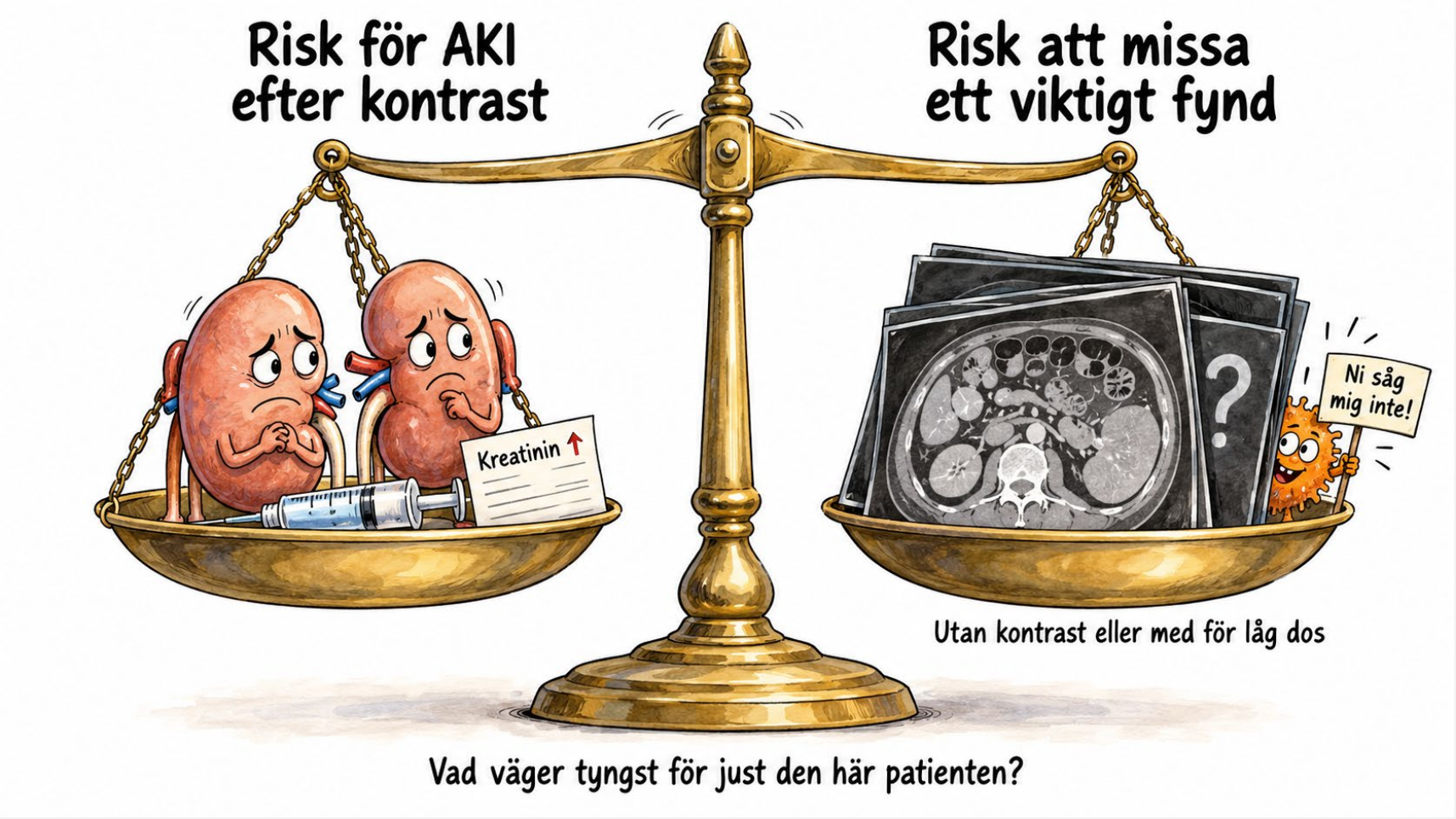
Among patients with pre-existing AKI, contrast administration was not associated with either persistent AKI at hospital discharge or initiation of dialysis within 180 days. Current consensus recommendations for use of intravenous CM in patients with stable renal disease may also be applied to patients with pre-existing AKI.

Nefrologernas syn på *CI / CA-AKI?*

- **Risken** - Generellt **överskattad** av andra kliniker
- **Signifikansen -** Klart **överdriven** i tidigare publikationer
- Vi ser misstänkta CI-AKI fall oerhört sällan och sker en kreastegring så är den vanligen **övergående** eller multifaktoriellt utlöst
- Vad vi däremot ofta ser är att patienter med nedsatt njurfunktion / transplantat förvägras adekvata undersökningar med kontrast – och NEJ det är inte anekdotiska sällan-fall utan en strid ström år efter år

Carin Wallquist
Överläkare, njurmedicin, Skånes universitetssjukhus;
ordförande, Guidelineutskottet, Svensk njurmedicinsk förening

Påverkar risken för AKI hur vi behandlar våra patienter?



Påverkar risken för AKI hur vi behandlar våra patienter?

ESC European Society of Cardiology
European Heart Journal (2026) **00**, 1–102
https://doi.org/10.1093/eurheartj/ehag098

ESC GUIDELINES

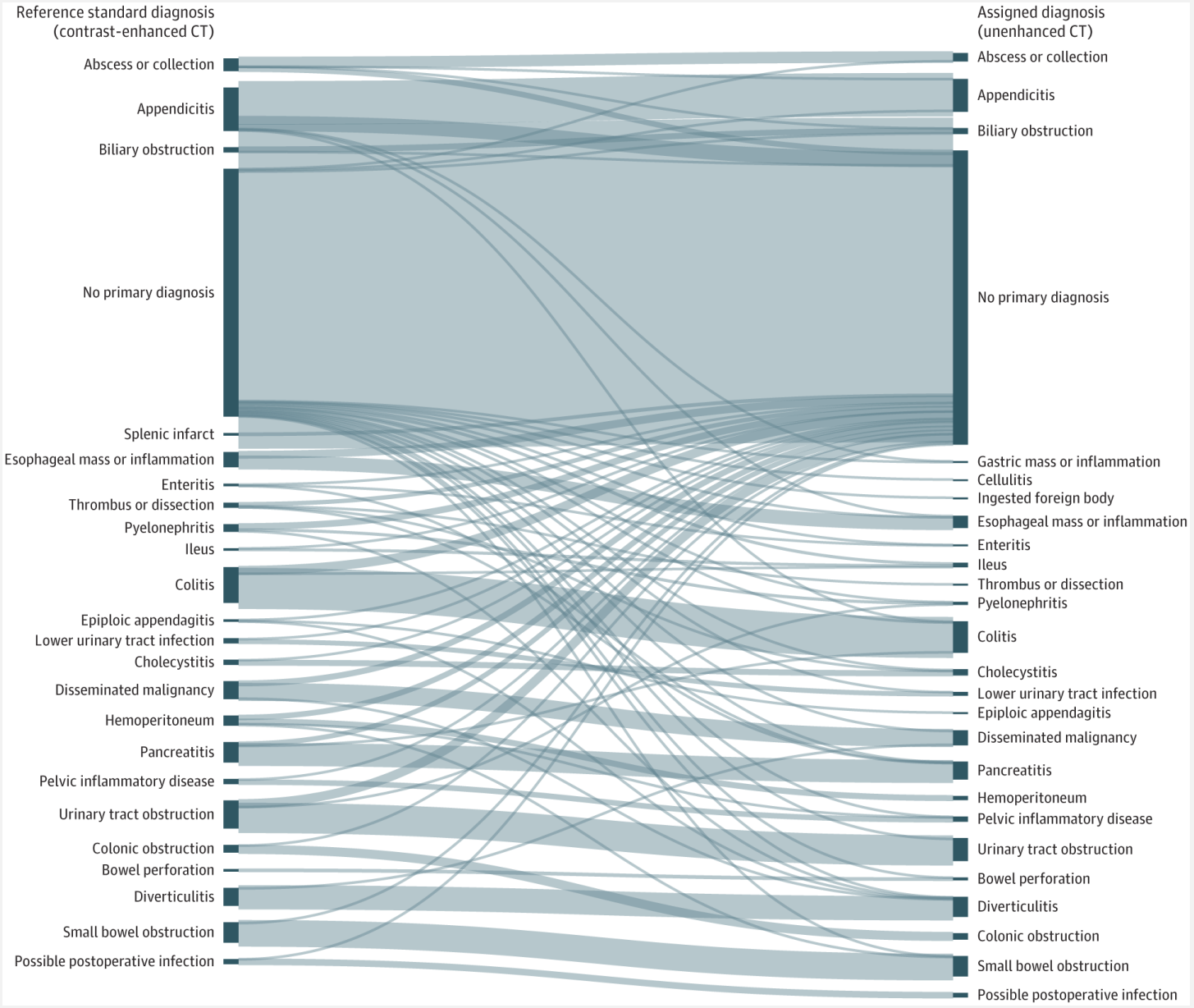
2026 ESC Guidelines for the management of cardiovascular disease and chronic kidney disease, in collaboration with the European Renal Association (ERA)

evaluation of potential kidney transplant recipients.[723] This low risk of KRT means that any risk of serious harm from CI-AKI is likely to be outweighed by the benefits of diagnostic imaging and therapeutic interventions when procedures are indicated. Harm of withholding or delaying procedures or therap-

Recommendation Table 30 — Recommendations to support safe use of contrast in chronic kidney disease (see Evidence Table 30)

Recommendations	Class[a]	Level[b]
Avoiding delays in procedures and interventions that use contrast agents is recommended for patients with CKD to ensure timely diagnosis and treatment.	I	C

CT utan contrast gav 30% lägre träffsäkerhet än CT med kontrast



Shaish H et al. Diagnostic Accuracy of Unenhanced Computed Tomography for Evaluation of Acute Abdominal Pain in the Emergency Department. JAMA Surg. 2023

European Radiology (2024) 34:1736–1745
https://doi.org/10.1007/s00330-023-10059-7

European Radiology
ESR EUROPEAN SOCIETY OF RADIOLOGY

CONTRAST MEDIA

Acute and long-term renal effects after iodine contrast media–enhanced computerised tomography in the critically ill—a retrospective bi-centre cohort study

Felix Berglund[1] · Ebba Eilertz[2] · Fredrik Nimmersjö[2] · Adam Wolf[2] · Christopher Nordlander[2] · Fredrik Palm[3] · Fredric Parenmark[4] · Johan Westerbergh[5] · Per Liss[1] · Robert Frithiof[6]

Table 1 Patient characteristics

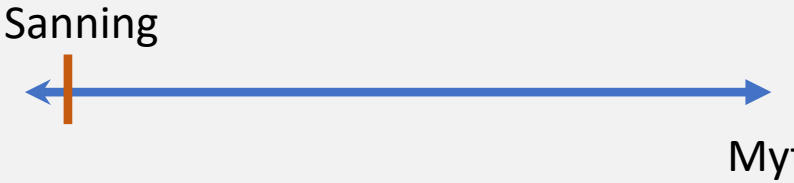
	n	Combined *n* = 611	Contrast at CT	
			No contrast *n* = 347	Contrast *n* = 264
Demography				
Hospital: University hospital	611	506 (82.8%)	288 (83.0%)	218 (82.6%)
County hospital		105 (17.2%)	59 (17.0%)	46 (17.4%)
Age	610	65.0 (48.0–73.0) [1]	66.0 (51.0–73.0) [1]	62.0 (43.8–73.0) [0]
Sex: Men	611	382 (62.5%)	219 (63.1%)	163 (61.7%)
Women		229 (37.5%)	128 (36.9%)	101 (38.3%)
Cause of admission				
Circulatory failure	609	31 (5.1%) [2]	22 (6.3%) [0]	9 (3.4%) [2]
Cardiac arrest		58 (9.5%)	38 (11.0%)	20 (7.6%)
Infection		129 (21.2%)	77 (22.2%)	52 (19.8%)
Respiratory failure		169 (27.8%)	82 (23.6%)	87 (33.2%)
Trauma		108 (17.7%)	62 (17.9%)	46 (17.6%)
Other		114 (18.7%)	66 (19.0%)	48 (18.3%)
Medical history				
Chronic kidney disease	572	39 (6.8%) [39]	33 (10.1%) [20]	6 (2.4%) [19]
Heart failure	572	68 (11.9%) [39]	41 (12.6%) [22]	27 (10.9%) [17]
Liver failure	572	25 (4.4%) [39]	16 (4.9%) [22]	9 (3.6%) [17]
Hypertension	609	237 (38.9%) [2]	145 (41.9%) [1]	92 (35.0%) [1]
Diabetes mellitus	610	117 (19.2%) [1]	73 (21.0%) [0]	44 (16.7%) [1]
Medical events and clinical markers				
Simplified Acute Physiology Score 3	610	64.0 (55.0–73.0) [1]	65.0 (55.5–74.0) [0]	62.0 (54.0–71.0) [1]
Highest lactate level	546	2.9 (1.9–4.4) [65]	3.0 (2.0–4.5) [43]	2.8 (1.9–4.3) [22]
Lowest Hb	565	85.0 (78.0–97.0) [46]	84.0 (78.0–98.0) [25]	85.0 (79.0–96.0) [21]
Mean arterial pressure at day of CT	575	75.0 (65.0–85.0) [36]	75.0 (65.0–84.0) [34]	76.0 (65.0–85.8) [2]
Partial pressure of arterial oxygen to fractional inspired oxygen at CT	567	26.1 (18.9–36.0) [44]	26.2 (19.5–36.5) [33]	26.1 (18.2–36.0) [11]
Days at intensive care unit	506	7.0 (4.0–12.0) [105]	6.0 (4.0–12.0) [59]	7.0 (4.0–13.0) [46]
Acute kidney injury (AKI)				
AKI stage at day of CT: 0	611	399 (65.3%)	202 (58.2%)	197 (74.6%)
1		117 (19.1%)	69 (19.9%)	48 (18.2%)
2		58 (9.5%)	44 (12.7%)	14 (5.3%)
3		37 (6.1%)	32 (9.2%)	5 (1.9%)
Creatinine				
Baseline creatinine	611	84.0 (70.0–94.5) [2]	86.8 (70.9–97.5) [1]	78.0 (69.4–92.5) [1]
Creatinine at day of CT	611	85.0 (62.0–132.0)	100.0 (66.0–166.5)	77.0 (59.0–109.0)
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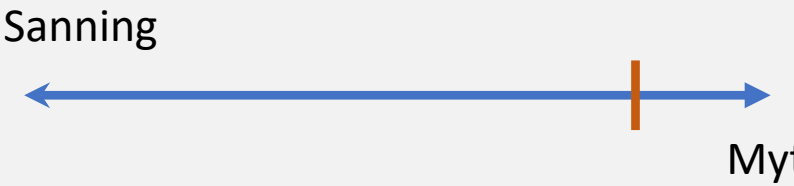
Kontrastinducerad nefropati – sanning eller myt



Kan kontrastmedel ge njurskada?



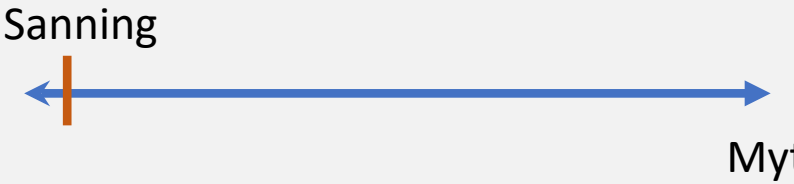
Patienter riskerar AKI när vi ger dem kontrast?



Vi bör ta hänsyn till njuren när vi bestämmer om kontrast ska ges eller ej



CI-AKI får alldeles för stor uppmärksamhet



Husets lag

§1 – Mor har alltid rätt

§2 – Om mor, mot förmodan har fel, så gäller automatiskt §1

Sammanfattning

§1 CT med kontrast ger inte en klinisk relevant ökning av risken för AKI

§2 Kan en kontrastförstärkt CT förbättra diagnostik och behandling? Utför då en kontrastförstärkt CT!

§3 Om en CT med kontrast, mot förmodan, ökar risken för AKI – gå direkt till §2.

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