Appendix A. List of Acronyms

AHRQ	Agency for Healthcare Research and Qaulity
AKI	Acute kidney injury
CI	Computerized tomography
CIN	Contrast induced nephropathy
CKD	Chronic kidney disease
CV	Cardiovascular
EPC	Evidence-based Practice Center
ESRD	End stage renal disease
GFR	Glomular filtration rate
HD	Hemodialysis
HF	Heart failure
HOCM	Hig osmolar coantrast media
IA	Intra-arterial
IOCM	Iso-osmolar contrast media
ITT	Intention to treat
IV	Intravenous
IVU	Intravenous urography
KQ	Key questions
lOCM	Low osmolar contrast media
MACE	Major adverse cardiac events
MeSH	Medical subject heading
MI	Myocardial infarction
NA	Not applicable
NR	Not reported
NS	Not significant
PCI	Percutaneous coronary intervention
PICOTS	Populastion, interventions, comparators, outcomes, timing, setting
PP	Protocol population
RCT	Randomized controlled trial
RRT	Renal replacement therapy
SEO	Strength of evidence
SIP	Scientific information package
TOO	Task Order Officer

Appendix B. Detailed Search Strategy

Database	Search	Included returns	Notes
PubMed	(("Kidney diseases"[mh] OR "Kidney disease"[tiab] OR "kidney diseases"[tiab] OR Nephropathy[tiab] OR "acute kidney injury"[mh] OR "acute kidney injury"[tiab] OR “acute renal injury”[tiab] OR "renal disease"[tiab] OR “renal diseases”[tiab]) AND ("contrast media"[mh] OR "contrast media"[tiab] OR "contrast medium"[tiab] OR "contrast material"[tiab])) NOT (animal[mh] NOT human[mh])	5308	
Embase	('contrast medium'/exp OR 'contrast medium':ab,ti OR 'contrast media':ab,ti OR 'contrast material':ab,ti) AND ('kidney disease'/exp OR 'kidney disease':ab,ti OR 'kidney diseases':ab,ti OR nephropathy:ab,ti OR 'acute kidney injury':ab,ti OR 'renal disease':ab,ti OR 'acute renal failure':ab,ti OR 'acute renal injury':ab,ti)	8952	12151 Limit to humans (study type): 9972 Limit to Article, Review, Conference Abstract, Conference Paper, Short Survey, Article in Press, Conference review (Publication type): 8952
Cochrane	ID Search #1 MeSH descriptor: [Kidney Diseases] explode all trees #2 "kidney disease":ti,ab,kw (Word variations have been searched) #3 nephropathy:ti,ab,kw (Word variations have been searched) #4 "acute kidney injury":ti,ab,kw (Word variations have been searched) #5 "renal disease":ti,ab,kw (Word variations have been searched) #6 "acute renal injury":ti,ab,kw #7 "renal diseases":ti,ab,kw #8 #1 or #2 or #3 or #4 or #5 or #6 or #7 #9 MeSH descriptor: [Contrast Media] explode all trees #10 "contrast media":ti,ab,kw (Word variations have been searched) #11 "contrast material":ti,ab,kw (Word variations have been searched) #12 "contrast medium":ti,ab,kw #13 #9 or #10 or #11 or #12 #14 #8 and #13	429	Other reviews: 52 Trials: 368 Technology assessments: 4 Economic evaluations: 5
Total		14,689	

Appendix C: Screening and Data Abstraction Forms

Title

DistillerSR https://systematic-review.ca/Submit/RenderForm.php?id=1&hide_abstract=1

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Refid: 12, Skateboards: Are they really perilous? A retrospective study from a district hospital.
Rethnam U, Yesupalan RS, Sinha A.

Submit Form and go to or Skip to Next

1. **Does this title/abstract apply to any of the Key questions? (see PICOTS document for more detail)**

- No
- Yes
- Uncertain

Clear Response

Submit Form and go to or Skip to Next

Abstract Screening– NO

DistillerSR https://systematic-review.ca/Submit/RenderForm.php?id=4

DistillerSR

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Refid: 12, Skateboards: Are they really perilous? A retrospective study from a district hospital.
Rethnam U, Yesupalan RS, Sinha A.

BACKGROUND: Skateboarding has been a popular sport among teenagers even with its attendant associated risks. The literature is packed with articles regarding the perils of skateboards. Is the skateboard as dangerous as has been portrayed?

METHODS: This was a retrospective study conducted over a 5 year period. All skateboard related injuries seen in the Orthopaedic unit were identified and data collated on patient demographics, mechanism & location of injury, annual incidence, type of injury, treatment needed including hospitalisation.

RESULTS: We encountered 50 patients with skateboard related injuries. Most patients were males and under the age of 15. The annual incidence has remained low at about 10. The upper limb was predominantly involved with most injuries being fractures. Most injuries occurred during summer. The commonest treatment modality was plaster immobilisation. The distal radius was the commonest bone to be fractured. There were no head & neck injuries, open fractures or injuries requiring surgical intervention.

CONCLUSION: Despite its negative image among the medical fraternity, the skateboard does not appear to be a dangerous sport with a low incidence and injuries encountered being not severe. Skateboarding should be restricted to supervised skateboard parks and skateboarders should wear protective gear. These measures would reduce the number of skateboarders injured in motor vehicle collisions, reduce the personal injuries among skateboarders, and reduce the number of pedestrians injured in collisions with skateboarders.

Submit Form and go to or Skip to Next

1. **Does this title/abstract apply to any of the above Key questions?**

- (●) No (answer reasons for exclusion)
  - Exclude article from review
    - ( ) No original data
    - ( ) No human data reported
    - ( ) Does not report an outcome of interest (see PICOTS)
    - ( ) Does not investigate an intervention of interest (see PICOTS)
    - ( ) No comparison group
    - ( ) short-term or long-term followup periods are insufficient (see PICOTS)
    - ( ) Abstract only
    - ( ) Qualitative study (focus group, directed interviews)
    - ( ) Does not apply to key questions
    - ( ) No abstract (use only for clearly not applicable titles of articles 1-3 pages in length)
  - Clear Response
- ( ) Yes (identify KQ)
- ( ) Unclear (screen article)

Clear Response

6. Comment

PICOTS

Submit Form and go to or Skip to Next

Abstract Screening– YES

DistillerSR https://systematic-review.ca/Submit/RenderForm.php?id=4

DistillerSR

Project CIN User renee.wilson (My Settings)

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Review | Datarama | Reports | References | Forms | Manage Levels | Users | Project | Logout

Refid: 12, Skateboards: Are they really perilous? A retrospective study from a district hospital.
Rethnam U, Yesupalan RS, Sinha A.

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Submit Form and go to or Skip to Next

1. **Does this title/abstract apply to any of the above Key questions?**

- ○ No (answer reasons for exclusion)
- ● Yes (identify KQ)

Include article for review

- ☐ KQ1: IV contrast media (comparative effectiveness of interventions to prevent CIN)
- ☐ KQ2: IA contrast media (comparative effectiveness of interventions to prevent CIN)
- ☐ KQ3: IV contrast media--comparative benefits and harms of the media
- ☐ KQ4: IA contrast media--comparative benefits and harms of the media

- ○ Unclear (screen article)

Clear Response

6. Comment

PICOTS

Submit Form and go to or Skip to Next

Abstract Screening– Unclear

DistillerSR https://systematic-review.ca/Submit/RenderForm.php?id=4

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Refid: 12, Skateboards: Are they really perilous? A retrospective study from a district hospital.
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Submit Form and go to or Skip to Next

1. **Does this title/abstract apply to any of the above Key questions?**

- No (answer reasons for exclusion)
- Yes (identify KQ)
- Unclear (screen article)
  - No abstract available; title appears applicable
  - Other reason

  Clear Response

Clear Response

6. Comment

PICOTS

Submit Form and go to or Skip to Next

Article Screening– NO

DistillerSR

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Review | Datarama | Reports | References | Forms | Manage Levels | Users | Project | Logout

Refid: 12, Skateboards: Are they really perilous? A retrospective study from a district hospital.
Rethnam U, Yesupalan RS, Sinha A.

Submit Form and go to or Skip to Next

1. **Does this ARTICLE apply to any of the above Key questions?**

- No (answer reasons for exclusion)

Exclude article

- No original data
- No human data reported
- Does not report an outcome of interest (see PICOTS)
- Does not investigate an intervention of interest (see PICOTS)
- No comparison group
- study compared an intervention of interest to a comparator of interest, but the patient groups being compared were fundamentally different
- short-term or long-term followup periods are insufficient (see PICOTS)
- Abstract only
- Qualitative study (focus group, directed interviews)
- Does not apply to key questions
- No abstract (use only for clearly not applicable titles of articles 1-3 pages in length)
- Non-English language (identify language if possible)

Clear Response

- Yes (identify KQ)
- Flag for discussion (**ONLY** use this option where queries can not be answerd by e-mail)

Clear Response

6. Comment

PICOTS

Submit Form and go to or Skip to Next

Article Screening– YES

DistillerSR https://systematic-review.ca/Submit/RenderForm.php?id=6&hide_abstract=1

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Refid: 12, Skateboards: Are they really perilous? A retrospective study from a district hospital.
Rethnam U, Yesupalan RS, Sinha A.

Submit Form and go to or Skip to Next

1. **Does this ARTICLE apply to any of the above Key questions?**

- No (answer reasons for exclusion)
- Yes (identify KQ)

Include article for data abstraction

- KQ1: IV contrast media (comparative effectiveness of interventions to prevent CIN)
- KQ2: IA contrast media (comparative effectiveness of interventions to prevent CIN)
- KQ3: IV contrast media--comparative benefits and harms of the media
- KQ4: IA contrast media--comparative benefits and harms of the media

- Flag for discussion (**ONLY** use this option where queries can not be answerd by e-mail)

Clear Response

6. Comment

PICOTS

Submit Form and go to or Skip to Next

Participant Characteristics

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Refid: 12, Skateboards: Are they really perilous? A retrospective study from a district hospital.
Rethnam U, Yesupalan RS, Sinha A.

Submit Form and go to or Skip to Next

Participant Characteristics at Baseline

1. Does the study report baseline characteristics for subgroups seperately?
(e.g., IV administration and IA administration)

- Yes
- No

Clear Response

2. Identify group for baseline characteristics
(You can submit this form multiple time)

Select an Answer

Arm 1 (control/usual care)	Arm 2	Arm 3	Arm 4	Arm 5
3.	4.	5.	6.	7.

8. N at baseline

- Total N
- Arm 1 (control/usual care) n
- Arm 2
- Arm 3
- Arm 4
- Arm 5
- Not reported

	Follow-up	Mean, median, max/min...	Units
9. Not reported Clear Response	10.	11. Select an Answer	12. Select an Answer

13. Sex

- reported

Overall Group	Arm 1	Arm 2	Arm 3	Arm 4	Arm 5

14.	15.	16.	17.	18.	19.
women, n women, %	women, n women, %	women, n women, %	women, n women, %	women, n women, %	women, n women, %

not reported

20. Age

reported

Overall Group	Arm 1	Arm 2	Arm 3	Arm 4	Arm 5
21. mean Median Range	22. mean Median Range	23. mean Median Range	24. mean Median Range	25. mean median range	26. mean median range

not reported

27. Race/ethnicity

Reported

	Overall Group	Arm 1	Arm 2	Arm 3	Arm 4	Arm 5
White, non-Hispanic	28. n %	29. n %	30. n %	31. n %	32. n %	33. n %
Black, non-Hispanic	34. n %	35. n %	36. n %	37. n %	38. n %	39. n %
Latino/Hispanic	40. n %	41. n %	42. n %	43. n %	44. n %	45. n %
Asian/Pacific Islander	46. n %	47. n %	48. n %	49. n %	50. n %	51. n %
American Indian/Alaska Native	52. n %	53. n %	54. n %	55. n %	56. n %	57. n %
58. Other	59. n %	60. n %	61. n %	62. n %	63. n %	64. n %

65. Other	66. n %	67. n %	68. n %	69. n %	70. n %	71. n %
72. Other	73. n %	74. n %	75. n %	76. n %	77. 2n %	78. 2n %

not reported

79. Education

Reported

	Overall Group	Arm 1	Arm 2	Arm 3	Arm 4	Arm 5
< High School	80. n %	81. n %	82. n %	83. n %	84. n %	85. n %
Completed High School	86. n %	87. n %	88. n %	89. n %	90. n %	91. n %
College Degree	92. n %	93. n %	94. n %	95. n %	96. n %	97. n %
Post-graduate Degree	98. n %	99. n %	100. n %	101. n %	102. n %	103. n %
Years of education	104. mean median min max	105. mean median min max	106. mean median min max	107. mean median min max	108. mean median min max	109. mean median min max
110. Other	111. n %	112. n %	113. n %	114. n %	115. n %	116. n %
117. Other	118. n %	119. n %	120. n %	121. n %	122. n %	123. n %

124. Other	125. n %	126. n %	127. n %	128. n %	129. n %	130. n %

not reported

131. Smoking

reported

	Overall Group	Arm 1	Arm 2	Arm 3	Arm 4	Arm 5
Current	132. n %	133. n %	134. n %	135. n %	136. n %	137. n %
Former	138. n %	139. n %	140. n %	141. n %	142. n %	143. n %
Ever	144. n %	145. n %	146. n %	147. n %	148. n %	149. n %
Never	150. n %	151. n %	152. n %	153. n %	154. n %	155. n %

not reported

156. Is the entire study population a subgroup (all particiupants have a specific disease or condition)?

Yes

Condition	Define
Renal insufficiency (included CKD)	157.
Diabetes	158.
On Dialysis	159.
160. Other	161.
162. Other	163.

166. Other Comments

167. **R2 only: if you are reviewing R1 data entry, enter your initials when you have completed the audit**

Submit Form and go to or Skip to Next

Study Characteristics

DistillerSR

Project: CN | User: renee-ann (My Settings)

Manager: Criteria

Review | Data Items | Reports | References | Forms | Manage Levels | Users | Project | Logout

Hand ** 2. Vlachakis Are they really panicoid? A retrospective study from a district hospital. Rahman U, Yasapalen RS, Sethi A.

Submit Form and go to or Skip to Next

Study Characteristics

1. Mainly relevant KQ

If (S QR//RE/A), start your answer this question correctly–future form assignments dependent on this question.

- KQ1. IV CM administration, interventions to prevent CIN
- KQ2. IA CM administration, interventions to prevent CIN
- KQ3. IV CM administration, harms and benefits of different CM
- KQ4. IA CM administration, harms and benefits of different CM

2. Comment (not this should be included at this level

RANDUM QIY

If you believe this article should be excluded contact renee.ann.brown@hqph.ca immediately

3. Does the study have a name?

- Yes
- No

Clear Response

4. If this study refers to another publication of the cohort with information about the study design, characteristics, or results on weight maintenance, please paste the entire reference(s) here. Enter information here ONLY if it is an article with data from the same parent study.

5. Years of recruitment or (calendar years)

- Start year
- End Year
- Not reported

6. Recruitment setting (choose all that apply)

- Inpatient (including ICU)
- Outpatient
- Emergency department
- other
- Not reported

7. Study Design

- Randomized intervention (controlled trial)
- Non-randomized intervention (controlled trial)
- Other observational design

8. Single or multi-center

- Single-center
- Multi-center
- Not specified

Inclusion criteria (convert all exclusion criteria to inclusion criteria)

1 the inclusion criteria are different across groups make a note in the "other comments"

Criteria	Male	Female	Age	Diagnostic test procedure	Condition	Language spoken-understood	Ethnicity	Other
INCLUUL	9.	10.	11. use > to greater than OR greater than or equal to use < to less than OR less than or equal to	12.	13. Choose all that apply	14.	15. Choose all that apply	16. If no additional inclusion criteria, write "none."
	Male only	Female only	>	Dacodine	CVD	English	White, non-Hispanic	
	Not listed as an inclusion criterion	Not listed as an inclusion criterion	<	Not listed as an inclusion criterion	T2DM	Spanish	Black, non-Hispanic	
			Other		CVD/T2DM at risk	Other (describe)	Latino/Hispanic	
			Not listed as an inclusion criterion		Hemodialysis	Not listed as an inclusion criterion	Asian/Pacific Islander	
					Renal dysfunction		American Indian/Alaska Native	
					Other Risk factors		Other	
					Not listed as an inclusion criterion		Other	
							Other	
							Other	
							not listed as an inclusion criterion	

17. COMMENTS about Study Characteristics

18. (12 only if you are reviewing IT data entry, enter your initials when you have completed the work.

Submit Form and go to or Skip to Next

Intervention KQ 1&2

DistillerSR

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Refid: 12, Skateboards: Are they really perilous? A retrospective study from a district hospital.
Rethnam U, Yesupalan RS, Sinha A.

Submit Form and go to or Skip to Next

Intervention Description
Key Questions 1 and 2

The following questions are in place to identify the contrast media (CM) used in the study.
THIS IS NOT a KQ 1/2 study if:
The CM are being compared and no preventive measures are being used.

1. Does the study report Interventions for subgroups seperately?
   (e.g., IV administration and IA administration)

   - (•) Yes
     2. Identify group for baseline characteristics
        (You can submit this form multiple time)

        Select an Answer
   - ( ) No

   Clear Response

3. Contrast Media used

   - [ ] Iodixanol
   - [ ] Iohexol
   - [ ] Iomeprol
   - [ ] Iopamidol
   - [ ] Iopentol
   - [ ] Iopromide
   - [ ] Ioxaglate
   - [ ] Ioxilan
   - [ ] LOCM
   - [ ] IOCM
   - [ ] Not specified
   - [ ] Other description

4. Contrast media administration route

   - ( ) IV
   - ( ) IA
   - (•) Not specified
   - ( ) Other

   Clear Response

5. Dose

- Define
- Not specified

6. Duration

- Define
- Not specified

Clear Response

7. Volume

- Define
- Not specified

Clear Response

The following questions are in place to idnetify and describe preventive measures for CIN.
Use Arm 1 EXCLUSIVELY for the control or standard care intervention. If there is not control, leave those columns blank under Arm 1
NOTE: the Arms below should match teh Arms described in the participant characteristics form.

	Arm 1 (control/usual care)	Arm 2	Arm 3	Arm 4	Arm 5
Administration route	8. **NO CONTROL OR USUAL CARE** Oral IV Not reported Other	9. Oral IV Not reported Other	10. Oral IV Not reported Other	11. Oral IV Not reported Other	12. Oral IV Not reported Other
Dose	13.	14.	15.	16.	17.
Duration	18.	19.	20.	21.	22.
Temporal association to CM administration	23. Prior to CM admin During CM admin After CM admin Not stated Other	24. Prior to CM admin During CM admin After CM admin Not stated Other	25. Prior to CM admin During CM admin After CM admin Not stated Other	26. Prior to CM admin During CM admin After CM admin Not stated Other	27. Prior to CM admin During CM admin After CM admin Not stated Other
Other details	28.	29.	30.	31.	32.

33. Comments

34. **R2 only: if you are reviewing R1 data entry, enter your initials when you have completed the audit**

Intervention KQ 3&4

DistillerSR

Project CIN User renee.wilson (My Settings)
Messages 16 new
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Review | Datarama | Reports | References | Forms | Manage Levels | Users | Project | Logout

Refid: 12, Skateboards: Are they really perilous? A retrospective study from a district hospital.
Rethnam U, Yesupalan RS, Sinha A.

Submit Form and go to or Skip to Next

Intervention Description
Key Questions 3_4

The following questions are in place to idnetify and describe contrast media (CM)only.
Use Arm 1 EXCLUSIVELY for the control or standard care intervention. If there is no control, leave those columns blank under Arm 1
NOTE: the Arms below should match the Arms described in the participant characteristics form

1. Does the study report Interventions for subgroups seperately?
(e.g., IV administration and IA administration)

- Yes
  2. Identify group for baseline characteristics
  (You can submit this form multiple time)

  Select an Answer

- No

Clear Response

	Arm 1 (control/usual care)	Arm 2	Arm 3	Arm 4	Arm 5
Contrast Medium (Media) used	3. ☐ Iodixanol ☐ Iohexol ☐ Iomeprol ☐ Iopamidol ☐ Iopentol ☐ Iopromide ☐ Ioxaglate ☐ Ioxilan ☐ LOCM ☐ IOCM ☐ Not specified ☐ Other description	4. ☐ Iodixanol ☐ Iohexol ☐ Iomeprol ☐ Iopamidol ☐ Iopentol ☐ Iopromide ☐ Ioxaglate ☐ Ioxilan ☐ LOCM ☐ IOCM ☐ Not specified ☐ Other description	5. ☐ Iodixanol ☐ Iohexol ☐ Iomeprol ☐ Iopamidol ☐ Iopentol ☐ Iopromide ☐ Ioxaglate ☐ Ioxilan ☐ LOCM ☐ IOCM ☐ Not specified ☐ Other description	6. ☐ Iodixanol ☐ Iohexol ☐ Iomeprol ☐ Iopamidol ☐ Iopentol ☐ Iopromide ☐ Ioxaglate ☐ Ioxilan ☐ LOCM ☐ IOCM ☐ Not specified ☐ Other description	7. ☐ Iodixanol ☐ Iohexol ☐ Iomeprol ☐ Iopamidol ☐ Iopentol ☐ Iopromide ☐ Ioxaglate ☐ Ioxilan ☐ LOCM ☐ IOCM ☐ Not specified ☐ Other description
Administration route	8. ☐ **NO CONTROL OR USUAL CARE** ☐ IV ☐ IA ☐ Not reported ☐ Other	9. ☐ IV ☐ IA ☐ Not reported ☐ Other	10. ☐ IV ☐ IA ☐ Not reported ☐ Other	11. ☐ IV ☐ IA ☐ Not reported ☐ Other	12. ☐ IV ☐ IA ☐ Not reported ☐ Other

Clinical Outcomes Continuous

DistillerSR

Review | Datasheet | Reports | References | Forms | Manage Users | Users | Project | Logout

Project: CIN User: mawalton (dfy Settings)
Message: None

Ref id: 12, Stalsboards, Are they really particular? A retrospective study from a district hospital.
Reviewer: U, Vasquez RS, Stalsb A.

Submit Form and go to or Skip to Next

Short term = ≤7 days or less post CIN administration
Long term = after 7 day post CIN administration

1. ***Primary outcome: CIN (you MUST include the definition of CIN used in the study)***

2. Clinical outcome (choose one)
   - Select an Answer

3. Is this a sub-group analysis?
   Include an author name
   If yes the population has a specific disease or condition, NOT a subgroup.
   - Yes
   - No
   - Clear Response

Make sure Arm designation is consistent across forms!

4. Type of outcome measure
   - Continuous

Time point	Arm 1 (control/placebo)	Arm 2	Arm 3	Arm 4	Arm 5	Comparison 1	Comp 1 Data	Comparison 2	Comp 2 Data	Comparison 3	Comp 3 Data	Comparison 4	Comp 4 Data	Comparison 5	Comp 5 Data	Comments
Baseline	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.	15.	16.	17.	18.	19.	20.
21. Time Point 1	22.	23.	24.	25.	26.	27.	28.	29.	30.	31.	32.	33.	34.	35.	36.	37.
38. Time Point 2	39.	40.	41.	42.	43.	44.	45.	46.	47.	48.	49.	50.	51.	52.	53.	54.
55. Time Point 3	56.	57.	58.	59.	60.	61.	62.	63.	64.	65.	66.	67.	68.	69.	70.	71.

Each cell: Analyzed; Mean; SD; n; Max; Min; 95% CI (LL); 95% CI (UL); Other (define); Other (explain)

Each comparison: Arm 1; Arm 2; Arm 3; Arm 4; Arm 5; Mean difference; Median difference; SD; n; 95% CI (LL); 95% CI (UL); Other (define); Other (explain); Positive; Stat Test; Adjusted for

72. Time Point 4	73.	74.	75.	76.	77.	78.	79.	80.	81.	82.	83.	84.	85.	86.	87.	88.

- Categorical
- Clear Response

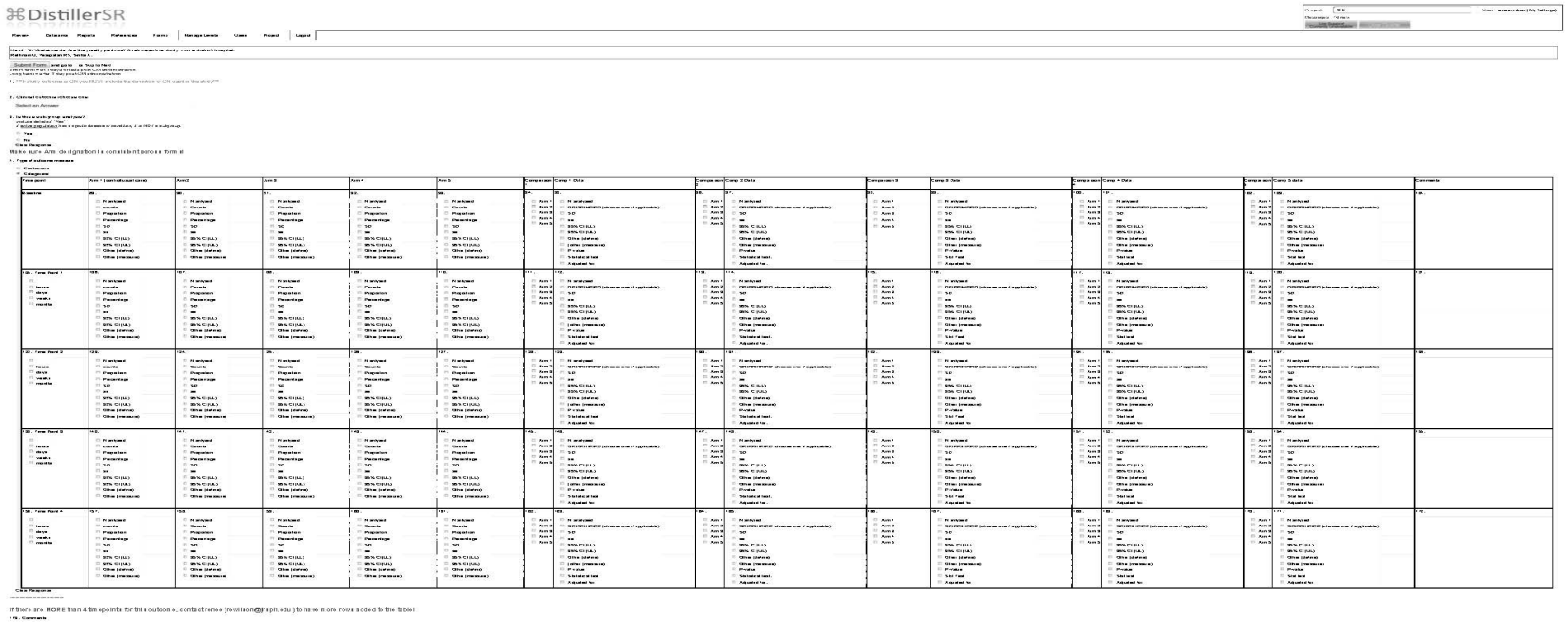
If there are MORE than 4 timepoints for this outcome, contact renee (revilson@phph.edu) to have more rows added to the table!

173. Comments

174. R2 only: If you are reviewing R1 data only, enter your initials when you've completed the audit

Submit Form and go to or Skip to Next

Clinical Outcomes Categorical



DistillerSR https://systematic-review.ca/Submit/RenderForm.php?id=18&hide_abstract=1

Adverse Events

DistillerSR

Project CIN User renee.wilson (My Settings)
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Review | Datarama | Reports | References | Forms | Manage Levels | Users | Project | Logout

Refid: 12, Skateboards: Are they really perilous? A retrospective study from a district hospital.
Rethnam U, Yesupalan RS, Sinha A.

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Adverse events

1. Did this study report adverse events?

Yes (Includes a explicite report of no adverse events)

Harm	Describe
Imaging delay	2.
Need for additional imaging	3.
Fluid overload	4.
Heart failure	5.
Anaphalaxis	6.
7. Other	8.

Cochrane Risk of Bias

DistillerSR

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Refid: 12, Skateboards: Are they really perilous? A retrospective study from a district hospital.
Rethnam U, Yesupalan RS, Sinha A.

Submit Form and go to or Skip to Next

Risk of Bias

1. Choose primary outcome (if study has more than 1 primary/main outcome, this form will need to be filled out multiple times).

Select an Answer

The full Cochrane Riskl of Bias tool can be accessed here: http://ohg.cochrane.org/sites/ohg.cochrane.org/files/uploads/Risk%20of%20bias%20assessment%20tool.pdf

Please refer to the link above while performing RoB assessments

Domain	Desription	Review Author's Judgement ...does the study:
Sequence Generation	Describe the method used to generate the allocation sequence in sufficient detail to allow an assessment of whether it should produce comparable groups.	2. Was the allocation sequence adequately generated? Select an Answer
Allocation Concealment	Describe the method used to conceal the allocation sequence in sufficient detail to determine whether intervention allocations could have been foreseen in advance of, or during enrollment.	3. Was allocation adequately concealed? Select an Answer
Blinding of Participants, Personnel, ad Outcome Assessors *Assessments should be made for each main outcome or class of*	Describe all measures used, if any to blind study personnel and participants from knowledge of which intervention a participant received. Provide any information relating to whether the intended blinding was effective.	4. Was knowledge of the allocated intervention adequately prevented during the srudy? Select an Answer

outcomes		
Incomplete Outcome Data *Assessments should be made for each main outcome or class of outcomes*	Describe the completeness of outcome data for each main outcome, including attrition and exclusion from the analysis. State whether attrition and exclusions were reported, the numbers in each intervention group (compare with total randomized participants), reason for attrition/exclusions where reported, and any re-inclusions in analyses performed by teh review authors.	5. Were incomplete oucome data adequately addressed? Select an Answer
Selective Outcome Reporting	State how the possibility of selective outcome reporting was examined by the review authors, and what was found	6. Are reports of the study free of suggestion of selective outcome reporting? Select an Answer
Other Sources of Bias	State any important concerns about bias not addresses in the other domains in the tool.	7. Was the study apparently free of other problems that could put it at a high risk of biase? Select an Answer

8. Comments

9. **R2 only: if you are reviewing R1 data entry, enter your initials when you have completed the audit**

Submit Form and go to or Skip to Next

Appendix D: List of Excluded Studies

Exclusion: Abstract Only.

M. R. Gandhi, P. Brown, C. A. Romanowski, S. K. Morcos, S. Campbell, A. M. el Nahas and T. A. Gray. The use of theophylline, an adenosine antagonist in the prevention of contrast media induced nephrotoxicity. Br J Radiol. 1992. 65:838

M. S. Davenport, S. Khalatbari, N. R. Dunnick, J. R. Dillman and J. H. Ellis. Contrast-induced nephrotoxicity: Risk of intravenous low osmolality iodinated contrast material stratified by estimated glomerular filtration rate. Abdominal Imaging. 2013. 38:628

J. Sugioka, M. Inagaki, S. Fukuzawa, A. Ikeda, S. Okino, J. Maekawa, S. Maekawa, S. Ichikawa, N. Kuroiwa and S. Okamoto. Risk prediction of contrast-induced nephropathy in diabetic patients undergoing primary percutaneous coronary intervention for acute myocardial infarction. Cardiology (Switzerland). 2013. 125:164

M. Fujimoto, K. Waseda, H. Takashima, K. Maeda, K. Asai, Y. Kuroda, T. Kosaka, A. Kurita, Y. Kuhara, H. Ando, S. Sakurai, D. Kato, A. Suzuki, Y. Nakano, T. Niwa, K. Mukai, S. Sato, T. Mizuno and T. Amano. Effect of oral hydration on renal function after coronary catheterization. American Journal of Cardiology. 2013. 111:89B

M. Habib, A. Hillis and A. Hamad. The role of ascorbic acid or n-acetylcysteine or combination in prevention of contrast-induced nephropathy in high-risk patients with ischemic heart disease. International Journal of Cardiology. 2013. 163:S64

M. Habib, A. Hillis and A. Hamad. Low dose of N-acetylcysteine plus ascorbic acid versus hydration with (saline 0.9%) for prevention of contrast-induced nephropathy in patients undergoing coronary angiography. International Journal of Cardiology. 2013. 163:S81

S. Hamdi, W. Selmi, A. Hraiech, W. Jomaa, K. B. Hamda and F. Maatouk. Prevention of contrast induced nephropathy in patients undergoing coronarography with ascorbic acid. JACC: Cardiovascular Interventions. 2013. 6:S22

J. Samide, N. Saad, T. Abraham and E. Balmir. A retrospective evaluation on the usage of iodinated contrast media in an Urban hospital setting. Critical Care Medicine. 2012. 40:265

J. Kooiman, Y. W. Sijpkens, H. C. Brulez, J. P. P. De Vries, J. F. Hamming, A. J. Van Der Molen, N. J. Aarts, S. C. Cannegieter, T. J. Rabelink and M. V. Huisman. Randomized study of short prehydration with sodium bicarbonate versus standard pre- and posthydration with sodium chloride to prevent contrast induced acute kidney injury: The Salina trial. Circulation. 2012. 126:#pages#

A. M. Fayed. Human albumin versus isotonic sodium bicarbonate in prevention of contrast induced nephropathy in critically ill patients. Intensive Care Medicine. 2012. 38:S243-S244

X. Qun and L. Shijuan. Protection of n-acetylcysteine for patients with contrast induced nephropathy after percutaneous coronary intervention treatment. Heart. 2012. 98:E214

R. Li and H. Chen. Prevention of contrast-induced nephropathy with ascorbic acid. Heart. 2012. 98:E211

J. Juch, J. Le Noble and N. Foudraine. Incidence and prevention of contrast induced nephropathy (CIN) in the ICU: Preventive administration of Na+ bicarbonate is not effective. Single dose amino-glycoside is a major risk factor. Intensive Care Medicine. 2012. 38:S46

G. Deray, L. Marti-Bonmati, O. Rouviere, L. Bacigalupo, B. Maes, T. Hannedouche, F. Vrtovsnik, C. Rigothier, J. Billiouw and P. Campioni. Renal safety evaluation after Gd-DOTA-enhanced-MRI compared with non-enhanced-MRI in patients at high risk of developing contrast medium induced nephropathy. Journal of Medical Imaging and Radiation Oncology. 2012. 56:90

M. Erturk, E. Akbay, G. Kurtulus, N. Isiksacan, M. Gul, I. F. Akturk, O. Surgit, F. Uzun, A. Yildirim and N. Uslu. Effect of iv or oral N-acetylcysteine in the prevention of contrast-induced nephropathy in patients with moderate to severe renal insufficiency. European Heart Journal. 2012. 33:77

A. K. Singh and J. A. Kari. 24-hour isotonic sodium choloride was better than 7-hour sodium bicarbonate for preventing CIN. Annals of Internal Medicine. 2012. 157:JC1-9

V. Brulotte, F. A. Leblond, S. Elkouri, E. Therasse, V. Pichette and P. Beaulieu. Impact of sodium bicarbonate administration and N-acetylcysteine on the prevention of contrast media-induced nephropathy in endovascular aortic aneurysm repair. European Journal of Anaesthesiology. 2012. 29:66

G. Gu, R. Lu, W. Cui, F. Liu, Y. Zhang and X. Yang. Low-dose furosemide administered with adequate hydration prevents contrast-induced nephropathy in patients undergoing coronary angiography. Circulation. 2012. 125:e868

K. Chatani, M. Abdel-Wahab, R. Toelg, V. Geist, M. Marwan, A. E. Mostafa and G. Richardt. Impact of iso-osmolar versus low-osmolar contrast agents on contrast-induced acute kidney injury in unselected patients undergoing TAVI. EuroIntervention. 2012. 8:N160

A. Lacquaniti, V. Donato, M. Rosaria Fazio, S. Lucisano, V. Cernaro, R. Lupica and M. Buemi. Contrast media, nephrotoxicity and neutrophil-gelatinase associated lipocalin: Between doubts and certainties. Nephrology Dialysis Transplantation. 2012. 27:ii354-ii355

S. Traub, A. Mitchell, A. E. Jones, A. Tang, J. O'Connor, J. Kellum and N. Shapiro. A randomized trial of N-acetyl cysteine and saline versus normal saline alone to prevent contrast nephropathy in emergency department patients undergoing contrast enhanced computed tomography. Academic Emergency Medicine. 2012. 19:S22

B. C. Chua, A. S. Aprjanto, N. Hamada and S. Sultan. Contrast Induced Nephropathy and Chronic Kidney Disease (CIN/CKD) as a consequence of utilising non ionic Iso-Osmolar Contrast Media (IOCM) versus Low- Osmolar Contrast Media (LOCM) following lower extremity endovascular revascularisation (EvR): A 5 years parallel group observational study. Irish Journal of Medical Science. 2012. 181:S16-S17

S. Ebisawa, T. Saigusa, K. Odagiri, S. Aso, K. Aizawa, M. Koshikawa, H. Kasai, A. Izawa, T. Tomita, Y. Miyashita, S. Kumazaki, T. Yaguchi, H. Hioki, J. Koyama, U. Ikeda, T. Kurita, M. Kimura and T. Suzuki. Impact of minimum contrast media on percutaneous coronary intervention for preventing contrast induced nephropathy in patients with coronary artery disease. Circulation. 2011. 124:#pages#

N. Mayaud, K. Isaaz, C. Mariat, A. Cerisier, M. Lamaud, L. Richard and A. Da. Contrast induced nephropathy in patients with normal renal function undergoing complex PCI with high dose of contrast media: Predictive value of Cystatin C. Journal of the American College of Cardiology. 2011. 58:B138

M. Elshawadfy, M. A. Oraby, H. M. Ismail and F. A. Maklady. Effectiveness of theophylline in prevention of contrast-induced nephropathy in risky Egyptian patients undergoing elective coronary angiography or percutaneous intervention: A randomized controlled trial. Journal of the American College of Cardiology. 2011. 58:B136

M. Menozzi, P. Magnavacchi, E. Puggioni, M. Valgimigli, L. Vignali, V. Guiducci, G. Pignatelli, P. Giacometti and A. Manari. Contrast induced acute kidney injury in patients undergoing primary angioplasty for acute myocardial infarction. a randomized trial on hydration with saline or bicarbonate. Journal of the American College of Cardiology. 2011. 58:B137-B138

A. Momeni, A. Ebrahimi and A. Khaledi. Comparison of three methods of contrast nephropathy prophylaxis in azotemic patients. Iranian Journal of Kidney Diseases. 2011. 5:10

S. Bajaj, M. Sharma, R. Parikh, S. Patel, N. Gupta, C. Chandran, A. Hamdan, F. Shamoon and M. Bikkina. Contrast induced nephropathy in patients with chronic kidney disease undergoing coronary angiography. Chest. 2011. 140:#pages#

W. Li, D. Li, T. Xu, Y. Zhang, H. Zhu and F. Han. Prevention of contrast-induced acute kidney injury with ascorbic acid and prostaglandin e1 in high risk factors patients undergoing PCI. Heart. 2011. 97:A151

Y. Miao and Z. Yu-Jie. Efficacy of short-term high-dose atorvastatin for prevention of contrastinduced nephropathy in patients with st segment elevation myocardial infarction undergoing percutaneous coronary intervention. Heart. 2011. 97:A229

X. Hou, Y. J. Wang, Q. X. Yin, J. L. Miao and H. Jiang. Prevention of contrast-induced nephropathy comparison of two hydration regimens in elderly patients undergoing percutaneous coronary intervention. Heart. 2011. 97:A230

L. Bertelli, F. A. Sgura, M. Manicardi, A. Campioli, G. Spadafora, C. Leuzzi, R. Rossi, G. Biondi Zoccai, G. M. Sangiorgi and M. G. Modena. Mid-term outcomes of iodixanol versus iomeprol contrast medium after primary angioplasty for st elevation myocardial infarction. European Heart Journal. 2011. 32:881

M. Brueck, H. Cengiz and A. Boening. Comparison of N-acetylcysteine or ascorbic acid versus placebo to prevent contrast-induced nephropathy in patients with renal insufficiency undergoing elective cardiac catheterization. European Heart Journal. 2011. 32:261-262

M. Mockel, M. J. Dumichen, K. Friedrich, Y. Kuhnle, J. O. Vollert, J. Searle, V. Combe, C. Schwenke and M. Schroder. Invasive renal hemodynamics after left ventricular and coronary

angiography with randomised use of different contrast media. EuroIntervention. 2011. 7:M15
X. Li, Y. Wang, N. Fu, R. Zhao, J. Xiao, Z. Li and H. Cong. Atorvastatin combining probucol can reduce the renal impairment induced with contrast-medium. EuroIntervention. 2011. 7:M17
Y. Chen, S. Hu, Y. Liu, L. Wang, G. Fu and Q. He. A randomised, double-blinded comparison of lopromide and lodixanol in renally impaired patients undergoing cardiac catheterisation (DIRECT study). EuroIntervention. 2011. 7:M11
J. Min, A. Ryan and J. Spalding. Renal morbidity, mortality, and costs in individuals undergoing invasive cardiac catheterization procedures with low-osmolar contrast media: A large retrospective database analysis. Value in Health. 2010. 13:A351
Y. Han, S. Wang, X. Wang, F. Li, X. Zhao and Q. Jing. Contrast-induced nephropathy following coronary intervention in elderly, renally impaired patients: A randomised comparison of the renal safety of iodixanol and iopromide. EuroIntervention. 2010. 6:#pages#
S. Rastelli, L. Zanoli, C. Marcantoni, J. Blanco, C. Tamburino and P. Castellino. Contrast media related risk of contrast induced nephropathy. NDT Plus. 2010. 3:iii56
H. El-Fishawy, N. Shaheen and A. Soliman. Ascorbic acid and acetylcysteine for prevention of acute deterioration of renal function following elective aorto-iliac and coronary angioplasty. NDT Plus. 2010. 3:iii300
S. S. Brar, A.-J. Shen, M. B. Jorgensen, V. J. Aharonian, V. Koshkaryan and A. I. Shah. A randomized controlled trial for the prevention of contrast induced nephropathy with sodium bicarbonate vs. sodium chloride in patients undergoing coronary angiography: 2-year results from the MEENA Trial. #journal#. 2010. #volume#:B77
J. G. Lavenberg and C. A. Umscheid. Prevention of contrast-induced nephropathy: acetylcysteine, sodium bicarbonate, or saline (Structured abstract). #journal#. 2011. #volume#:#pages#

Exclusion: Followup less than one year

E. A. McGillicuddy, K. M. Schuster, L. J. Kaplan, A. A. Maung, F. Y. Lui, L. L. Maerz, D. C. Johnson and K. A. Davis. Contrast-induced nephropathy in elderly trauma patients. J Trauma. 2010. 68:294-7
T. Nozue, I. Michishita, T. Iwaki, I. Mizuguchi and M. Miura. Contrast medium volume to estimated glomerular filtration rate ratio as a predictor of contrast-induced nephropathy developing after elective percutaneous coronary intervention. J Cardiol. 2009. 54:214-20
S. Khanal, N. Attallah, D. E. Smith, E. Kline-Rogers, D. Share, M. J. O'Donnell and M. Moscucci. Statin therapy reduces contrast-induced nephropathy: an analysis of contemporary percutaneous interventions. Am J Med. 2005. 118:843-9

Exclusion: Unobtainable

M. M. Rahman, S. S. Haque, B. Rokeya, M. A. Siddique, S. K. Banerjee, S. A. Ahsan, F. Rahman, M. Mahmood, K. Ahmed, M. M. Bhuiyan, A. I. Joarder and R. C. Debnath. Trimetazidine in the prevention of contrast induced nephropathy after coronary angiogram. Mymensingh Med J. 2012. 21:292-9

Exclusion: No comparison group of interest

D. Abe, A. Sato, T. Hoshi, Y. Kakefuda, H. Watabe, E. Ojima, D. Hiraya, T. Harunari, N. Takeyasu and K. Aonuma. Clinical Predictors of Contrast-Induced Acute Kidney Injury in Patients Undergoing Emergency Versus Elective Percutaneous Coronary Intervention. Circ J. 2013. #volume#:#pages#
N. Tan, Y. Liu, J. Y. Chen, Y. L. Zhou, X. Li, L. W. Li, D. Q. Yu, Z. J. Chen, X. Q. Liu and S. J. Huang. Use of the contrast volume or grams of iodine-to-creatinine clearance ratio to predict mortality after percutaneous coronary intervention. Am Heart J. 2013. 165:600-8
P. Burchardt, P. Guzik, P. Tabaczewski, T. Synowiec, M. Bogdan, P. Faner, A. Chmielarz-Sobocinska and A. Palasz. Early renal dysfunction after contrast media administration despite prophylactic hydration. Int J Cardiovasc Imaging. 2013. 29:959-66
S. Raposeiras-Roubin, E. Abu-Assi, R. Ocaranza-Sanchez, B. Alvarez-Alvarez, C. Cambeiro-Gonzalez, R. Fandino-Vaquero, A. Garcia-

Castelo, J. M. Garcia-Acuna and J. R. Gonzalez-Juanatey. Dosing of iodinated contrast volume: A new simple algorithm to stratify the risk of contrast-induced nephropathy in patients with acute coronary syndrome: A New Simple Algorithm to Stratify the Risk of Contrast-Induced Nephropathy in Patients With Acute Coronary Syndrome. Catheter Cardiovasc Interv. 2013. #volume#:#pages#

S. Morabito, V. Pistolesi, G. Benedetti, A. Di Roma, R. Colantonio, M. Mancone, G. Sardella, L. Cibelli, M. Ambrosino, F. Polistena and A. Pierucci. Incidence of contrast-induced acute kidney injury associated with diagnostic or interventional coronary angiography. J Nephrol. 2012. 25:1098-107

Y. Kanei, K. Ayabe, J. Ratcliffe, L. Vales, N. Nakra, P. Friedman and J. Fox. The impact of iso-osmolar contrast use in emergent percutaneous coronary intervention for ST-segment elevation myocardial infarction. J Invasive Cardiol. 2011. 23:448-50

H. S. Gurm, S. R. Dixon, D. E. Smith, D. Share, T. Lalonde, A. Greenbaum and M. Moscucci. Renal function-based contrast dosing to define safe limits of radiographic contrast media in patients undergoing percutaneous coronary interventions. J Am Coll Cardiol. 2011. 58:907-14

H. J. Yoon and S. H. Hur. Determination of safe contrast media dosage to estimated glomerular filtration rate ratios to avoid contrast-induced nephropathy after elective percutaneous coronary intervention. Korean Circ J. 2011. 41:265-71

X. C. Wang, X. H. Fu, Y. B. Wang, X. W. Jia, W. L. Wu, X. S. Gu, J. Zhang, J. L. Su, G. Z. Hao, Y. F. Jiang, W. Z. Fan and S. Q. Li. Prediction of contrast-induced nephropathy in diabetics undergoing elective percutaneous coronary intervention: role of the ratio of contrast medium volume to estimated glomerular filtration rate. Chin Med J (Engl). 2011. 124:892-6

Y. Liu, N. Tan, Y. L. Zhou, P. C. He, J. F. Luo and J. Y. Chen. The contrast medium volume to estimated glomerular filtration rate ratio as a predictor of contrast-induced nephropathy after primary percutaneous coronary intervention. Int Urol Nephrol. 2012. 44:221-9

F. Ribichini, M. Graziani, G. Gambaro, P. Pasoli, M. Pighi, G. Pesarini, C. Abaterusso, T. Yabarek, S. Brunelleschi, P. Rizzotti, A. Lupo and C. Vassanelli. Early creatinine shifts predict contrast-induced nephropathy and persistent renal damage after angiography. Am J Med. 2010. 123:755-63

H. Trivedi and W. D. Foley. Contrast-induced nephropathy after a second contrast exposure. Ren Fail. 2010. 32:796-801

J. R. Brown, J. F. Robb, C. A. Block, A. C. Schoolwerth, A. V. Kaplan, G. T. O'Connor, R. J. Solomon and D. J. Malenka. Does safe dosing of iodinated contrast prevent contrast-induced acute kidney injury?. Circ Cardiovasc Interv. 2010. 3:346-50

S. Worasuwannarak and S. Pornratanarangsi. Prediction of contrast-induced nephropathy in diabetic patients undergoing elective cardiac catheterization or PCI: role of volume-to-creatinine clearance ratio and iodine dose-to-creatinine clearance ratio. J Med Assoc Thai. 2010. 93 Suppl 1:S29-34

E. A. McGillicuddy, K. M. Schuster, L. J. Kaplan, A. A. Maung, F. Y. Lui, L. L. Maerz, D. C. Johnson and K. A. Davis. Contrast-induced nephropathy in elderly trauma patients. J Trauma. 2010. 68:294-7

S. M. Kim, R. H. Cha, J. P. Lee, D. K. Kim, K. H. Oh, K. W. Joo, C. S. Lim, S. Kim and Y. S. Kim. Incidence and outcomes of contrast-induced nephropathy after computed tomography in patients with CKD: a quality improvement report. Am J Kidney Dis. 2010. 55:1018-25

D. Kiski, W. Stepper, E. Brand, G. Breithardt and H. Reinecke. Impact of renin-angiotensin-aldosterone blockade by angiotensin-converting enzyme inhibitors or AT-1 blockers on frequency of contrast medium-induced nephropathy: a post-hoc analysis from the Dialysis-versus-Diuresis (DVD) trial. Nephrol Dial Transplant. 2010. 25:759-64

M. Shamkhalova, N. V. Zaitseva, K. O. Kurumova, M. V. Shestakova, A. D. Deev, S. T. Matskeplishvili, E. F. Tugeeva and I. Buziashvili Iu. [Contrast-induced nephropathy in coronarography of patients with type 2 diabetes mellitus: risk factors, prognostic significance, prophylactic approaches]. Ter Arkh. 2009. 81:36-42

T. Nozue, I. Michishita, T. Iwaki, I. Mizuguchi and M. Miura. Contrast medium volume to estimated glomerular filtration rate ratio as a predictor of contrast-induced nephropathy developing after elective percutaneous coronary intervention. J Cardiol. 2009. 54:214-20

E. Chong, K. K. Poh, L. Shen, P. Chai and H. C. Tan. Diabetic patients with normal baseline renal function are at increased risk of developing contrast-induced nephropathy post-percutaneous coronary intervention. Singapore Med J. 2009. 50:250-4

A. M. From, B. J. Bartholmai, A. W. Williams, S. S. Cha and F. S. McDonald. Mortality associated with nephropathy after radiographic contrast exposure. Mayo Clin Proc. 2008. 83:1095-100

G. La Manna, L. Pancaldi, V. Dalmastri, V. Cuna, A. Capecchi, G. Comai, E. Persici, G. Bacchi, G. Cianciolo, A. Lombardi, C. Marrozzini, L. Coli and S. Stefoni. Post-coronarography application of continuous veno-venous hemofiltration in the prevention of contrast nephropathy in patients with complex multisystem deficiency. In Vivo. 2008. 22:123-9

W. Huber, B. Jeschke, M. Page, W. Weiss, H. Salmhofer, U. Schweigart, K. Ilgmann, J. Reichenberger, B. Neu and M. Classen. Reduced incidence of radiocontrast-induced nephropathy in ICU patients under theophylline prophylaxis: a prospective comparison to series of patients at similar risk. Intensive Care Med. 2001. 27:1200-9

H. Madyoon, L. Croushore, D. Weaver and V. Mathur. Use of fenoldopam to prevent radiocontrast nephropathy in high-risk patients. Catheter Cardiovasc Interv. 2001. 53:341-5

R. Mikkonen, T. Kontkanen and L. Kivisaari. Acute and late adverse reactions to low-osmolal contrast media. Acta Radiol. 1995. 36:72-6

C. J. Davidson, M. Hlatky, K. G. Morris, K. Pieper, T. N. Skelton, S. J. Schwab and T. M. Bashore. Cardiovascular and renal toxicity of a nonionic radiographic contrast agent after cardiac catheterization. A prospective trial. Ann Intern Med. 1989. 110:119-24

W. K. Laskey, C. Jenkins, F. Selzer, O. C. Marroquin, R. L. Wilensky, R. Glaser, H. A. Cohen and D. R. Holmes Jr. Volume-to-Creatinine Clearance Ratio. A Pharmacokinetically Based Risk Factor for Prediction of Early Creatinine Increase After Percutaneous Coronary Intervention. Journal of the American College of Cardiology. 2007. 50:584-590

D. Drobnie-Kovac, A. Cerne, I. Kranjec and M. Globokar-Zajec. Effects of nonionic radiographic contrast media on renal function after cardiac catheterisation. Radiology and Oncology. 1996. 30:95-99

R. E. Katholi, G. J. Taylor, W. T. Woods, K. A. Womack, C. R. Katholi, W. P. McCann, H. W. Moses, J. T. Dove, F. L. Mikell, R. C. Woodruff, B. D. Miller and J. A. Schneider. Nephrotoxicity of nonionic low-osmolality versus ionic high-osmolality contrast media: A prospective double-blind randomized comparison in human beings. Radiology. 1993. 186:183-187

D. Conen, G. Buerkle, A. P. Perruchoud, H. J. Buettner and C. Mueller. Hypertension is an independent risk factor for contrast nephropathy after percutaneous coronary intervention. #journal#. 2006. #volume#:237-41

Exclusion: No intervention of interest

M. M. Rahman, S. S. Haque, B. Rokeya, M. A. Siddique, S. K. Banerjee, S. A. Ahsan, F. Rahman, M. Mahmood, K. Ahmed, M. M. Bhuiyan, A. I. Joarder and R. C. Debnath. Trimetazidine in the prevention of contrast induced nephropathy after coronary angiogram. Mymensingh Med J. 2012. 21:292-9

R. H. Xu, G. Z. Ma, Z. X. Cai, P. Chen, Z. D. Zhu and W. L. Wang. Combined use of hydration and alprostadil for preventing contrast-induced nephropathy following percutaneous coronary intervention in elderly patients. Exp Ther Med. 2013. 6:863-867

D. Abe, A. Sato, T. Hoshi, Y. Kakefuda, H. Watabe, E. Ojima, D. Hiraya, T. Harunari, N. Takeyasu and K. Aonuma. Clinical Predictors of Contrast-Induced Acute Kidney Injury in Patients Undergoing Emergency Versus Elective Percutaneous Coronary Intervention. Circ J. 2013. #volume#:#pages#

D. Capodanno, M. Ministeri, S. Cumbo, V. Dalessandro and C. Tamburino. Volume-to-creatinine clearance ratio in patients undergoing coronary angiography with or without percutaneous coronary intervention: Implications of varying definitions of contrast-induced nephropathy. Catheter Cardiovasc Interv. 2013. #volume#:#pages#

M. Yamamoto, K. Hayashida, G. Mouillet, B. Chevalier, K. Meguro, Y. Watanabe, J. L. Dubois-Rande, M. C. Morice, T. Lefevre and E. Teiger. Renal function-based contrast dosing predicts acute kidney injury following transcatheter aortic valve implantation. JACC Cardiovasc Interv. 2013. 6:479-86

D. Markota, I. Markota, B. Starcevic, M. Tomic, Z. Prskalo and I. Brizic. Prevention of contrast-induced nephropathy with Na/K citrate. Eur Heart J. 2013. 34:2362-7

D. Markota, I. Markota, B. Starcevic, M. Tomic, Z. Prskalo and I. Brizic. Prevention of contrast-induced nephropathy with Na/K citrate. Eur Heart J. 2013. 34:2362-7

W. Geng, X. H. Fu, X. S. Gu, Y. B. Wang, X. C. Wang, W. Li, Y. F. Jiang, G. Z. Hao, W. Z. Fan and L. Xue. Preventive effects of anisodamine

against contrast-induced nephropathy in type 2 diabetics with renal insufficiency undergoing coronary angiography or angioplasty. Chin Med J (Engl). 2012. 125:3368-72

W. Geng, X. H. Fu, X. S. Gu, Y. B. Wang, X. C. Wang, W. Li, Y. F. Jiang, G. Z. Hao, W. Z. Fan and L. Xue. Preventive effects of anisodamine against contrast-induced nephropathy in type 2 diabetics with renal insufficiency undergoing coronary angiography or angioplasty. Chin Med J (Engl). 2012. 125:3368-72

Y. B. Wang, X. H. Fu, X. S. Gu, X. C. Wang, Y. J. Zhao, G. Z. Hao, Y. F. Jiang, W. Z. Fan, W. L. Wu, S. Q. Li and L. Xue. Safety and efficacy of anisodamine on prevention of contrast induced nephropathy in patients with acute coronary syndrome. Chin Med J (Engl). 2012. 125:1063-7

Y. B. Wang, X. H. Fu, X. S. Gu, X. C. Wang, Y. J. Zhao, G. Z. Hao, Y. F. Jiang, W. Z. Fan, W. L. Wu, S. Q. Li and L. Xue. Safety and efficacy of anisodamine on prevention of contrast induced nephropathy in patients with acute coronary syndrome. Chin Med J (Engl). 2012. 125:1063-7

T. M. Kitzler, A. Jaberi, G. Sendlhofer, P. Rehak, C. Binder, E. Petnehazy, R. Stacher and P. Kotanko. Efficacy of vitamin E and N-acetylcysteine in the prevention of contrast induced kidney injury in patients with chronic kidney disease: a double blind, randomized controlled trial. Wien Klin Wochenschr. 2012. 124:312-9

X. C. Wang, X. H. Fu, Y. B. Wang, X. W. Jia, W. L. Wu, X. S. Gu, J. Zhang, J. L. Su, G. Z. Hao, Y. F. Jiang, W. Z. Fan and S. Q. Li. Prediction of contrast-induced nephropathy in diabetics undergoing elective percutaneous coronary intervention: role of the ratio of contrast medium volume to estimated glomerular filtration rate. Chin Med J (Engl). 2011. 124:892-6

Y. Liu, N. Tan, Y. L. Zhou, P. C. He, J. F. Luo and J. Y. Chen. The contrast medium volume to estimated glomerular filtration rate ratio as a predictor of contrast-induced nephropathy after primary percutaneous coronary intervention. Int Urol Nephrol. 2012. 44:221-9

T. Saitoh, H. Satoh, M. Nobuhara, M. Machii, T. Tanaka, H. Ohtani, M. Saotome, T. Urushida, H. Katoh and H. Hayashi. Intravenous glutathione prevents renal oxidative stress after coronary angiography more effectively than oral N-acetylcysteine. Heart Vessels. 2011. 26:465-72

T. Saitoh, H. Satoh, M. Nobuhara, M. Machii, T. Tanaka, H. Ohtani, M. Saotome, T. Urushida, H. Katoh and H. Hayashi. Intravenous glutathione prevents renal oxidative stress after coronary angiography more effectively than oral N-acetylcysteine. Heart Vessels. 2011. 26:465-72

H. Trivedi and W. D. Foley. Contrast-induced nephropathy after a second contrast exposure. Ren Fail. 2010. 32:796-801

S. Yoshida, H. Kamihata, S. Nakamura, T. Senoo, K. Manabe, M. Motohiro, T. Sugiura and T. Iwasaka. Prevention of contrast-induced nephropathy by chronic pravastatin treatment in patients with cardiovascular disease and renal insufficiency. J Cardiol. 2009. 54:192-8

S. Yoshida, H. Kamihata, S. Nakamura, T. Senoo, K. Manabe, M. Motohiro, T. Sugiura and T. Iwasaka. Prevention of contrast-induced nephropathy by chronic pravastatin treatment in patients with cardiovascular disease and renal insufficiency. J Cardiol. 2009. 54:192-8

E. Chong, K. K. Poh, L. Shen, P. Chai and H. C. Tan. Diabetic patients with normal baseline renal function are at increased risk of developing contrast-induced nephropathy post-percutaneous coronary intervention. Singapore Med J. 2009. 50:250-4

S. H. Jo, B. K. Koo, J. S. Park, H. J. Kang, Y. J. Kim, H. L. Kim, I. H. Chae, D. J. Choi, D. W. Sohn, B. H. Oh, Y. B. Park, Y. S. Choi and H. S. Kim. N-acetylcysteine versus AScorbic acid for preventing contrast-Induced nephropathy in patients with renal insufficiency undergoing coronary angiography NASPI study-a prospective randomized controlled trial. Am Heart J. 2009. 157:576-83

A. Bouzas-Mosquera, J. M. Vazquez-Rodriguez, R. Calvino-Santos, N. Vazquez-Gonzalez and A. Castro-Beiras. Statin therapy and contrast-induced nephropathy after primary angioplasty. Int J Cardiol. 2009. 134:430-1

G. Patti, A. Nusca, M. Chello, V. Pasceri, A. D'Ambrosio, G. W. Vetrovec and G. Di Sciascio. Usefulness of statin pretreatment to prevent contrast-induced nephropathy and to improve long-term outcome in patients undergoing percutaneous coronary intervention. Am J Cardiol. 2008. 101:279-85

G. Patti, A. Nusca, M. Chello, V. Pasceri, A. D'Ambrosio, G. W. Vetrovec and G. Di Sciascio. Usefulness of statin pretreatment to prevent contrast-induced nephropathy and to improve long-term outcome in patients undergoing percutaneous coronary intervention. Am J Cardiol. 2008. 101:279-85

M. Haase, A. Haase-Fielitz, S. Ratnaike, M. C. Reade, S. M. Bagshaw, S. Morgera, D. Dragun and R. Bellomo. N-Acetylcysteine does not artifactually lower plasma creatinine

concentration. Nephrol Dial Transplant. 2008. 23:1581-7

B. Cheruvu, K. Henning, J. Mulligan, D. Klippenstein, D. Lawrence, L. Gurtoo and R. H. Gottlieb. Iodixanol: risk of subsequent contrast nephropathy in cancer patients with underlying renal insufficiency undergoing diagnostic computed tomography examinations. J Comput Assist Tomogr. 2007. 31:493-8

L. C. Coyle, A. Rodriguez, R. E. Jeschke, A. Simon-Lee, K. C. Abbott and A. J. Taylor. Acetylcysteine In Diabetes (AID): a randomized study of acetylcysteine for the prevention of contrast nephropathy in diabetics. Am Heart J. 2006. 151:1032 e9-12

L. C. Clavijo, T. L. Pinto, P. K. Kuchulakanti, R. Torguson, W. W. Chu, L. F. Satler, K. M. Kent, W. O. Suddath, R. Waksman and A. D. Pichard. Effect of a rapid intra-arterial infusion of dextrose 5% prior to coronary angiography on frequency of contrast-induced nephropathy in high-risk patients. Am J Cardiol. 2006. 97:981-3

F. Assadi. Acetazolamide for prevention of contrast-induced nephropathy: a new use for an old drug. Pediatr Cardiol. 2006. 27:238-42

D. C. Balderramo, M. B. Verdu, C. F. Ramacciotti, L. S. Cremona, P. A. Lemos, M. Orias and M. Eduardo, Jr.. Renoprotective effect of high periprocedural doses of oral N-acetylcysteine in patients scheduled to undergo a same-day angiography. Rev Fac Cien Med Univ Nac Cordoba. 2004. 61:13-9

S. Khanal, N. Attallah, D. E. Smith, E. Kline-Rogers, D. Share, M. J. O'Donnell and M. Moscucci. Statin therapy reduces contrast-induced nephropathy: an analysis of contemporary percutaneous interventions. Am J Med. 2005. 118:843-9

N. K. Gill, E. A. Piccione, D. A. Vido, B. A. Clark and R. P. Shannon. Gender as a risk factor for contrast nephropathy: effects of hydration and N-acetylcysteine. Clin Cardiol. 2004. 27:554-8

N. K. Gill, E. A. Piccione, D. A. Vido, B. A. Clark and R. P. Shannon. Gender as a risk factor for contrast nephropathy: effects of hydration and N-acetylcysteine. Clin Cardiol. 2004. 27:554-8

B. A. Bartholomew, K. J. Harjai, S. Dukkipati, J. A. Boura, M. W. Yerkey, S. Glazier, C. L. Grines and W. W. O'Neill. Impact of nephropathy after percutaneous coronary intervention and a method for risk stratification. Am J Cardiol. 2004. 93:1515-9

S. D. Weisbord, F. J. Bruns, M. I. Saul and P. M. Palevsky. Provider use of preventive strategies for radiocontrast nephropathy in high-risk patients. Nephron Clin Pract. 2004. 96:c56-62

A. Kapoor, S. Kumar, S. Gulati, S. Gambhir, R. S. Sethi and N. Sinha. The role of theophylline in contrast-induced nephropathy: a case-control study. Nephrol Dial Transplant. 2002. 17:1936-41

A. Kolonko, A. Wiecek and F. Kokot. The nonselective adenosine antagonist theophylline does prevent renal dysfunction induced by radiographic contrast agents. J Nephrol. 1998. 11:151-6

A. Kapoor, N. Sinha, R. K. Sharma, S. Shrivastava, S. Radhakrishnan, P. K. Goel and R. Bajaj. Use of dopamine in prevention of contrast induced acute renal failure--a randomised study. Int J Cardiol. 1996. 53:233-6

L. S. Weisberg, P. B. Kurnik and B. R. Kurnik. Dopamine and renal blood flow in radiocontrast-induced nephropathy in humans. Ren Fail. 1993. 15:61-8

K. G. Harris, T. P. Smith, A. H. Cragg and J. H. Lemke. Nephrotoxicity from contrast material in renal insufficiency: ionic versus nonionic agents. Radiology. 1991. 179:849-52

G. Deray, M. F. Bellin, H. Boulechfar, B. Baumelou, F. Koskas, A. Baumelou, J. Grellet and C. Jacobs. Nephrotoxicity of contrast media in high-risk patients with renal insufficiency: comparison of low- and high-osmolar contrast agents. Am J Nephrol. 1991. 11:309-12

G. Deray, M. F. Bellin, H. Boulechfar, B. Baumelou, F. Koskas, A. Baumelou, J. Grellet and C. Jacobs. Nephrotoxicity of contrast media in high-risk patients with renal insufficiency: comparison of low- and high-osmolar contrast agents. Am J Nephrol. 1991. 11:309-12

R. G. Cigarroa, R. A. Lange, R. H. Williams and L. D. Hillis. Dosing of contrast material to prevent contrast nephropathy in patients with renal disease. Am J Med. 1989. 86:649-52

R. G. Cigarroa, R. A. Lange, R. H. Williams and L. D. Hillis. Dosing of contrast material to prevent contrast nephropathy in patients with renal disease. Am J Med. 1989. 86:649-52

P. S. Parfrey, S. M. Griffiths, B. J. Barrett, M. D. Paul, M. Genge, J. Withers, N. Farid and P. J. McManamon. Contrast material-induced renal failure in patients with diabetes mellitus, renal insufficiency, or both. A prospective controlled study. N Engl J Med. 1989. 320:143-9

C. J. Davidson, M. Hlatky, K. G. Morris, K. Pieper, T. N. Skelton, S. J. Schwab and T. M. Bashore. Cardiovascular and renal toxicity of a nonionic radiographic contrast agent after cardiac catheterization. A prospective trial. Ann Intern Med. 1989. 110:119-24

H. H. Neumayer, W. Junge, A. Kufner and A. Wenning. Prevention of radiocontrast-media-induced nephrotoxicity by the calcium channel blocker nitrendipine: a prospective randomised clinical trial. Nephrol Dial Transplant. 1989. 4:1030-6

C. Donadio, G. Tramonti, R. Giordani, A. Lucchetti, A. Calderazzi, P. Sbragia and C. Bianchi. Glomerular and tubular effects of ionic and nonionic contrast media (diatrizoate and iopamidol). Contrib Nephrol. 1988. 68:212-9

B. C. Cramer, P. S. Parfrey, T. A. Hutchinson, D. Baran, D. M. Melanson, R. E. Ethier and J. F. Seely. Renal function following infusion of radiologic contrast material. A prospective controlled study. Arch Intern Med. 1985. 145:87-9

R. L. Eisenberg, W. O. Bank and M. W. Hedgock. Renal failure after major angiography can be avoided with hydration. AJR Am J Roentgenol. 1981. 136:859-61

R. Metys, A. Hornych, B. Burianova and J. Jirka. Influence of tri-iodinated contrast media on renal function. Nephron. 1971. 8:559-65

R. Metys, A. Hornych, B. Burianova and J. Jirka. Influence of tri-iodinated contrast media on renal function. Nephron. 1971. 8:559-65

Y. Miao, Y. Zhong, H. Yan, W. Li, B. Y. Wang and J. Jin. Alprostadil plays a protective role in contrast-induced nephropathy in the elderly. International Urology and Nephrology. 2013. 45:1179-1185

Y. Miao, Y. Zhong, H. Yan, W. Li, B. Y. Wang and J. Jin. Alprostadil plays a protective role in contrast-induced nephropathy in the elderly. International Urology and Nephrology. 2013. 45:1179-1185

N. Baris, E. Ozpelit, N. Bilgin Dogan, H. Kangul, S. Gul, B. Akdeniz and S. Guneri. The effects of chronic usage of enzyme inhibitors and angiotensin receptor blockers on contrast-induced nephropathy in low-risk patients. Anadolu Kardiyoloji Dergisi. 2013. 13:245-250

M. Habib, A. Hillis and A. Hamad. The role of ascorbic acid or n-acetylcysteine or combination in prevention of contrast-induced nephropathy in high-risk patients with ischemic heart disease. International Journal of Cardiology. 2013. 163:S64

M. A. Albabtain, A. Almasood, H. Alshurafah, H. Alamri and H. Tamim. Efficacy of ascorbic acid, N-acetylcysteine, or combination of both on top of saline hydration versus saline hydration alone on prevention of contrast-induced nephropathy: A prospective randomized study. Journal of Interventional Cardiology. 2013. 26:90-96

M. A. Albabtain, A. Almasood, H. Alshurafah, H. Alamri and H. Tamim. Efficacy of ascorbic acid, N-acetylcysteine, or combination of both on top of saline hydration versus saline hydration alone on prevention of contrast-induced nephropathy: A prospective randomized study. Journal of Interventional Cardiology. 2013. 26:90-96

R. Li and H. Chen. Prevention of contrast-induced nephropathy with ascorbic acid. Heart. 2012. 98:E211

M. M. Sadeghi, M. Gharipour, P. Nilforoush, H. Shamsolkotabi, H. M. Sadeghi, A. Kiani, P. M. Sadeghi and N. Farahmand. Influence of the timing of cardiac catheterization and amount of contrast media on acute renal failure after cardiac surgery. Journal of Research in Medical Sciences. 2011. 16:502-508

H. Uyarel, N. Cam, M. Ergelen, E. Akkaya, E. Ayhan, T. Isik, G. Cicek, Z. Y. Gunaydin, D. Osmonov, M. Gul, D. Demirci, M. R. Guney, R. Ozturk and I. Yekeler. Contrast-induced nephropathy in patients undergoing primary angioplasty for acute myocardial infarction: Incidence, a simple risk score, and prognosis. Archives of Medical Science. 2009. 5:550-558

U. Kim, Y. J. Kim, W. J. Lee, S. H. Lee, G. R. Hong, J. S. Park, D. G. Shin and B. S. Shim. The estimated glomerular filtration rate with using the mayo clinic quadratic equation as a new predictor for developing contrast induced nephropathy in patients with angina pectoris. Korean Circulation Journal. 2008. 38:301-304

K. Spargias, E. Alexopoulos, S. Kyrzopoulos, P. Iacovis, D. C. Greenwood, A. Manginas, V. Voudris, G. Pavlides, C. E. Buller, D. Kremastinos and D. V. Cokkinos. Ascorbic acid prevents contrast-mediated nephropathy in patients with renal dysfunction undergoing coronary angiography or intervention. Circulation. 2004. 110:2837-2842

R. E. Katholi, G. J. Taylor, W. P. McCann, W. T. Woods Jr, K. A. Womack, C. D. McCoy, C. R. Katholi, H. W. Moses, G. J. Mishkel, C. L. Lucore, R. M. Holloway, B. D. Miller, R. C. Woodruff, J. T. Dove, F. L. Mikell and J. A. Schneider. Nephrotoxicity from contrast media: Attenuation with theophylline. Radiology. 1995. 195:17-22

R. E. Katholi, G. J. Taylor, W. T. Woods, K. A. Womack, C. R. Katholi, W. P. McCann, H. W. Moses, J. T. Dove, F. L. Mikell, R. C. Woodruff, B. D. Miller and J. A. Schneider. Nephrotoxicity of nonionic low-osmolality versus ionic high-osmolality contrast media: A prospective double-blind randomized comparison in human beings. Radiology. 1993. 186:183-187

C. P. Taliercio, R. E. Vlietstra, D. M. Ilstrup, J. C. Burnett, K. K. Menke, S. L. Stensrud and D. R. Holmes Jr. A randomized comparison of the nephrotoxicity of iopamidol and diatrizoate in high risk patients undergoing cardiac angiography. Journal of the American College of Cardiology. 1991. 17:384-390

V. Lufft, L. Hoogestraat-Lufft, L. M. Fels, D. Egbeyong-Baiyee, G. Tusch, M. Galanski and C. J. Olbricht. Contrast media nephropathy: intravenous CT angiography versus intraarterial digital subtraction angiography in renal artery stenosis: a prospective randomized trial. #journal#. 2002. #volume#:236-42

D. Conen, G. Buerkle, A. P. Perruchoud, H. J. Buettner and C. Mueller. Hypertension is an independent risk factor for contrast nephropathy after percutaneous coronary intervention. #journal#. 2006. #volume#:237-41

Exclusion: Does not apply to Key Questions (includes studies applicable to Key Questins 1 and 2)

J. L. Rosenstock, E. Gilles, A. B. Geller, G. Panagopoulos, S. Mathew, D. Malieckal, M. V. DeVita and M. F. Michelis. Impact of heart failure on the incidence of contrast-induced nephropathy in patients with chronic kidney disease. Int Urol Nephrol. 2010. 42:1049-54

J. L. Rosenstock, E. Gilles, A. B. Geller, G. Panagopoulos, S. Mathew, D. Malieckal, M. V. DeVita and M. F. Michelis. Impact of heart failure on the incidence of contrast-induced nephropathy in patients with chronic kidney disease. Int Urol Nephrol. 2010. 42:1049-54

D. Kiski, W. Stepper, G. Breithardt and H. Reinecke. Impact of female gender on frequency of contrast medium-induced nephropathy: post hoc analysis of dialysis versus diuresis trial. J Womens Health (Larchmt). 2010. 19:1363-8

M. Haase, A. Haase-Fielitz, S. Ratnaike, M. C. Reade, S. M. Bagshaw, S. Morgera, D. Dragun and R. Bellomo. N-Acetylcysteine does not artifactually lower plasma creatinine concentration. Nephrol Dial Transplant. 2008. 23:1581-7

A. Kapoor, S. Kumar, S. Gulati, S. Gambhir, R. S. Sethi and N. Sinha. The role of theophylline in contrast-induced nephropathy: a case-control study. Nephrol Dial Transplant. 2002. 17:1936-41

A. Kapoor, N. Sinha, R. K. Sharma, S. Shrivastava, S. Radhakrishnan, P. K. Goel and R. Bajaj. Use of dopamine in prevention of contrast induced acute renal failure--a randomised study. Int J Cardiol. 1996. 53:233-6

P. Kjaersgaard, J. A. Jakobsen, J. O. Nossen and K. J. Berg. Determination of glomerular filtration rate with Visipaque in patients with severely reduced renal function. Eur Radiol. 1996. 6:865-71

C. Donadio, G. Tramonti, R. Giordani, A. Lucchetti, A. Calderazzi, P. Sbragia and C. Bianchi. Glomerular and tubular effects of ionic and nonionic contrast media (diatrizoate and iopamidol). Contrib Nephrol. 1988. 68:212-9

N. Baris, E. Ozpelit, N. Bilgin Dogan, H. Kangul, S. Gul, B. Akdeniz and S. Guneri. The effects of chronic usage of enzyme inhibitors and angiotensin receptor blockers on contrast-induced nephropathy in low-risk patients. Anadolu Kardiyoloji Dergisi. 2013. 13:245-250

R. P. Karlsberg, S. Y. Dohad and R. Sheng. Contrast mediuminduced acute kidney injury: Comparison of intravenous and intraarterial administration of iodinated contrast medium. Journal of Vascular and Interventional Radiology. 2011. 22:1159-1165

R. P. Karlsberg, S. Y. Dohad and R. Sheng. Contrast mediuminduced acute kidney injury: Comparison of intravenous and intraarterial administration of iodinated contrast medium. Journal of Vascular and Interventional Radiology. 2011. 22:1159-1165

W. K. Laskey, C. Jenkins, F. Selzer, O. C. Marroquin, R. L. Wilensky, R. Glaser, H. A. Cohen and D. R. Holmes Jr. Volume-to-Creatinine Clearance Ratio. A Pharmacokinetically Based Risk Factor for Prediction of Early Creatinine Increase After Percutaneous Coronary Intervention. Journal of the American College of Cardiology. 2007. 50:584-590

C. P. Taliercio, R. E. Vlietstra, D. M. Ilstrup, J. C. Burnett, K. K. Menke, S. L. Stensrud and D. R. Holmes Jr. A randomized comparison of the nephrotoxicity of iopamidol and diatrizoate in high risk patients undergoing cardiac angiography. Journal of the American College of Cardiology. 1991. 17:384-390

P. Boucek, T. Havrdova, O. Oliyarnyk, J. Skibova, V. Pecenkova, T. Pucelikova and D. Sarkady. Prevention of contrast-induced nephropathy in diabetic patients with impaired renal function: A randomized, double blind trial of sodium bicarbonate versus sodium chloride-based hydration. Diabetes Res Clin Pract. 2013. 101:303-8

M. Brueck, H. Cengiz, R. Hoeltgen, M. Wieczorek, R. H. Boedeker, C. Scheibelhut and A. Boening. Usefulness of N-acetylcysteine or ascorbic acid versus placebo to prevent contrast-induced acute kidney injury in patients undergoing elective cardiac catheterization: a single-center, prospective, randomized, double-blind, placebo-controlled trial. J Invasive Cardiol. 2013. 25:276-83

B. G. Chousterman, L. Bouadma, S. Moutereau, S. Loric, A. Alvarez-Gonzalez, A. Mekontso-Dessap, J. P. Laissy, A. Rahmouni, S. Katsahian, L. Brochard and F. Schortgen. Prevention of contrast-induced nephropathy by N-acetylcysteine in critically ill patients: different definitions, different results. J Crit Care. 2013. 28:701-9

V. Spini, E. Cecchi, M. Chiostri, D. Landi, S. M. Romano, A. Mattesini, G. F. Gensini and C. Giglioli. Effects of two different treatments with continuous renal replacement therapy in patients with chronic renal dysfunction submitted to coronary invasive procedures. J Invasive Cardiol. 2013. 25:80-4

D. G. Kong, Y. F. Hou, L. L. Ma, D. K. Yao and L. X. Wang. Comparison of oral and intravenous hydration strategies for the prevention of contrast-induced nephropathy in patients undergoing coronary angiography or angioplasty: a randomized clinical trial. Acta Cardiol. 2012. 67:565-9

A. M. Leone, A. R. De Caterina, A. Sciahbasi, A. Aurelio, E. Basile, I. Porto, C. Trani, F. Burzotta, G. Niccoli, R. Mongiardo, M. A. Mazzari, A. Buffon, N. Panocchia, E. Romagnoli, E. Lioy, A. G. Rebuzzi and F. Crea. Sodium bicarbonate plus N-acetylcysteine to prevent contrast-induced nephropathy in primary and rescue percutaneous coronary interventions: the BINARIO (BIcarbonato e N-Acetil-cisteina nell'infaRto mIocardico acutO) study. EuroIntervention. 2012. 8:839-47

C. Quintavalle, D. Fiore, F. De Micco, G. Visconti, A. Focaccio, B. Golia, B. Ricciardelli, E. Donnarumma, A. Bianco, M. A. Zabatta, G. Troncone, A. Colombo, C. Briguori and G. Condorelli. Impact of a high loading dose of atorvastatin on contrast-induced acute kidney injury. Circulation. 2012. 126:3008-16

H. Shemirani and M. Pourrmoghaddas. A randomized trial of saline hydration to prevent contrast-induced nephropathy in patients on regular captopril or furosemide therapy undergoing percutaneous coronary intervention. Saudi J Kidney Dis Transpl. 2012. 23:280-5

T. Klima, A. Christ, I. Marana, S. Kalbermatter, H. Uthoff, E. Burri, S. Hartwiger, C. Schindler, T. Breidthardt, G. Marenzi and C. Mueller. Sodium chloride vs. sodium bicarbonate for the prevention of contrast medium-induced nephropathy: a randomized controlled trial. Eur Heart J. 2012. 33:2071-9

H. S. Gurm, D. E. Smith, O. Berwanger, D. Share, T. Schreiber, M. Moscucci and B. K. Nallamothu. Contemporary use and effectiveness of N-acetylcysteine in preventing contrast-induced nephropathy among patients undergoing percutaneous coronary intervention. JACC Cardiovasc Interv. 2012. 5:98-104

M. Maioli, A. Toso, M. Leoncini, C. Micheletti and F. Bellandi. Effects of hydration in contrast-induced acute kidney injury after primary angioplasty: a randomized, controlled trial. Circ Cardiovasc Interv. 2011. 4:456-62

U. Ludwig, M. K. Riedel, M. Backes, A. Imhof, R. Muche and F. Keller. MESNA (sodium 2-mercaptoethanesulfonate) for prevention of contrast medium-induced nephrotoxicity - controlled trial. Clin Nephrol. 2011. 75:302-8

M. Malhis, S. Al-Bitar and K. Al-Deen Zaiat. The role of theophylline in prevention of radiocontrast media-induced nephropathy. Saudi J Kidney Dis Transpl. 2010. 21:276-83

M. Pakfetrat, M. H. Nikoo, L. Malekmakan, M. Tabandeh, J. Roozbeh, M. H. Nasab, M. A. Ostovan, S. Salari, M. Kafi, N. M. Vaziri, F. Adl, M. Hosseini and P. Khajehdehi. A comparison of sodium bicarbonate infusion versus normal saline infusion and its combination with oral acetazolamide for prevention of contrast-induced nephropathy: a randomized, double-blind trial. Int Urol Nephrol. 2009. 41:629-34

S. D. Weisbord, M. K. Mor, A. L. Resnick, K. C. Hartwig, A. F. Sonel, M. J. Fine and P. M. Palevsky. Prevention, incidence, and outcomes of contrast-induced acute kidney injury. Arch Intern Med. 2008. 168:1325-32

S. H. Jo, B. K. Koo, J. S. Park, H. J. Kang, Y. S. Cho, Y. J. Kim, T. J. Youn, W. Y. Chung, I. H. Chae, D. J. Choi, D. W. Sohn, B. H. Oh, Y. B. Park, Y. S. Choi and H. S. Kim. Prevention of radiocontrast medium-induced nephropathy using short-term high-dose simvastatin in patients with renal insufficiency undergoing coronary angiography (PROMISS) trial--a randomized controlled study. Am Heart J. 2008. 155:499 e1-8

A. M. From, B. J. Bartholmai, A. W. Williams, S. S. Cha, A. Pflueger and F. S. McDonald. Sodium bicarbonate is associated with an increased

incidence of contrast nephropathy: a retrospective cohort study of 7977 patients at mayo clinic. Clin J Am Soc Nephrol. 2008. 3:10-8

P. T. Lee, K. J. Chou, C. P. Liu, G. Y. Mar, C. L. Chen, C. Y. Hsu, H. C. Fang and H. M. Chung. Renal protection for coronary angiography in advanced renal failure patients by prophylactic hemodialysis. A randomized controlled trial. J Am Coll Cardiol. 2007. 50:1015-20

P. A. Poletti, P. Saudan, A. Platon, B. Mermillod, A. M. Sautter, B. Vermeulen, F. P. Sarasin, C. D. Becker and P. Y. Martin. I.v. N-acetylcysteine and emergency CT: use of serum creatinine and cystatin C as markers of radiocontrast nephrotoxicity. AJR Am J Roentgenol. 2007. 189:687-92

C. Briguori, F. Airoldi, D. D'Andrea, E. Bonizzoni, N. Morici, A. Focaccio, I. Michev, M. Montorfano, M. Carlino, J. Cosgrave, B. Ricciardelli and A. Colombo. Renal Insufficiency Following Contrast Media Administration Trial (REMEDIAL): a randomized comparison of 3 preventive strategies. Circulation. 2007. 115:1211-7

W. Huber, F. Eckel, M. Hennig, H. Rosenbrock, A. Wacker, D. Saur, A. Sennefelder, R. Hennico, C. Schenk, A. Meining, R. Schmelz, R. Fritsch, W. Weiss, P. Hamar, U. Heemann and R. M. Schmid. Prophylaxis of contrast material-induced nephropathy in patients in intensive care: acetylcysteine, theophylline, or both? A randomized study. Radiology. 2006. 239:793-804

B. Dussol, S. Morange, A. Loundoun, P. Auquier and Y. Berland. A randomized trial of saline hydration to prevent contrast nephropathy in chronic renal failure patients. Nephrol Dial Transplant. 2006. 21:2120-6

O. Gulel, T. Keles, H. Eraslan, S. Aydogdu, E. Diker and V. Ulusoy. Prophylactic acetylcysteine usage for prevention of contrast nephropathy after coronary angiography. J Cardiovasc Pharmacol. 2005. 46:464-7

B. D. Bader, E. D. Berger, M. B. Heede, I. Silberbaur, S. Duda, T. Risler and C. M. Erley. What is the best hydration regimen to prevent contrast media-induced nephrotoxicity?. Clin Nephrol. 2004. 62:1-7

J. W. Fung, C. C. Szeto, W. W. Chan, L. C. Kum, A. K. Chan, J. T. Wong, E. B. Wu, G. W. Yip, J. Y. Chan, C. M. Yu, K. S. Woo and J. E. Sanderson. Effect of N-acetylcysteine for prevention of contrast nephropathy in patients with moderate to severe renal insufficiency: a randomized trial. Am J Kidney Dis. 2004. 43:801-8

R. A. Krasuski, B. M. Beard, J. D. Geoghagan, C. M. Thompson and S. A. Guidera. Optimal timing of hydration to erase contrast-associated nephropathy: the OTHER CAN study. J Invasive Cardiol. 2003. 15:699-702

F. Boccalandro, M. Amhad, R. W. Smalling and S. Sdringola. Oral acetylcysteine does not protect renal function from moderate to high doses of intravenous radiographic contrast. Catheter Cardiovasc Interv. 2003. 58:336-41

W. Huber, K. Ilgmann, M. Page, M. Hennig, U. Schweigart, B. Jeschke, L. Lutilsky, W. Weiss, H. Salmhofer and M. Classen. Effect of theophylline on contrast material-nephropathy in patients with chronic renal insufficiency: controlled, randomized, double-blinded study. Radiology. 2002. 223:772-9

B. Vogt, P. Ferrari, C. Schonholzer, H. P. Marti, M. Mohaupt, M. Wiederkehr, C. Cereghetti, A. Serra, U. Huynh-Do, D. Uehlinger and F. J. Frey. Prophylactic hemodialysis after radiocontrast media in patients with renal insufficiency is potentially harmful. Am J Med. 2001. 111:692-8

C. M. Erley, S. H. Duda, D. Rehfuss, B. Scholtes, J. Bock, C. Muller, H. Osswald and T. Risler. Prevention of radiocontrast-media-induced nephropathy in patients with pre-existing renal insufficiency by hydration in combination with the adenosine antagonist theophylline. Nephrol Dial Transplant. 1999. 14:1146-9

K. A. Hall, R. W. Wong, G. C. Hunter, B. M. Camazine, W. A. Rappaport, S. H. Smyth, D. A. Bull, K. E. McIntyre, V. M. Bernhard and R. L. Misiorowski. Contrast-induced nephrotoxicity: the effects of vasodilator therapy. J Surg Res. 1992. 53:317-20

J. M. Weinstein, S. Heyman and M. Brezis. Potential deleterious effect of furosemide in radiocontrast nephropathy. Nephron. 1992. 62:413-5

B. G. Chousterman, L. Bouadma, S. Loric, A. Alvarez-Gonzalez, A. Mekontso-Dessap, J. P. Laissy, A. Rahmouni, L. Brochard and F. Schortgen. Prevention of contrast induced nephropathy (CIN) by N-acetylcystein (NAC) : Different definitions, Different results. Intensive Care Medicine. 2011. 37:S49

M. Demir, A. Kutlucan, H. Akin, O. Aydin and M. T. Sezer. Comparison of different agents on radiographic contrast agent induced nephropathy. European Journal of General Medicine. 2008. 5:222-227

G. Sterner, B. Frennby, J. Kurkus and U. Nyman. Does post-angiographic hemodialysis reduce the risk of contrast-medium nephropathy?. #journal#. 2000. #volume#:323-6

T. F. Hsu, M. K. Huang, S. H. Yu, D. H. Yen, W. F. Kao, Y. C. Chen and M. S. Huang. N-acetylcysteine for the prevention of contrast-induced nephropathy in the emergency department. Intern Med. 2012. 51:2709-14

K. E. Burns, F. Priestap and C. Martin. N-acetylcysteine in critically ill patients undergoing contrast-enhanced computed tomography: a randomized trial. Clin Nephrol. 2010. 74:323-6

F. Sar, T. Saler, A. Ecebay, Z. A. Saglam, S. Ozturk and R. Kazancioglu. The efficacy of n-acetylcysteine in preventing contrast-induced nephropathy in type 2 diabetic patients without nephropathy. J Nephrol. 2010. 23:478-82

M. Tepel, M. van der Giet, C. Schwarzfeld, U. Laufer, D. Liermann and W. Zidek. Prevention of radiographic-contrast-agent-induced reductions in renal function by acetylcysteine. N Engl J Med. 2000. 343:180-4

H. Khalili, S. Dashti-Khavidaki, H. Tabifar, N. Ahmadinejad and F. Ahmadi. N-acetylcysteine in the prevention of contrast agent-induced nephrotoxicity in patients undergoing computed tomography studies. Therapy. 2006. 3:773-777

Y. Han, G. Zhu, L. Han, F. Hou, W. Huang, H. Liu, J. Gan, T. Jiang, X. Li, W. Wang, S. Ding, S. Jia, W. Shen, D. Wang, L. Sun, J. Qiu, X. Wang, Y. Li, J. Deng, J. Li, K. Xu, B. Xu, R. Mehran and Y. Huo. Short-Term Rosuvastatin Therapy for Prevention of Contrast-Induced Acute Kidney Injury in Patients with Diabetes and Chronic Kidney Disease. J Am Coll Cardiol. 2013. #volume#:#pages#

N. Alessandri, L. Lanzi, C. M. Garante, F. Tersigni, R. Sergiacomi, M. Petrassi, A. Di Matteo and F. Tufano. Prevention of acute renal failure post-contrast imaging in cardiology: a randomized study. Eur Rev Med Pharmacol Sci. 2013. 17 Suppl 1:13-21

N. Oguzhan, H. Cilan, M. Sipahioglu, A. Unal, I. Kocyigit, F. Kavuncuoglu, T. Arikan, M. Akpek, D. Elcik, O. Sahin, E. Gulme, C. Pala, B. Tokgoz, C. Utas, A. Oguzhan and O. Oymak. The lack of benefit of a combination of an angiotensin receptor blocker and calcium channel blocker on contrast-induced nephropathy in patients with chronic kidney disease. Ren Fail. 2013. 35:434-9

V. O. Gomes, R. Lasevitch, V. C. Lima, F. S. Brito, Jr., J. C. Perez-Alva, B. Moulin, A. Arruda, D. Oliveira and P. Caramori. Hydration with sodium bicarbonate does not prevent contrast nephropathy: a multicenter clinical trial. Arq Bras Cardiol. 2012. 99:1129-34

R. M. Heguilen, A. A. Liste, M. Payaslian, M. G. Ortemberg, L. M. Albarracin and A. R. Bernasconi. N-acethyl-cysteine reduces the occurrence of contrast-induced acute kidney injury in patients with renal dysfunction: a single-center randomized controlled trial. Clin Exp Nephrol. 2013. 17:396-404

Y. Chen, S. Hu, Y. Liu, R. Zhao, L. Wang, G. Fu, Q. He, X. Su, Y. Zheng, X. Qi, H. Liu, J. Wang, W. Gao, M. Wang, S. Liu, X. Zheng, B. He, P. Yang, S. Zhou, C. Gao and C. Qiu. Renal tolerability of iopromide and iodixanol in 562 renally impaired patients undergoing cardiac catheterisation: the DIRECT study. EuroIntervention. 2012. 8:830-8

N. Tamai, S. Ito, K. Nakasuka, K. Morimoto, K. Miyata, M. Inomata, T. Yoshida, S. Suzuki, Y. Murakami and K. Sato. Sodium bicarbonate for the prevention of contrast-induced nephropathy: the efficacy of high concentration solution. J Invasive Cardiol. 2012. 24:439-42

W. Li, X. Fu, Y. Wang, X. Li, Z. Yang, X. Wang, W. Geng, X. Gu, G. Hao, Y. Jiang, W. Fan, W. Wu and S. Li. Beneficial effects of high-dose atorvastatin pretreatment on renal function in patients with acute ST-segment elevation myocardial infarction undergoing emergency percutaneous coronary intervention. Cardiology. 2012. 122:195-202

M. Y. Rim, H. Ro, W. C. Kang, A. J. Kim, H. Park, J. H. Chang, H. H. Lee, W. Chung and J. Y. Jung. The effect of renin-angiotensin-aldosterone system blockade on contrast-induced acute kidney injury: a propensity-matched study. Am J Kidney Dis. 2012. 60:576-82

M. E. Bilasy, M. A. Oraby, H. M. Ismail and F. A. Maklady. Effectiveness of theophylline in preventing contrast-induced nephropathy after coronary angiographic procedures. J Interv Cardiol. 2012. 25:404-10

S. Talati, A. J. Kirtane, A. Hassanin, R. Mehran, M. B. Leon, J. W. Moses and G. Weisz. Direct infusion of fenoldopam into the renal arteries to protect against contrast-induced nephropathy in patients at increased risk. Clin Exp Pharmacol Physiol. 2012. 39:506-9

E. Aslanger, B. Uslu, C. Akdeniz, N. Polat, Y. Cizgici and H. Oflaz. Intrarenal application of N-acetylcysteine for the prevention of contrast medium-induced nephropathy in primary angioplasty. Coron Artery Dis. 2012. 23:265-70

L. Yin, G. Li, T. Liu, R. Yuan, X. Zheng, G. Xu, Y. Xu, J. Che, X. Liu, X. Ma, F. Li, E. Liu, X. Chen, L. Wu, Z. Fan, Y. Ruan, M. He and Y. Li. Probucol for the prevention of cystatin C-based contrast-induced acute kidney injury following primary or urgent angioplasty: a randomized, controlled trial. Int J Cardiol. 2013. 167:426-9

O. Gunebakmaz, M. G. Kaya, F. Koc, M. Akpek, A. Kasapkara, M. T. Inanc, M. Yarlioglues, B. Calapkorur, Z. Karadag and A. Oguzhan. Does nebivolol prevent contrast-induced nephropathy in humans?. Clin Cardiol. 2012. 35:250-4

G. Marenzi, C. Ferrari, I. Marana, E. Assanelli, M. De Metrio, G. Teruzzi, F. Veglia, F. Fabbiocchi, P. Montorsi and A. L. Bartorelli. Prevention of contrast nephropathy by furosemide with matched hydration: the MYTHOS (Induced Diuresis With Matched Hydration Compared to Standard Hydration for Contrast Induced Nephropathy Prevention) trial. JACC Cardiovasc Interv. 2012. 5:90-7

E. Alioglu, S. Saygi, U. Turk, B. Kirilmaz, N. Tuzun, C. Duman, I. Tengiz, S. Yildiz and E. Ercan. N-acetylcysteine in preventing contrast-induced nephropathy assessed by cystatin C. Cardiovasc Ther. 2013. 31:168-73

X. M. Li, H. L. Cong, T. T. Li, L. J. He and Y. J. Zhou. Impact of benazepril on contrast-induced acute kidney injury for patients with mild to moderate renal insufficiency undergoing percutaneous coronary intervention. Chin Med J (Engl). 2011. 124:2101-6

A. Firouzi, A. Eshraghi, F. Shakerian, H. R. Sanati, N. Salehi, A. Zahedmehr, R. Kiani, M. Madani and A. Pedarzadeh. Efficacy of pentoxifylline in prevention of contrast-induced nephropathy in angioplasty patients. Int Urol Nephrol. 2012. 44:1145-9

J. R. Rey, D. Iglesias, E. Lopez De Sa, E. Armada, R. Moreno, O. Salvador, C. Monedero Mdel, S. G. Blas, A. M. Iniesta and J. L. Lopez-Sendon. Prevention of contrast-induced nephropathy with haemofiltration in high-risk patients after percutaneous coronary intervention. Acute Card Care. 2011. 13:164-9

. Acetylcysteine for prevention of renal outcomes in patients undergoing coronary and peripheral vascular angiography: main results from the randomized Acetylcysteine for Contrast-induced nephropathy Trial (ACT). Circulation. 2011. 124:1250-9

C. Briguori, G. Visconti, A. Focaccio, F. Airoldi, M. Valgimigli, G. M. Sangiorgi, B. Golia, B. Ricciardelli and G. Condorelli. Renal Insufficiency After Contrast Media Administration Trial II (REMEDIAL II): RenalGuard System in high-risk patients for contrast-induced acute kidney injury. Circulation. 2011. 124:1260-9

Z. Jaffery, A. Verma, C. J. White, A. G. Grant, T. J. Collins, M. A. Grise, J. S. Jenkins, P. W. McMullan, R. A. Patel, J. P. Reilly, S. N. Thornton and S. R. Ramee. A randomized trial of intravenous n-acetylcysteine to prevent contrast induced nephropathy in acute coronary syndromes. Catheter Cardiovasc Interv. 2012. 79:921-6

A. M. Hafiz, M. F. Jan, N. Mori, F. Shaikh, J. Wallach, T. Bajwa and S. Allaqaband. Prevention of contrast-induced acute kidney injury in patients with stable chronic renal disease undergoing elective percutaneous coronary and peripheral interventions: randomized comparison of two preventive strategies. Catheter Cardiovasc Interv. 2012. 79:929-37

G. Patti, E. Ricottini, A. Nusca, G. Colonna, V. Pasceri, A. D'Ambrosio, A. Montinaro and G. Di Sciascio. Short-term, high-dose Atorvastatin pretreatment to prevent contrast-induced nephropathy in patients with acute coronary syndromes undergoing percutaneous coronary intervention (from the ARMYDA-CIN [atorvastatin for reduction of myocardial damage during angioplasty--contrast-induced nephropathy] trial. Am J Cardiol. 2011. 108:1-7

A. Awal, S. A. Ahsan, M. A. Siddique, S. Banerjee, M. I. Hasan, S. M. Zaman, J. Arzu and B. Subedi. Effect of hydration with or without n-acetylcysteine on contrast induced nephropathy in patients undergoing coronary angiography and percutaneous coronary intervention. Mymensingh Med J. 2011. 20:264-9

A. Tanaka, Y. Suzuki, N. Suzuki, T. Hirai, N. Yasuda, K. Miki, M. Fujita and T. Tanaka. Does N-acetylcysteine reduce the incidence of contrast-induced nephropathy and clinical events in patients undergoing primary angioplasty for acute myocardial infarction?. Intern Med. 2011. 50:673-7

S. W. Lee, W. J. Kim, Y. H. Kim, S. W. Park, D. W. Park, S. C. Yun, J. Y. Lee, S. J. Kang, C. W. Lee, J. H. Lee, S. W. Choi, I. W. Seong, J. Suh, Y. H. Cho, N. H. Lee, S. S. Cheong, S. Y. Yoo, B. K. Lee, S. G. Lee, M. S. Hyon, W. Y. Shin, J. S. Jang and S. J. Park. Preventive strategies of renal insufficiency in patients with diabetes undergoing intervention or arteriography (the PREVENT Trial). Am J Cardiol. 2011. 107:1447-52

M. Motohiro, H. Kamihata, S. Tsujimoto, T. Seno, K. Manabe, T. Isono, Y. Sutani, F. Yuasa and T. Iwasaka. A new protocol using sodium bicarbonate for the prevention of contrast-induced nephropathy in patients undergoing coronary angiography. Am J Cardiol. 2011. 107:1604-8

H. Ueda, T. Yamada, M. Masuda, Y. Okuyama, T. Morita, Y. Furukawa, T. Koji, Y. Iwasaki, T.

Okada, M. Kawasaki, Y. Kuramoto, T. Naito, T. Fujimoto, I. Komuro and M. Fukunami. Prevention of contrast-induced nephropathy by bolus injection of sodium bicarbonate in patients with chronic kidney disease undergoing emergent coronary procedures. Am J Cardiol. 2011. 107:1163-7

P. Calabro, R. Bianchi, M. Crisci, M. Caprile, M. C. Bigazzi, R. Palmieri, E. Golia, A. De Vita, I. J. Romano, G. Limongelli, M. G. Russo and R. Calabro. Use and efficacy of saline hydration and N-acetyl cysteine to prevent contrast-induced nephropathy in low-risk populations undergoing coronary artery angiography. Intern Emerg Med. 2011. 6:503-7

F. Koc, K. Ozdemir, M. G. Kaya, O. Dogdu, M. A. Vatankulu, S. Ayhan, U. Erkorkmaz, O. Sonmez, M. U. Aygul, N. Kalay, M. Kayrak, T. Karabag, Y. Alihanoglu and O. Gunebakmaz. Intravenous N-acetylcysteine plus high-dose hydration versus high-dose hydration and standard hydration for the prevention of contrast-induced nephropathy: CASIS--a multicenter prospective controlled trial. Int J Cardiol. 2012. 155:418-23

H. Buyukhatipoglu, Y. Sezen, A. Yildiz, M. Bas, I. Kirhan, T. Ulas, M. N. Turan, A. Taskin and N. Aksoy. N-acetylcysteine fails to prevent renal dysfunction and oxidative stress after noniodine contrast media administration during percutaneous coronary interventions. Pol Arch Med Wewn. 2010. 120:383-9

S. Acikel, H. Muderrisoglu, A. Yildirir, A. Aydinalp, E. Sade, N. Bayraktar, U. Bal and B. Ozin. Prevention of contrast-induced impairment of renal function by short-term or long-term statin therapy in patients undergoing elective coronary angiography. Blood Coagul Fibrinolysis. 2010. 21:750-7

M. C. Reed, M. Moscucci, D. E. Smith, D. Share, T. LaLonde, S. A. Mahmood, C. D'Haem, R. McNamara, A. Greenbaum and H. S. Gurm. The relative renal safety of iodixanol and low-osmolar contrast media in patients undergoing percutaneous coronary intervention. Insights from Blue Cross Blue Shield of Michigan Cardiovascular Consortium (BMC2). J Invasive Cardiol. 2010. 22:467-72

J. Matejka, I. Varvarovsky, P. Vojtisek, A. Herman, V. Rozsival, V. Borkova and J. Kvasnicka. Prevention of contrast-induced acute kidney injury by theophylline in elderly patients with chronic kidney disease. Heart Vessels. 2010. 25:536-42

R. Cho, N. Javed, D. Traub, S. Kodali, F. Atem and V. Srinivasan. Oral hydration and alkalinization is noninferior to intravenous therapy for prevention of contrast-induced nephropathy in patients with chronic kidney disease. J Interv Cardiol. 2010. 23:460-6

U. Sadat, S. R. Walsh, A. G. Norden, J. H. Gillard and J. R. Boyle. Does oral N-acetylcysteine reduce contrast-induced renal injury in patients with peripheral arterial disease undergoing peripheral angiography? A randomized-controlled study. Angiology. 2011. 62:225-30

H. Thiele, L. Hildebrand, C. Schirdewahn, I. Eitel, V. Adams, G. Fuernau, S. Erbs, A. Linke, K. W. Diederich, M. Nowak, S. Desch, M. Gutberlet and G. Schuler. Impact of high-dose N-acetylcysteine versus placebo on contrast-induced nephropathy and myocardial reperfusion injury in unselected patients with ST-segment elevation myocardial infarction undergoing primary percutaneous coronary intervention. The LIPSIA-N-ACC (Prospective, Single-Blind, Placebo-Controlled, Randomized Leipzig Immediate PercutaneouS Coronary Intervention Acute Myocardial Infarction N-ACC) Trial. J Am Coll Cardiol. 2010. 55:2201-9

H. Ozhan, I. Erden, S. Ordu, M. Aydin, O. Caglar, C. Basar, S. Yalcin and R. Alemdar. Efficacy of short-term high-dose atorvastatin for prevention of contrast-induced nephropathy in patients undergoing coronary angiography. Angiology. 2010. 61:711-4

T. Kinbara, T. Hayano, N. Ohtani, Y. Furutani, K. Moritani and M. Matsuzaki. Efficacy of N-acetylcysteine and aminophylline in preventing contrast-induced nephropathy. J Cardiol. 2010. 55:174-9

A. Vasheghani-Farahani, G. Sadigh, S. E. Kassaian, S. M. Khatami, A. Fotouhi, S. A. Razavi, M. A. Mansournia, A. Kazemisaeid, A. Soleimani, H. R. Pourhosseini, M. Alidoosti, A. M. Hajizeinali, K. Hoseini and E. Nematipour. Sodium bicarbonate in preventing contrast nephropathy in patients at risk for volume overload: a randomized controlled trial. J Nephrol. 2010. 23:216-23

D. Castini, S. Lucreziotti, L. Bosotti, D. Salerno Uriarte, C. Sponzilli, A. Verzoni and F. Lombardi. Prevention of contrast-induced nephropathy: a single center randomized study. Clin Cardiol. 2010. 33:E63-8

A. Toso, M. Maioli, M. Leoncini, M. Gallopin, D. Tedeschi, C. Micheletti, C. Manzone, M. Amato and F. Bellandi. Usefulness of atorvastatin (80 mg) in prevention of contrast-induced nephropathy in patients with chronic renal disease. Am J Cardiol. 2010. 105:288-92

N. Carbonell, R. Sanjuan, M. Blasco, A. Jorda and A. Miguel. N-acetylcysteine: short-term clinical

benefits after coronary angiography in high-risk renal patients. Rev Esp Cardiol. 2010. 63:12-9

E. Alexopoulos, K. Spargias, S. Kyrzopoulos, A. Manginas, G. Pavlides, V. Voudris, S. Lerakis, D. S. McLean and D. V. Cokkinos. Contrast-induced acute kidney injury in patients with renal dysfunction undergoing a coronary procedure and receiving non-ionic low-osmolar versus iso-osmolar contrast media. Am J Med Sci. 2010. 339:25-30

A. Tamura, Y. Goto, K. Miyamoto, S. Naono, Y. Kawano, M. Kotoku, T. Watanabe and J. Kadota. Efficacy of single-bolus administration of sodium bicarbonate to prevent contrast-induced nephropathy in patients with mild renal insufficiency undergoing an elective coronary procedure. Am J Cardiol. 2009. 104:921-5

L. Shavit, R. Korenfeld, M. Lifschitz, A. Butnaru and I. Slotki. Sodium bicarbonate versus sodium chloride and oral N-acetylcysteine for the prevention of contrast-induced nephropathy in advanced chronic kidney disease. J Interv Cardiol. 2009. 22:556-63

J. Xinwei, F. Xianghua, Z. Jing, G. Xinshun, X. Ling, F. Weize, H. Guozhen, J. Yunfa, W. Weili and L. Shiqiang. Comparison of usefulness of simvastatin 20 mg versus 80 mg in preventing contrast-induced nephropathy in patients with acute coronary syndrome undergoing percutaneous coronary intervention. Am J Cardiol. 2009. 104:519-24

A. Vasheghani-Farahani, G. Sadigh, S. E. Kassaian, S. M. Khatami, A. Fotouhi, S. A. Razavi, M. A. Mansournia, A. Yamini-Sharif, A. Amirzadegan, M. Salarifar, S. Sadeghian, G. Davoodi, M. A. Borumand, F. A. Esfehani and S. Darabian. Sodium bicarbonate plus isotonic saline versus saline for prevention of contrast-induced nephropathy in patients undergoing coronary angiography: a randomized controlled trial. Am J Kidney Dis. 2009. 54:610-8

M. Amini, M. Salarifar, A. Amirbaigloo, F. Masoudkabir and F. Esfahani. N-acetylcysteine does not prevent contrast-induced nephropathy after cardiac catheterization in patients with diabetes mellitus and chronic kidney disease: a randomized clinical trial. Trials. 2009. 10:45

F. Ferrario, M. T. Barone, G. Landoni, A. Genderini, M. Heidemperger, M. Trezzi, E. Piccaluga, P. Danna and D. Scorza. Acetylcysteine and non-ionic isosmolar contrast-induced nephropathy--a randomized controlled study. Nephrol Dial Transplant. 2009. 24:3103-7

M. Baskurt, B. Okcun, O. Abaci, G. M. Dogan, K. Kilickesmez, A. A. Ozkan, M. Ersanli and T. Gurmen. N-acetylcysteine versus N-acetylcysteine + theophylline for the prevention of contrast nephropathy. Eur J Clin Invest. 2009. 39:793-9

P. Budhiraja, Z. Chen and M. Popovtzer. Sodium bicarbonate versus normal saline for protection against contrast nephropathy. Ren Fail. 2009. 31:118-23

G. Li, L. Yin, T. Liu, X. Zheng, G. Xu, Y. Xu, R. Yuan, J. Che, H. Liu, L. Zhou, X. Chen, M. He, Y. Li, L. Wu and E. Liu. Role of probucol in preventing contrast-induced acute kidney injury after coronary interventional procedure. Am J Cardiol. 2009. 103:512-4

A. E. Heng, E. Cellarier, B. Aublet-Cuvelier, V. Decalf, P. Motreff, X. Marcaggi, P. Deteix and B. Souweine. Is treatment with N-acetylcysteine to prevent contrast-induced nephropathy when using bicarbonate hydration out of date?. Clin Nephrol. 2008. 70:475-84

B. Holscher, C. Heitmeyer, M. Fobker, G. Breithardt, R. M. Schaefer and H. Reinecke. Predictors for contrast media-induced nephropathy and long-term survival: prospectively assessed data from the randomized controlled Dialysis-Versus-Diuresis (DVD) trial. Can J Cardiol. 2008. 24:845-50

E. Adolph, B. Holdt-Lehmann, T. Chatterjee, S. Paschka, A. Prott, H. Schneider, T. Koerber, H. Ince, M. Steiner, P. Schuff-Werner and C. A. Nienaber. Renal Insufficiency Following Radiocontrast Exposure Trial (REINFORCE): a randomized comparison of sodium bicarbonate versus sodium chloride hydration for the prevention of contrast-induced nephropathy. Coron Artery Dis. 2008. 19:413-9

B. J. Kim, K. C. Sung, B. S. Kim, J. H. Kang, K. B. Lee, H. Kim and M. H. Lee. Effect of N-acetylcysteine on cystatin C-based renal function after elective coronary angiography (ENABLE Study): a prospective, randomized trial. Int J Cardiol. 2010. 138:239-45

S. S. Brar, A. Y. Shen, M. B. Jorgensen, A. Kotlewski, V. J. Aharonian, N. Desai, M. Ree, A. I. Shah and R. J. Burchette. Sodium bicarbonate vs sodium chloride for the prevention of contrast medium-induced nephropathy in patients undergoing coronary angiography: a randomized trial. JAMA. 2008. 300:1038-46

M. Masuda, T. Yamada, Y. Okuyama, T. Morita, S. Sanada, Y. Furukawa, Y. Tsukamoto, K. Okuda, Y. Iwasaki, T. Yasui and M. Fukunami. Sodium bicarbonate improves long-term clinical outcomes compared with sodium chloride in patients with chronic kidney disease undergoing

an emergent coronary procedure. Circ J. 2008. 72:1610-4

M. Maioli, A. Toso, M. Leoncini, M. Gallopin, D. Tedeschi, C. Micheletti and F. Bellandi. Sodium bicarbonate versus saline for the prevention of contrast-induced nephropathy in patients with renal dysfunction undergoing coronary angiography or intervention. J Am Coll Cardiol. 2008. 52:599-604

J. L. Rosenstock, R. Bruno, J. K. Kim, L. Lubarsky, R. Schaller, G. Panagopoulos, M. V. DeVita and M. F. Michelis. The effect of withdrawal of ACE inhibitors or angiotensin receptor blockers prior to coronary angiography on the incidence of contrast-induced nephropathy. Int Urol Nephrol. 2008. 40:749-55

B. Marron, E. Ruiz, C. Fernandez, P. Almeida, C. Horcajada, F. Navarro and C. Caramelo. [Systemic and renal effects of preventing contrast nephrotoxicity with isotonic (0.9%) and hypotonic (0.45%) saline]. Rev Esp Cardiol. 2007. 60:1018-25

D. K. Lawlor, L. Moist, G. DeRose, K. A. Harris, M. B. Lovell, S. W. Kribs, J. Elliot and T. L. Forbes. Prevention of contrast-induced nephropathy in vascular surgery patients. Ann Vasc Surg. 2007. 21:593-7

M. Masuda, T. Yamada, T. Mine, T. Morita, S. Tamaki, Y. Tsukamoto, K. Okuda, Y. Iwasaki, M. Hori and M. Fukunami. Comparison of usefulness of sodium bicarbonate versus sodium chloride to prevent contrast-induced nephropathy in patients undergoing an emergent coronary procedure. Am J Cardiol. 2007. 100:781-6

E. E. Ozcan, S. Guneri, B. Akdeniz, I. Z. Akyildiz, O. Senaslan, N. Baris, O. Aslan and O. Badak. Sodium bicarbonate, N-acetylcysteine, and saline for prevention of radiocontrast-induced nephropathy. A comparison of 3 regimens for protecting contrast-induced nephropathy in patients undergoing coronary procedures. A single-center prospective controlled trial. Am Heart J. 2007. 154:539-44

S. L. Chen, J. Zhang, F. Yei, Z. Zhu, Z. Liu, S. Lin, J. Chu, J. Yan, R. Zhang and T. W. Kwan. Clinical outcomes of contrast-induced nephropathy in patients undergoing percutaneous coronary intervention: a prospective, multicenter, randomized study to analyze the effect of hydration and acetylcysteine. Int J Cardiol. 2008. 126:407-13

R. A. Seyon, L. A. Jensen, I. A. Ferguson and R. G. Williams. Efficacy of N-acetylcysteine and hydration versus placebo and hydration in decreasing contrast-induced renal dysfunction in patients undergoing coronary angiography with or without concomitant percutaneous coronary intervention. Heart Lung. 2007. 36:195-204

P. Schmidt, D. Pang, D. Nykamp, G. Knowlton and H. Jia. N-acetylcysteine and sodium bicarbonate versus N-acetylcysteine and standard hydration for the prevention of radiocontrast-induced nephropathy following coronary angiography. Ann Pharmacother. 2007. 41:46-50

H. Reinecke, M. Fobker, J. Wellmann, B. Becke, J. Fleiter, C. Heitmeyer, G. Breithardt, H. W. Hense and R. M. Schaefer. A randomized controlled trial comparing hydration therapy to additional hemodialysis or N-acetylcysteine for the prevention of contrast medium-induced nephropathy: the Dialysis-versus-Diuresis (DVD) Trial. Clin Res Cardiol. 2007. 96:130-9

N. Ramesh, R. K. Pillai, T. Abraham, N. P. Padmaja, S. Hameed and G. Vijayaraghavan. Reno-protective effect of N-acetyl cysteine in patients with impaired renal function undergoing coronary angiography and interventions. J Assoc Physicians India. 2006. 54:449-52

N. Carbonell, M. Blasco, R. Sanjuan, E. Perez-Sancho, J. Sanchis, L. Insa, V. Bodi, J. Nunez, R. Garcia-Ramon and A. Miguel. Intravenous N-acetylcysteine for preventing contrast-induced nephropathy: a randomised trial. Int J Cardiol. 2007. 115:57-62

G. Marenzi, E. Assanelli, I. Marana, G. Lauri, J. Campodonico, M. Grazi, M. De Metrio, S. Galli, F. Fabbiocchi, P. Montorsi, F. Veglia and A. L. Bartorelli. N-acetylcysteine and contrast-induced nephropathy in primary angioplasty. N Engl J Med. 2006. 354:2773-82

S. Kawashima, H. Takano, Y. Iino, M. Takayama and T. Takano. Prophylactic hemodialysis does not prevent contrast-induced nephropathy after cardiac catheterization in patients with chronic renal insufficiency. Circ J. 2006. 70:553-8

C. Sandhu, A. M. Belli and D. B. Oliveira. The role of N-acetylcysteine in the prevention of contrast-induced nephrotoxicity. Cardiovasc Intervent Radiol. 2006. 29:344-7

G. Marenzi, G. Lauri, J. Campodonico, I. Marana, E. Assanelli, M. De Metrio, M. Grazi, F. Veglia, F. Fabbiocchi, P. Montorsi and A. L. Bartorelli. Comparison of two hemofiltration protocols for prevention of contrast-induced nephropathy in high-risk patients. Am J Med. 2006. 119:155-62

E. Kotlyar, A. M. Keogh, S. Thavapalachandran, C. S. Allada, J. Sharp, L. Dias and D. Muller. Prehydration alone is sufficient to prevent contrast-induced nephropathy after day-only angiography procedures--a randomised controlled trial. Heart Lung Circ. 2005. 14:245-51

C. Briguori, A. Colombo, F. Airoldi, N. Morici, G. M. Sangiorgi, A. Violante, A. Focaccio, M. Montorfano, M. Carlino, G. Condorelli and B. Ricciardelli. Nephrotoxicity of low-osmolality versus iso-osmolality contrast agents: impact of N-acetylcysteine. Kidney Int. 2005. 68:2250-5

T. M. Ng, S. W. Shurmur, M. Silver, L. R. Nissen, E. L. O'Leary, R. S. Rigmaiden, M. Cieciorka, L. L. Porter, B. A. Ineck, M. E. Kline and S. E. Puumala. Comparison of N-acetylcysteine and fenoldopam for preventing contrast-induced nephropathy (CAFCIN). Int J Cardiol. 2006. 109:322-8

Y. C. Hsieh, C. T. Ting, T. J. Liu, C. L. Wang, Y. T. Chen and W. L. Lee. Short- and long-term renal outcomes of immediate prophylactic hemodialysis after cardiovascular catheterizations in patients with severe renal insufficiency. Int J Cardiol. 2005. 101:407-13

V. O. Gomes, C. E. Poli de Figueredo, P. Caramori, R. Lasevitch, L. C. Bodanese, A. Araujo, A. P. Roedel, A. P. Caramori, F. S. Brito, Jr., H. G. Bezerra, P. Nery and A. Brizolara. N-acetylcysteine does not prevent contrast induced nephropathy after cardiac catheterisation with an ionic low osmolality contrast medium: a multicentre clinical trial. Heart. 2005. 91:774-8

A. D. Azmus, C. Gottschall, A. Manica, J. Manica, K. Duro, M. Frey, L. Bulcao and C. Lima. Effectiveness of acetylcysteine in prevention of contrast nephropathy. J Invasive Cardiol. 2005. 17:80-4

S. J. Shah and C. Y. Hsu. Has acetylcysteine use changed the incidence of contrast nephropathy in hospitalized patients? A before-after study. Am J Med. 2004. 117:948-52

S. T. Rashid, M. Salman, F. Myint, D. M. Baker, S. Agarwal, P. Sweny and G. Hamilton. Prevention of contrast-induced nephropathy in vascular patients undergoing angiography: a randomized controlled trial of intravenous N-acetylcysteine. J Vasc Surg. 2004. 40:1136-41

N. Attallah, L. Yassine, J. Musial, J. Yee and K. Fisher. The potential role of statins in contrast nephropathy. Clin Nephrol. 2004. 62:273-8

S. E. Miner, V. Dzavik, P. Nguyen-Ho, R. Richardson, J. Mitchell, D. Atchison, P. Seidelin, P. Daly, J. Ross, P. R. McLaughlin, D. Ing, P. Lewycky, A. Barolet and L. Schwartz. N-acetylcysteine reduces contrast-associated nephropathy but not clinical events during long-term follow-up. Am Heart J. 2004. 148:690-5

J. G. Webb, G. E. Pate, K. H. Humphries, C. E. Buller, S. Shalansky, A. Al Shamari, A. Sutander, T. Williams, R. S. Fox and A. Levin. A randomized controlled trial of intravenous N-acetylcysteine for the prevention of contrast-induced nephropathy after cardiac catheterization: lack of effect. Am Heart J. 2004. 148:422-9

C. Briguori, A. Colombo, F. Airoldi, A. Violante, A. Castelli, P. Balestrieri, P. Paolo Elia, B. Golia, S. Lepore, G. Riviezzo, P. Scarpato, M. Librera, A. Focaccio and B. Ricciardelli. N-Acetylcysteine versus fenoldopam mesylate to prevent contrast agent-associated nephrotoxicity. J Am Coll Cardiol. 2004. 44:762-5

G. Marenzi and A. L. Bartorelli. Hemofiltration in the prevention of radiocontrast agent induced nephropathy. Minerva Anestesiol. 2004. 70:189-91

G. J. Merten, W. P. Burgess, L. V. Gray, J. H. Holleman, T. S. Roush, G. J. Kowalchuk, R. M. Bersin, A. Van Moore, C. A. Simonton, 3rd, R. A. Rittase, H. J. Norton and T. P. Kennedy. Prevention of contrast-induced nephropathy with sodium bicarbonate: a randomized controlled trial. JAMA. 2004. 291:2328-34

L. F. Drager, L. Andrade, J. F. Barros de Toledo, F. R. Laurindo, L. A. Machado Cesar and A. C. Seguro. Renal effects of N-acetylcysteine in patients at risk for contrast nephropathy: decrease in oxidant stress-mediated renal tubular injury. Nephrol Dial Transplant. 2004. 19:1803-7

I. Goldenberg, M. Shechter, S. Matetzky, M. Jonas, M. Adam, H. Pres, D. Elian, O. Agranat, E. Schwammenthal and V. Guetta. Oral acetylcysteine as an adjunct to saline hydration for the prevention of contrast-induced nephropathy following coronary angiography. A randomized controlled trial and review of the current literature. Eur Heart J. 2004. 25:212-8

C. Briguori, A. Colombo, A. Violante, P. Balestrieri, F. Manganelli, P. Paolo Elia, B. Golia, S. Lepore, G. Riviezzo, P. Scarpato, A. Focaccio, M. Librera, E. Bonizzoni and B. Ricciardelli. Standard vs double dose of N-acetylcysteine to prevent contrast agent associated nephrotoxicity. Eur Heart J. 2004. 25:206-11

J. M. Kefer, C. E. Hanet, S. Boitte, L. Wilmotte and M. De Kock. Acetylcysteine, coronary procedure and prevention of contrast-induced worsening of renal function: which benefit for which patient?. Acta Cardiol. 2003. 58:555-60

J. B. Oldemeyer, W. P. Biddle, R. L. Wurdeman, A. N. Mooss, E. Cichowski and D. E. Hilleman. Acetylcysteine in the prevention of contrast-induced nephropathy after coronary angiography. Am Heart J. 2003. 146:E23

B. D. MacNeill, S. A. Harding, H. Bazari, K. K. Patton, P. Colon-Hernadez, D. DeJoseph and I. K. Jang. Prophylaxis of contrast-induced

nephropathy in patients undergoing coronary angiography. Catheter Cardiovasc Interv. 2003. 60:458-61

Q. L. Raven, T. Walton, A. M. Howe and E. J. Macon. Role of acetylcysteine in the prevention of contrast-media-induced nephrotoxicity. Am J Health Syst Pharm. 2003. 60:2232-5

H. Frank, D. Werner, V. Lorusso, L. Klinghammer, W. G. Daniel, U. Kunzendorf and J. Ludwig. Simultaneous hemodialysis during coronary angiography fails to prevent radiocontrast-induced nephropathy in chronic renal failure. Clin Nephrol. 2003. 60:176-82

G. Marenzi, I. Marana, G. Lauri, E. Assanelli, M. Grazi, J. Campodonico, D. Trabattoni, F. Fabbiocchi, P. Montorsi and A. L. Bartorelli. The prevention of radiocontrast-agent-induced nephropathy by hemofiltration. N Engl J Med. 2003. 349:1333-40

C. S. Baker, A. Wragg, S. Kumar, R. De Palma, L. R. Baker and C. J. Knight. A rapid protocol for the prevention of contrast-induced renal dysfunction: the RAPPID study. J Am Coll Cardiol. 2003. 41:2114-8

G. M. Tadros, E. N. Mouhayar, A. O. Akinwande, B. Campbell, C. Wood and J. A. Blankenship. Prevention of radiocontrast-induced nephropathy with N-acetylcysteine in patients undergoing coronary angiography. J Invasive Cardiol. 2003. 15:311-4

J. Kay, W. H. Chow, T. M. Chan, S. K. Lo, O. H. Kwok, A. Yip, K. Fan, C. H. Lee and W. F. Lam. Acetylcysteine for prevention of acute deterioration of renal function following elective coronary angiography and intervention: a randomized controlled trial. JAMA. 2003. 289:553-8

J. D. Durham, C. Caputo, J. Dokko, T. Zaharakis, M. Pahlavan, J. Keltz, P. Dutka, K. Marzo, J. K. Maesaka and S. Fishbane. A randomized controlled trial of N-acetylcysteine to prevent contrast nephropathy in cardiac angiography. Kidney Int. 2002. 62:2202-7

H. S. Trivedi, H. Moore, S. Nasr, K. Aggarwal, A. Agrawal, P. Goel and J. Hewett. A randomized prospective trial to assess the role of saline hydration on the development of contrast nephrotoxicity. Nephron Clin Pract. 2003. 93:C29-34

S. Allaqaband, R. Tumuluri, A. M. Malik, A. Gupta, P. Volkert, Y. Shalev and T. K. Bajwa. Prospective randomized study of N-acetylcysteine, fenoldopam, and saline for prevention of radiocontrast-induced nephropathy. Catheter Cardiovasc Interv. 2002. 57:279-83

K. G. Shyu, J. J. Cheng and P. Kuan. Acetylcysteine protects against acute renal damage in patients with abnormal renal function undergoing a coronary procedure. J Am Coll Cardiol. 2002. 40:1383-8

C. Briguori, F. Manganelli, P. Scarpato, P. P. Elia, B. Golia, G. Riviezzo, S. Lepore, M. Librera, B. Villari, A. Colombo and B. Ricciardelli. Acetylcysteine and contrast agent-associated nephrotoxicity. J Am Coll Cardiol. 2002. 40:298-303

C. Mueller, G. Buerkle, H. J. Buettner, J. Petersen, A. P. Perruchoud, U. Eriksson, S. Marsch and H. Roskamm. Prevention of contrast media-associated nephropathy: randomized comparison of 2 hydration regimens in 1620 patients undergoing coronary angioplasty. Arch Intern Med. 2002. 162:329-36

N. W. Shammas, M. J. Kapalis, M. Harris, D. McKinney and E. P. Coyne. Aminophylline does not protect against radiocontrast nephropathy in patients undergoing percutaneous angiographic procedures. J Invasive Cardiol. 2001. 13:738-40

A. S. Abizaid, C. E. Clark, G. S. Mintz, S. Dosa, J. J. Popma, A. D. Pichard, L. F. Satler, M. Harvey, K. M. Kent and M. B. Leon. Effects of dopamine and aminophylline on contrast-induced acute renal failure after coronary angioplasty in patients with preexisting renal insufficiency. Am J Cardiol. 1999. 83:260-3, A5

M. A. Stevens, P. A. McCullough, K. J. Tobin, J. P. Speck, D. C. Westveer, D. A. Guido-Allen, G. C. Timmis and W. W. O'Neill. A prospective randomized trial of prevention measures in patients at high risk for contrast nephropathy: results of the P.R.I.N.C.E. Study. Prevention of Radiocontrast Induced Nephropathy Clinical Evaluation. J Am Coll Cardiol. 1999. 33:403-11

S. S. Hans, B. A. Hans, R. Dhillon, C. Dmuchowski and J. Glover. Effect of dopamine on renal function after arteriography in patients with pre-existing renal insufficiency. Am Surg. 1998. 64:432-6

T. Lehnert, E. Keller, K. Gondolf, T. Schaffner, H. Pavenstadt and P. Schollmeyer. Effect of haemodialysis after contrast medium administration in patients with renal insufficiency. Nephrol Dial Transplant. 1998. 13:358-62

R. Solomon, C. Werner, D. Mann, J. D'Elia and P. Silva. Effects of saline, mannitol, and furosemide to prevent acute decreases in renal function induced by radiocontrast agents. N Engl J Med. 1994. 331:1416-20

L. S. Weisberg, P. B. Kurnik and B. R. Kurnik. Risk of radiocontrast nephropathy in patients with and

without diabetes mellitus. Kidney Int. 1994. 45:259-65

T. Erol, A. Tekin, M. T. Katircibasi, N. Sezgin, M. Bilgi, G. Tekin, A. Zumrutdal, A. T. Sezgin and H. Muderrisoglu. Efficacy of allopurinol pretreatment for prevention of contrast-induced nephropathy: A randomized controlled trial. International Journal of Cardiology. 2013. 167:1396-1399

F. Koc, K. Ozdemir, F. Altunkas, A. Celik, O. Dogdu, M. Karayakali, E. E. Gul, U. Erkorkmaz, H. Kadi, M. Akpek and M. G. Kaya. Sodium bicarbonate versus isotonic saline for the prevention of contrast-induced nephropathy in patients with diabetes mellitus undergoing coronary angiography and/or intervention: A multicenter prospective randomized study. Journal of Investigative Medicine. 2013. 61:872-877

G. Q. Gu, R. Lu, W. Cui, F. Liu, Y. Zhang, X. H. Yang, X. F. Chen and W. M. Jia. Low-dose furosemide administered with adequate hydration reduces contrast-induced nephropathy in patients undergoing coronary angiography. Cardiology (Switzerland). 2013. 125:69-73

O. Berwanger, A. B. Cavalcanti, A. M. G. Sousa, A. Buehler, H. J. Castello-Junior, M. J. C. Cantarelli, J. A. Mangione, R. R. Bergo, L. E. K. Sao Thiago, P. M. S. Nunes, P. A. M. Da Motta, A. Kodama, E. Victor, V. O. Carvalho and J. E. Sousa. Acetylcysteine for the prevention of renal outcomes in patients with diabetes mellitus undergoing coronary and peripheral vascular angiography: A substudy of the acetylcysteine for contrast-induced nephropathy trial. Circulation: Cardiovascular Interventions. 2013. 6:139-145

H. Rashid, Q. Tufail and T. Shafi. Role of N - Acetylcysteine in prevention of contrast induced nephropathy. Pakistan Journal of Medical and Health Sciences. 2011. 5:735-737

Y. Hassan, Z. A. Zainal, N. A. Aziz, S. W. Al-Jabi and O. Ismail. Prevention of radiocontrast-induced nephropathy after coronary angiography: N-acetylcysteine plus saline hydration versus saline hydration. Tropical Journal of Pharmaceutical Research. 2011. 10:133-140

Y. Hassan, Z. A. Zainal, N. A. Aziz, S. W. Al-Jabi and O. Ismail. Prevention of radiocontrast-induced nephropathy after coronary angiography: N-acetylcysteine plus saline hydration versus saline hydration. Tropical Journal of Pharmaceutical Research. 2011. 10:133-140

J. A. Ratcliffe, P. Thiagarajah, J. Chen, G. Kavala, Y. Kanei, J. Fox, R. Gowda, S. J. Schmitz, P. Friedmann and S. Bergmann. Prevention of contrast-induced nephropathy: A randomized controlled trial of sodium bicarbonate and N-acetylcysteine. International Journal of Angiology. 2009. 18:193-197

C. S. Staniloae, S. Doucet, S. K. Sharma, R. E. Katholi, K. R. Mody, J. T. Coppola and R. Solomon. N-acetylcysteine added to volume expansion with sodium bicarbonate does not further prevent contrast-induced nephropathy: Results from the cardiac angiography in renally impaired patients study. Journal of Interventional Cardiology. 2009. 22:261-265

W. M. Izani Wan Mohamed, Z. Darus and Z. Yusof. Oral N-acetylcysteine in prevention of contrast induced nephropathy following coronary angiogram. International Medical Journal. 2008. 15:353-361

J. H. Wang, Y. M. Subeq, W. C. Tsai, R. P. Lee and B. G. Hsu. Intravenous N-acetylcysteine with saline hydration improves renal function and ameliorates plasma total homocysteine in patients undergoing cardiac angiography. Renal Failure. 2008. 30:527-533

M. Kimmel, M. Butscheid, S. Brenner, U. Kuhlmann, U. Klotz and D. M. Alscher. Improved estimation of glomerular filtration rate by serum cystatin C in preventing contrast induced nephropathy by N-acetylcysteine or zinc - Preliminary results. Nephrology Dialysis Transplantation. 2008. 23:1241-1245

C. H. Hsu, J. D. Lee, P. H. Lo, J. J. Lin, H. W. Chang and H. T. Chou. Prevention of radiocontrast-induced nephropathy with N-acetylcysteine after cardiac angiography in diabetic patients with renal dysfunction. Mid-Taiwan Journal of Medicine. 2007. 12:173-183

A. Baranska-Kosakowska, M. Zakliczynski, R. Przybylski and M. Zembala. Role of N-Acetylcysteine on Renal Function in Patients After Orthotopic Heart Transplantation Undergoing Coronary Angiography. Transplantation Proceedings. 2007. 39:2853-2855

A. Recio-Mayoral, M. Chaparro, B. Prado, R. Cozar, I. Mendez, D. Banerjee, J. C. Kaski, J. Cubero and J. M. Cruz. The Reno-Protective Effect of Hydration With Sodium Bicarbonate Plus N-Acetylcysteine in Patients Undergoing Emergency Percutaneous Coronary Intervention. The RENO Study. Journal of the American College of Cardiology. 2007. 49:1283-1288

S. H. Rezkalla and M. Benz. Effectiveness of Acetylcysteine on Preventing Renal Dysfunction

in Patients Undergoing Coronary Procedures. Wisconsin Medical Journal. 2004. 103:38-41

A. Ochoa, G. Pellizzon, S. Addala, C. Grines, Y. Isayenko, J. Boura, D. Rempinski, W. O'Neill and J. Kahn. Abbreviated dosing of N-acetylcysteine prevents contrast-induced nephropathy after elective and urgent coronary angiography and intervention. #journal#. 2004. #volume#:159-65

M. Hashemi, A. Kharazi and S. Shahidi. Captopril for prevention of contrast induced nephropathy in patients undergoing coronary angioplasty: a double blind placebo controlled clinical trial. #journal#. 2005. #volume#:305-8

Exclusion: Non-English

H. Suzuki. [Therapeutic strategy for prevention of contrast-induced nephropathy]. Nihon Rinsho. 2011. 69 Suppl 7:220-5

J. Z. Su, Y. Xue, W. Q. Cai, Q. Y. Huang, D. J. Chai, G. L. Chen, F. B. Wang, X. P. Chen and D. S. Zhang. [Association between high sensitivity C-reactive protein and contrast induced acute kidney injury in patients with acute coronary syndrome undergoing percutaneous coronary intervention: impact of atorvastatin]. Zhonghua Xin Xue Guan Bing Za Zhi. 2011. 39:807-11

M. Shamkhalova, N. V. Zaitseva, K. O. Kurumova, M. V. Shestakova, A. D. Deev, S. T. Matskeplishvili, E. F. Tugeeva and I. Buziashvili Iu. [Contrast-induced nephropathy in coronarography of patients with type 2 diabetes mellitus: risk factors, prognostic significance, prophylactic approaches]. Ter Arkh. 2009. 81:36-42

X. Zhou, Y. Z. Jin, Q. Wang, R. Min and X. Y. Zhang. [Efficacy of high dose atorvastatin on preventing contrast induced nephropathy in patients underwent coronary angiography]. Zhonghua Xin Xue Guan Bing Za Zhi. 2009. 37:394-6

L. Yin, G. P. Li, T. Liu, H. M. Liu, X. Chen, M. He, X. T. Zheng, E. Z. Liu and L. J. Zhou. [Role of probucol in preventing contrast induced acute kidney injury after coronary interventional procedure: a randomized trial]. Zhonghua Xin Xue Guan Bing Za Zhi. 2009. 37:385-8

N. Kamiyama, R. Ogawa, H. Hamada, T. Ohno, R. Asano, J. Umemura and H. Yoshida. Preventive effect of N-acetylcysteine on contrast-induced nephropathy following coronary angiography and angioplasty. Yakugaku Zasshi. 2008. 128:1333-9

V. A. Sulimov and A. E. Udovichenko. [The use of isoosmolar contrast medium for lowering of rate and clinical significance of contrast-induced nephropathy in patients with diabetes mellitus]. Kardiologiia. 2008. 48:51-5

L. Shavit, M. Lifschitz, T. Lachish, D. Rosenmann, J. Balkin and I. Slotki. [Use of N-acetylcysteine prior to cardiac catheterization to prevent acute renal injury in patients with stage III chronic kidney disease]. Harefuah. 2007. 146:655-9, 736

L. Shavit, M. Lifschitz, T. Lachish, D. Rosenmann, J. Balkin and I. Slotki. [Use of N-acetylcysteine prior to cardiac catheterization to prevent acute renal injury in patients with stage III chronic kidney disease]. Harefuah. 2007. 146:655-9, 736

A. Hoshino, S. Enomoto, H. Kawahito, H. Kurata, Y. Nakahara and T. Nakamura. [Prevention of contrast-induced nephropathy using cardiac catheterization combined with hydration, oral N-acetylcysteine, sodium bicarbonate and iso-osmolar contrast agents]. J Cardiol. 2007. 50:119-26

A. Hoshino, S. Enomoto, H. Kawahito, H. Kurata, Y. Nakahara and T. Nakamura. [Prevention of contrast-induced nephropathy using cardiac catheterization combined with hydration, oral N-acetylcysteine, sodium bicarbonate and iso-osmolar contrast agents]. J Cardiol. 2007. 50:119-26

C. Y. Chen, L. Cao, D. K. Chen, M. Chu and J. Tu. [Influence of high- and low-osmolality contrast media on renal function in children]. Zhonghua Er Ke Za Zhi. 2006. 44:280-4

C. Y. Chen, L. Cao, D. K. Chen, M. Chu and J. Tu. [Influence of high- and low-osmolality contrast media on renal function in children]. Zhonghua Er Ke Za Zhi. 2006. 44:280-4

R. El Mahmoud, C. Le Feuvre, K. H. Le Quan Sang, G. Helft, F. Beygui, J. P. Batisse and J. P. Metzger. [Absence of nephro-protective effect of acetylcysteine in patients with chronic renal failure investigated by coronary angiography]. Arch Mal Coeur Vaiss. 2003. 96:1157-61

A. Vallero, G. Cesano, M. Pozzato, R. Garbo, M. Minelli, F. Quarello and M. Formica. [Contrast nephropathy in cardiac procedures: no advantages with prophylactic use of N-acetylcysteine (NAC)]. G Ital Nefrol. 2002. 19:529-33

A. Vallero, G. Cesano, M. Pozzato, R. Garbo, M. Minelli, F. Quarello and M. Formica. [Contrast nephropathy in cardiac procedures: no advantages with prophylactic use of N-

acetylcysteine (NAC)]. G Ital Nefrol. 2002. 19:529-33
E. D. Berger, B. D. Bader, J. Bosker, T. Risler and C. M. Erley. [Contrast media-induced kidney failure cannot be prevented by hemodialysis]. Dtsch Med Wochenschr. 2001. 126:162-6
E. D. Berger, B. D. Bader, J. Bosker, T. Risler and C. M. Erley. [Contrast media-induced kidney failure cannot be prevented by hemodialysis]. Dtsch Med Wochenschr. 2001. 126:162-6
S. Usutani. [Contrast nephropathy with a non-ionic iodide medium in patients with normal and mildly impaired renal function]. Nihon Jinzo Gakkai Shi. 2000. 42:338-45
S. Usutani. [Contrast nephropathy with a non-ionic iodide medium in patients with normal and mildly impaired renal function]. Nihon Jinzo Gakkai Shi. 2000. 42:338-45
T. Diez, D. Bagilet, M. Ramos, H. Jolly, M. Diab, R. Marcucci and L. Rojo. [Evaluation of two methods to avoid the nephropathy associated with radiologic contrast]. Medicina (B Aires). 1999. 59:55-8
T. Diez, D. Bagilet, M. Ramos, H. Jolly, M. Diab, R. Marcucci and L. Rojo. [Evaluation of two methods to avoid the nephropathy associated with radiologic contrast]. Medicina (B Aires). 1999. 59:55-8
H. Porst, R. Mayer and W. Clauss. [Nephrotoxicity of ionic and nonionic contrast media in selective renovasography]. Urologe A. 1986. 25:120-3
J. Prinseau, F. Jardin, A. Sanchez, A. Baglin, M. Domart, J. Lubetzki, A. Margairaz and D. Fritel. [Acute renal failure after intravenous urography in diabetics. Incidence of lactic acidosis in metformin treatment]. Ann Med Interne (Paris). 1977. 128:173-7
P. Stage, E. Brix, K. Folke and A. Karle. [Intravenous urography in renal insufficiency. Use of large doses of contrast media]. Ugeskr Laeger. 1971. 133:299-302
P. Stage, E. Brix, K. Folke and A. Karle. [Intravenous urography in renal insufficiency. Use of large doses of contrast media]. Ugeskr Laeger. 1971. 133:299-302
S. Grazi, G. Leonetti, S. Romano, O. Bonazzi and A. Ligresti. [On the nephrotoxic action of repeated injections of contrast medium during selective renal arteriography]. Atti Accad Fisiocrit Siena Med Fis. 1967. 16:789-98
S. Grazi, G. Leonetti, S. Romano, O. Bonazzi and A. Ligresti. [On the nephrotoxic action of repeated injections of contrast medium during selective renal arteriography]. Atti Accad Fisiocrit Siena Med Fis. 1967. 16:789-98
A. Hornych, V. Prat, Z. Hejl and R. Dejdar. [EFFECT OF AORTOGRAAPHY ON KIDNEY FUNCTION WITH REFERENCE TO VARIOUS CONTRAST MEDIA]. Cas Lek Cesk. 1963. 102:928-34
A. Hornych, V. Prat, Z. Hejl and R. Dejdar. [EFFECT OF AORTOGRAAPHY ON KIDNEY FUNCTION WITH REFERENCE TO VARIOUS CONTRAST MEDIA]. Cas Lek Cesk. 1963. 102:928-34
B. C. Zhang, Y. D. Zhang, K. Zhao, X. Y. Wang and X. X. Jiang. A prospective study on the risk of contrast induced nephropathy in the patients who underwent contrast-enhanced CT examination. Chinese Journal of Radiology (China). 2013. 47:335-339
B. C. Zhang, Y. D. Zhang, K. Zhao, X. Y. Wang and X. X. Jiang. A prospective study on the risk of contrast induced nephropathy in the patients who underwent contrast-enhanced CT examination. Chinese Journal of Radiology (China). 2013. 47:335-339
J. W. Pan, Z. G. Lu, J. Y. Zhang, C. Y. Xuan, S. Qi, N. S. Wang and M. Wei. Delayed contrast-induced nephropathy occurring after percutaneous coronary intervention. Journal of Interventional Radiology (China). 2013. 22:15-19
J. W. Pan, Z. G. Lu, J. Y. Zhang, C. Y. Xuan, S. Qi, N. S. Wang and M. Wei. Delayed contrast-induced nephropathy occurring after percutaneous coronary intervention. Journal of Interventional Radiology (China). 2013. 22:15-19
M. Gul, B. Turan, M. Ugur, A. Turer, U. Findikcioglu, M. Ergelen and H. Uyarel. Nephrotoxicity of iodixanol versus iopamidol in patients with acute coronary syndrome. Turk Kardiyoloji Dernegi Arsivi. 2013. 41:21-27
M. Gul, B. Turan, M. Ugur, A. Turer, U. Findikcioglu, M. Ergelen and H. Uyarel. Nephrotoxicity of iodixanol versus iopamidol in patients with acute coronary syndrome. Turk Kardiyoloji Dernegi Arsivi. 2013. 41:21-27
H. Sanadgol, S. Abdani, P. Tabatabaiee, M. Mohammadi and A. Baradaran. Comparison between the efficacy of high dose short-term statin therapy and normal saline in prevention of contrast-induced nephropathy among patients receiving iodixanol. Journal of Isfahan Medical School. 2012. 30:#pages#
H. Sanadgol, S. Abdani, P. Tabatabaiee, M. Mohammadi and A. Baradaran. Comparison between the efficacy of high dose short-term statin therapy and normal saline in prevention of contrast-induced nephropathy among patients

receiving iodixanol. Journal of Isfahan Medical School. 2012. 30:#pages#
C. M. Campanale, A. Nusca, R. Contuzzi, G. Patti, A. D'Ambrosio and G. Di Sciascio. GIK and N-Acetyl-cysteine in prevention of CIN in diabetic and/or with chronic renal failure patients undergoing PCI: Preliminary results from a randomized trial. Giornale Italiano di Cardiologia. 2011. 12:e111-e112
D. J. Yu, J. Z. Su, G. L. Chen, W. Q. Cai, X. Q. Jin and D. J. Chai. Effect of different doses of Atorvastatin in contrast-induced nephropathy. Chinese Journal of Interventional Imaging and Therapy. 2010. 7:520-524
D. J. Yu, J. Z. Su, G. L. Chen, W. Q. Cai, X. Q. Jin and D. J. Chai. Effect of different doses of Atorvastatin in contrast-induced nephropathy. Chinese Journal of Interventional Imaging and Therapy. 2010. 7:520-524
K. Negita, T. Miura, A. Katsumi, H. Tamai, K. Takemoto and M. Watarai. Protective effect orally administered N-acetylcysteine on Contrast media-induced nephropathy: evaluation in acute and chronic phases. Japanese Journal of Interventional Cardiology. 2008. 23:460-464
K. Negita, T. Miura, A. Katsumi, H. Tamai, K. Takemoto and M. Watarai. Protective effect orally administered N-acetylcysteine on Contrast media-induced nephropathy: evaluation in acute and chronic phases. Japanese Journal of Interventional Cardiology. 2008. 23:460-464
Y. H. Li, L. L. Zhang and C. Y. Zhao. Influences of an iso-osmolar versus a low-osmolar contrast media on radiographic contrast nephropathy in high-risk patients. Journal of Clinical Rehabilitative Tissue Engineering Research. 2008. 12:683-686
Y. H. Li, L. L. Zhang and C. Y. Zhao. Influences of an iso-osmolar versus a low-osmolar contrast media on radiographic contrast nephropathy in high-risk patients. Journal of Clinical Rehabilitative Tissue Engineering Research. 2008. 12:683-686
R. Funada, Y. Oikawa, J. Yajima, K. Nagashima, H. Kirigaya, O. Shiraiwa, A. Goda, Y. Shiratori, K. Ikeno and T. Aizawa. The prevention of radiocontrast-agent induced nephropathy in renal dysfunction patients: A comparison between perioperative, postoperative hemodialysis and hydration. Japanese Journal of Interventional Cardiology. 2006. 21:228-232
R. Funada, Y. Oikawa, J. Yajima, K. Nagashima, H. Kirigaya, O. Shiraiwa, A. Goda, Y. Shiratori, K. Ikeno and T. Aizawa. The prevention of radiocontrast-agent induced nephropathy in renal dysfunction patients: A comparison between perioperative, postoperative hemodialysis and hydration. Japanese Journal of Interventional Cardiology. 2006. 21:228-232
K. Sugaya, O. Nishizawa, H. Noto, T. Suzuki, N. Shimoda, S. Miyagata, T. Harada and S. Tsuchida. Comparative study on nephrotoxicity of ionic and non-ionic contrast agents for drip infused urography. Acta Urologica Japonica. 1992. 38:767-773
K. Sugaya, O. Nishizawa, H. Noto, T. Suzuki, N. Shimoda, S. Miyagata, T. Harada and S. Tsuchida. Comparative study on nephrotoxicity of ionic and non-ionic contrast agents for drip infused urography. Acta Urologica Japonica. 1992. 38:767-773
P. Mannella, G. Tataranni and G. Benea. Renal investigation by means of contrast medium in hypertensive patients: Nephrotoxicity comparison between ionic and non-ionic contrast media. Radiologia Medica. 1983. 69:422-425
P. Mannella, G. Tataranni and G. Benea. Renal investigation by means of contrast medium in hypertensive patients: Nephrotoxicity comparison between ionic and non-ionic contrast media. Radiologia Medica. 1983. 69:422-425
E. Esplugas, C. Molina and R. Romero. Nephrotoxicity of contrast medium in cardiac catheterization. A prospective study. Revista Espanola de Cardiologia. 1983. 36:293-296
E. Esplugas, C. Molina and R. Romero. Nephrotoxicity of contrast medium in cardiac catheterization. A prospective study. Revista Espanola de Cardiologia. 1983. 36:293-296
G. F. Hobikoglu, T. Norgaz, H. Aksu, O. Ozer, I. Sari, A. Karabulut, E. Onturk and A. Narin. [The effectiveness of oral N-acetylcysteine administered three hours before angiography in the prevention of contrast nephropathy in patients with mildly elevated creatinine levels]. #journal#. 2007. #volume#:9-12

Exclusion: No outcome of interest

B. A. Bartholomew, K. J. Harjai, S. Dukkipati, J. A. Boura, M. W. Yerkey, S. Glazier, C. L. Grines and W. W. O'Neill. Impact of nephropathy after percutaneous coronary intervention and a method for risk stratification. Am J Cardiol. 2004. 93:1515-9
A. Kolonko, A. Wiecek and F. Kokot. The nonselective adenosine antagonist theophylline

does prevent renal dysfunction induced by radiographic contrast agents. J Nephrol. 1998. 11:151-6
T. Furukawa, J. Ueda, S. Takahashi and K. Sakaguchi. Elimination of low-osmolality contrast media by hemodialysis. Acta Radiol. 1996. 37:966-71
S. Hayami, M. Ishigooka, Y. Suzuki, T. Hashimoto, T. Nakada and K. Mitobe. Comparison of the nephrotoxicity between ioversol and iohexol. Int Urol Nephrol. 1996. 28:615-9
P. Kjaersgaard, J. A. Jakobsen, J. O. Nossen and K. J. Berg. Determination of glomerular filtration rate with Visipaque in patients with severely reduced renal function. Eur Radiol. 1996. 6:865-71
R. Mikkonen, T. Kontkanen and L. Kivisaari. Acute and late adverse reactions to low-osmolal contrast media. Acta Radiol. 1995. 36:72-6
M. Fujimoto, K. Waseda, H. Takashima, K. Maeda, K. Asai, Y. Kuroda, T. Kosaka, A. Kurita, Y. Kuhara, H. Ando, S. Sakurai, D. Kato, A. Suzuki, Y. Nakano, T. Niwa, K. Mukai, S. Sato, T. Mizuno and T. Amano. Effect of oral hydration on renal function after coronary catheterization. American Journal of Cardiology. 2013. 111:89B
M. M. Sadeghi, M. Gharipour, P. Nilforoush, H. Shamsolkotabi, H. M. Sadeghi, A. Kiani, P. M. Sadeghi and N. Farahmand. Influence of the timing of cardiac catheterization and amount of contrast media on acute renal failure after cardiac surgery. Journal of Research in Medical Sciences. 2011. 16:502-508
H. H. Schild, C. K. Kuhl, U. Hubner-Steiner, I. Bohm and U. Speck. Adverse events after unenhanced and monomeric and dimeric contrast-enhanced CT: A prospective randomized controlled trial. Radiology. 2006. 240:56-64
H. Oi, H. Yamazaki and M. Matsushita. Delayed vs. immediate adverse reactions to ionic and non-ionic low- osmolality contrast media. Radiation Medicine - Medical Imaging and Radiation Oncology. 1997. 15:23-27

Exclusion: No original data

C. Briguori. Renalguard system in high-risk patients for contrast-induced acute kidney injury. Minerva Cardioangiol. 2012. 60:291-7
R. G. Silva, N. G. Silva, F. Lucchesi and E. A. Burdmann. Prevention of contrast-induced nephropathy by use of bicarbonate solution: preliminary results and literature review. J Bras Nefrol. 2010. 32:292-302
R. G. Silva, N. G. Silva, F. Lucchesi and E. A. Burdmann. Prevention of contrast-induced nephropathy by use of bicarbonate solution: preliminary results and literature review. J Bras Nefrol. 2010. 32:292-302
L. Bolognese, G. Falsini, S. Grotti, U. Limbruno, F. Liistro, A. Carrera, P. Angioli, A. Picchi, K. Ducci and C. Pierli. The contrast media and nephrotoxicity following coronary revascularization by primary angioplasty for acute myocardial infarction study: design and rationale of the CONTRAST-AMI study. J Cardiovasc Med (Hagerstown). 2010. 11:199-206
H. S. Thomsen and S. K. Morcos. Risk of contrast-medium-induced nephropathy in high-risk patients undergoing MDCT--a pooled analysis of two randomized trials. Eur Radiol. 2009. 19:891-7
I. Goldenberg, M. Chonchol and V. Guetta. Reversible acute kidney injury following contrast exposure and the risk of long-term mortality. Am J Nephrol. 2009. 29:136-44
I. Goldenberg, M. Chonchol and V. Guetta. Reversible acute kidney injury following contrast exposure and the risk of long-term mortality. Am J Nephrol. 2009. 29:136-44
A. Bouzas-Mosquera, J. M. Vazquez-Rodriguez, R. Calvino-Santos, N. Vazquez-Gonzalez and A. Castro-Beiras. Statin therapy and contrast-induced nephropathy after primary angioplasty. Int J Cardiol. 2009. 134:430-1
M. R. Gandhi, P. Brown, C. A. Romanowski, S. K. Morcos, S. Campbell, A. M. el Nahas and T. A. Gray. The use of theophylline, an adenosine antagonist in the prevention of contrast media induced nephrotoxicity. Br J Radiol. 1992. 65:838
J. L. Teruel, R. Marcen, J. A. Herrero, C. Felipe and J. Ortuno. An easy and effective procedure to prevent radiocontrast agent nephrotoxicity in high-risk patients. Nephron. 1989. 51:282
J. L. Teruel, R. Marcen, J. A. Herrero, C. Felipe and J. Ortuno. An easy and effective procedure to prevent radiocontrast agent nephrotoxicity in high-risk patients. Nephron. 1989. 51:282
H. Uyarel, N. Cam, M. Ergelen, E. Akkaya, E. Ayhan, T. Isik, G. Cicek, Z. Y. Gunaydin, D. Osmonov, M. Gul, D. Demirci, M. R. Guney, R. Ozturk and I. Yekeler. Contrast-induced nephropathy in patients undergoing primary angioplasty for acute myocardial infarction: Incidence, a simple risk score, and prognosis. Archives of Medical Science. 2009. 5:550-558

C. M. Erley. Prevention of contrast-media-induced renal impairment by adenosine antagonists in humans. Drug Development Research. 1998. 45:172-175

J. S. Berns and M. R. Rudnick. Radiocontrast media associated nephrotoxicity. Kidney. 1992. 24:3-6

C. J. Davidson and T. M. Bashore. Comparison of ionic and low-osmolar contrast media during cardiac catheterization. Trends in Cardiovascular Medicine. 1991. 1:86-91

Exclusion: Qualitative study

H. Oi, H. Yamazaki and M. Matsushita. Delayed vs. immediate adverse reactions to ionic and non-ionic low- osmolality contrast media. Radiation Medicine - Medical Imaging and Radiation Oncology. 1997. 15:23-27

Exclusion: Study compared an intervention of interest to a comparator of interest, but the patient groups being compared were fundamentally different

P. Calabr, R. Bianchi, M. Caprile, C. Sordelli, M. Cappelli Bigazzi, R. Palmieri, G. Gigantino, G. Umongelli, G. Capozzi, S. Cuomo and R. Calabro. Use of NaCl saline hydration and N-Acetyl Cysteine to prevent contrast induced nephropathy in different populations of patients at high and low risk undergoing coronary artery angiography. Minerva Cardioangiologica. 2010. 58:35-40

Appendix E. Evidence Tables

Evidence Table 1 - Participant Characteristics for studies comparing contrast media for the prevention of contrast induced nephropathy.

Author, year	Study Population	Arm*	ARM define	N	Follow-up Period	Sex, n female (%)	Age, mean unless otherwise specified(Range)	Race, n (%)	Education	Smoking status, n (%)	Comments
Aspelin, 2003[1]	Diabetics with mild to moderate renal insufficiency (serum creatinins 1.5 to 3.5 mg/dl)	Total		129	7 days	53 (41)		NR	NR	NR	
Barrett, 2006[2]	General	Total		166	48-72 Hours	48(31.4)	67	NR	NR	NR	
		2	Iodixanol	82		25	67	White: 43(56.6) Black: 4(5.3) Asian/Pac: 29(38.2) Other: 0(0)	NR	NR	
		3	Iopamidol	84		23	67.3	White: 42(54.6) Black: 8(10.4) Asian/Pac: 24(31.2) Other: 3(3.9)	NR	NR	
Becker, 2013[3]	General	Total		113	72 Hours	61(54)	52	White: 22 Black: 23 Latino: 30 Asian/Pac: 38	NR	NR	
		1	Iopamidol	32		NR	NR	NR	NR	NR	
		2	Iohexol	35		NR	NR	NR	NR	NR	
		3	Iopromide	21		NR	NR	NR	NR	NR	
		4	Iodixanol	25		NR	NR	NR	NR	NR	
Bolognese, 2012[4]	STEMI	Total		475	72 Hours	110(23)	66	NR	NR	Current: 173	
		1	Iopromide	239		53	65	NR	NR	Current: 85	
		2	Iodixanol	236		57	66	NR	NR	Current: 88	

Evidence Table 1 - Participant Characteristics for studies comparing contrast media for the prevention of contrast induced nephropathy (continued).

Author, year	Study Population	Arm*	ARM define	N	Follow-up Period	Sex, n female (%)	Age, mean unless otherwise specified(Range)	Race, n (%)	Education	Smoking status, n (%)	Comments
Campbell, 1990[5]	General	Total		478	NR	213	57.8	NR	NR	NR	Arm 1 is actually not the control/usual care, but just one of the treatment arms. 252 arterial and 226 IV injections of contrast
		1	Ioxaglate (Hexabrix 320)	161		NR	NR	NR	NR	NR	
		2	Iohexol (Omnipaque 350)	158		NR	NR	NR	NR	NR	
		3	Iopamidol (Isovue 370)	159		NR	NR	NR	NR	NR	
Carraro, 1998[6]	Mild to moderate renal insufficiency (serum cr 135 to 265 micromol/L within the previous 2 weeks)	Total		64	7 Days	9(14.1)	68	NR	NR	NR	
		2	Iodixanol	32		4	67	NR	NR	NR	
		3	Iopromide	32		5	69	NR	NR	NR	
Chuang, 2009[7]	General	Total		50	7 Days	16(32)	58	NR	NR	NR	
		2	Iodixanol	25		7(28)	62.9	NR		NR	
		3	Iohexol	25		9(36)	53.0	NR		NR	

Evidence Table 1 - Participant Characteristics for studies comparing contrast media for the prevention of contrast induced nephropathy (continued).

Author, year	Study Population	Arm*	ARM define	N	Follow-up Period	Sex, n female (%)	Age, mean unless otherwise specified(Range)	Race, n (%)	Education	Smoking status, n (%)	Comments
Dillman, 2012[8]	General	Total		389	3 Days	204(52.4)	NR	NR	NR	NR	
		2	Iopamidol	199		99(49.7)	56.7	Black: 12(6.0) Other: 187(94)	NR	NR	
		3	Iohexol	190		105(55.3)	56.1	Black: 12(6.3) Other: 178(93.7)	NR	NR	
Feldkamp, 2006[9]	General	Total		83	48 Hours	54(24.4)	62	NR	NR	NR	
		2	Iodixanol	42		15	60.5	NR	NR	NR	
		3	Iopromid	41		12	62.7	NR	NR	NR	
Hardiek, 2008[10]	History of diabetes	Total		106	7 Days	85(83.3)	66	NR	NR	NR	
		2	Iodixanol	54		52	65 (36-83)	White: (98) Black: (2)	NR	NR	
		3	Iopamidol	48		33	66 (46-84)	White: (100) Black: (0)	NR	NR	
Hernandez, 2009[11]	Diabetic Patients	Total		250	72 Hours	92(36.8)	70	NR	NR	NR	
		2	Ioversol	132		47(33.6)	70.1	NR	NR	NR	
		3	Iodixanol	118		45(38.1)	69.1	NR	NR	NR	
Jakobsen, 1996[12]	Severe but stable pre-dialytic renal failure	Total		16	120 Hours	4(25)	55	NR	NR	NR	
		2	Iodixanol	8		1	55 (33-70)	NR	NR	NR	
		3	Iohexol	8		3	58 (33-72)	NR	NR	NR	
Jevnikar, 1988[13]	General	Total		23	20 Hours	4	56.1	NR	NR	NR	
		2	Ioxaglate	8		NR	NR	NR	NR	NR	
		3	Iohexol	8		NR	NR	NR	NR	NR	
		4	Diatrizoate	7		NR	NR	NR	NR	NR	
Jo, 2006[14]	General	Total		275	1 Month	121(43.6)	67	NR	NR	NR	
		2	Iodixanol	140		61	66.1	NR	NR	NR	
		3	Ioxaglate	135		60	68.7	NR	NR	NR	

Evidence Table 1 - Participant Characteristics for studies comparing contrast media for the prevention of contrast induced nephropathy (continued).

Author, year	Study Population	Arm*	ARM define	N	Follow-up Period	Sex, n female (%)	Age, mean unless otherwise specified(Range)	Race, n (%)	Education	Smoking status, n (%)	Comments
Juergens, 2009[15]	Cr>130 - CrCl<60	Total		191	7 Days	46(24.1)	70	NR	NR	NR	
		2	Iopromide	100		27(27)	69.4	NR	NR	NR	
		3	Iodixanol	91		19(21)	70.2	NR	NR	NR	
Koutsikos, 1992[16]	Non-diabetics with satisfactory renal function (serum cr < 130 micromol/L) with perphieral or renal arterial vascular disease	Total		24	24 Hours	8(33.3)	NR	NR	NR	NR	
		2	Diatrizoate	8		1	41.6 (30-51)	NR		NR	
		3	Ioxaglate	8		1	48.33 (37-66)	NR		NR	
		4	Iohexol	8		6	37.61 (16-58)	NR		NR	
Kuhn, 2008[17]	Moderate to severe chronic kidney disease (estimated glomerular filtration rate [GFR] = 20–59 mL/min/1.73 m2), Type 1 or 2 diabetes	Total		248	72 Hours	132(53.2)	69	NR	NR	NR	
		2	Iopamidol 370	125		54	69.5	NR		NR	
		3	Iodixanol 320	123		62	68.3	NR		NR	

Evidence Table 1 - Participant Characteristics for studies comparing contrast media for the prevention of contrast induced nephropathy (continued).

Author, year	Study Population	Arm*	ARM define	N	Follow-up Period	Sex, n female (%)	Age, mean unless otherwise specified(Range)	Race, n (%)	Education	Smoking status, n (%)	Comments
Laskey, 2009[18]	CKD of non-acute etiology, type 1 or 2	Total		418	7 Days	148(35)	69.6 (41-87)	White: 307(73) Black: 22(5) Asian/Pac: 76(18) Other: 13(3)	NR	NR	
		2	Iodixanol	215		76(35)	69.6 (42-87)	White: 156(73) Black: 16(7) Asian/Pac: 39(18) Other: 4(2)		NR	
		3	Iopamidol	203		72(35)	69.7 (41-87)	White: 151(74) Black: 6(3) Asian/Pac: 37(18) Other: 9(4)		NR	
Limbruno, 2013[19]	General	Total		113	5 Days	49(43.4)	7	NR	NR	NR	
		2	Iodixanol	57		29(51)	77	NR		NR	
		3	Iobitridol	56		20(36)	76	NR		NR	
Mehran, 2009[20]	Renal impairment scheduled for coronary angio having 2 consecutive stable serum creatinine levels (>1.5 mg/dl and </=3.0 mg/dl) with most recent obtained within 24 hours before angiography	Total		NR	30 Days	18(12.3)	71	NR	NR	NR	
		2	Iodixanol	72		(12.5)	71.6	NR	NR	NR	
		3	Ioxaglate	74		(12.2)	71.3	NR	NR	NR	

Evidence Table 1 - Participant Characteristics for studies comparing contrast media for the prevention of contrast induced nephropathy (continued).

Author, year	Study Population	Arm*	ARM define	N	Follow-up Period	Sex, n female (%)	Age, mean unless otherwise specified(Range)	Race, n (%)	Education	Smoking status, n (%)	Comments
Millward, 1996[21]	General	Total		48	NR	12(25.0)	63	NR	NR	NR	
		2	Ioxaglate	14		3	Median: 62 (51-79)	NR	NR	NR	
		3	Ioversol	34		9	Median: 62 (25-78)	NR	NR	NR	
Nguyen, 2008[22]	CKD Cr <1.5	Total		117	90 Days	34(29.1)	64	NR	NR	NR	
		2	Iodixanol	61		16	63	NR	NR	NR	
		3	Iopromide	56		18	65.8	NR	NR	NR	
Nie, 2008[23]	CrCl <60 ml/min	Total		208	3-7 Days	66(31.7)	61	NR	NR	NR	
		2	Iodixanol	106		33(31.2)	61	NR	NR	Current: 38(35.8)	
		3	Iopromide	102		33(32.4)	60	NR	NR	Current: 33(33.7)	
Rudnick, 2008[24]	SCr ≥ 1.7 mg/dL for men and ≥ 1.5 mg/dL for women	Total		299	72 Hours	87(41)	72	NR	NR	NR	
		2	Iodixanol	156		(31.8)	71.1	NR		NR	
		3	Ioversol	143		(27.4)	72.6	NR	NR	NR	
Serafin, 2011[25]	Neurosurgical patients	Total		92	72 Hours	67(72.8)	50	NR	NR	NR	
		2	Iopromide	48		35	49.6	NR	NR	NR	
		3	Iodixanol	44		32	49.6	NR	NR	NR	
Shin, 2011[26]	Impaired renal function; creatinine clearance (CrCl) <60 ml/min	Total		420	1 Month	194(46)	72	NR	NR	All: 199(47)	
		2	Iodixanol	215		105(49)	71.1	NR	NR	Current: 98(46)	
		3	Iopromide	205		89(43)	71.9	NR	NR	Current: 101(49)	

Evidence Table 1 - Participant Characteristics for studies comparing contrast media for the prevention of contrast induced nephropathy (continued).

Author, year	Study Population	Arm*	ARM define	N	Follow-up Period	Sex, n female (%)	Age, mean unless otherwise specified(Range)	Race, n (%)	Education	Smoking status, n (%)	Comments
Solomon, 2007[27]	General	Total		414	120 Hours	149(36.0)	71	NR	NR	NR	
		2	Iopamidol-370	204		66	72.4	NR	NR	NR	
		3	Iodixanol-320	210		83	70.5	NR	NR	NR	
Solomon, 2009[28]	General	Total		294	Range: 12+ Months	108(37)	NR	NR	NR	NR	This population is the long term follow-up data from another randomized, double blind study of prevention CIN strategies (iopamidol vs. iodixanol) Age reported as n in two groups: 18 to 64 and >/= 65
		1	Iodixanol	149		44	NR	NR	NR	NR	
		2	Iopamidol	145		29	NR	NR	NR	NR	
Wessely, 2009[29]	General	Total		324	6 Months	89(31.3)	74	NR	NR	NR	
		2	Iodixanol	162		43(27)	75.0	NR	NR	NR	
		3	Iomeprol	162		46(28)	73.2	NR	NR	NR	
Zo'o, 2011[30]	General	Total		145	10 Days	59(40.7)	8	NR	NR	NR	
		2	Iobitridol	74		31(41.9)	8.7 (1-16)	NR	NR	NR	
		3	Iodixanol	71		28(39.4)	8.1 (0-16)	NR	NR	NR	

CIN=Contrast Induced Nephropathy; CKD=Chronic Kidney Disease; Cr=Creatinine; CrCl=Creatinine Clearance; GFR=Glomerular Filtration Rate; IV=Intravenous; Mg/dl=Milligrams per decliter; Micromol/L=Micromoles per liter; Ml/min/1.73m^2=milliliter per minute per 1.73 meters squared; NR=Not Reported; SCr=Serum Creatinine; STEMI=ST Elevation Myocardial Infarction

Evidence Table 2 - Study characteristics for studies comparing contrast media for the prevention of contrast induced nephropathy.

Author, Year	Key Question	Design	Sub group analysis	Recruitment date	Recruitment setting	Multi or single center	Inclusion criteria	Comments
Aspelin, 2003[1]	4	RCT		1999-2001	NR	Multi-center	Diabetic, serum creatinine 1.5-3.5 mg/dl 3 months prior to procedure,. Not pregnant or lactating, no IV administration of iodinated contrast media within 7 days of the study, no treatment with metformin or non-steroidal anti-inflammatory drugs, no nephrotoxic drugs within 7 days, no serious reaction to iodinated contrast media, no newly discovered unstable diabetes, no renal transplantation, no serious concomitant disease, no end stage renal disease necessitation dialysis.	
Barrett, 2006[2]	3	RCT/ Controlled	Yes	2004 to 2005	Outpatient	Multi-center	>18 years, CE-MDCT imaging of the liver or MDCT angiography of the lower-extremity vasculature, CVD; NYHA 1-2, moderate to severe Cr.>1.5, not received an investigational drug within 30 days before admission to the study, not undergone or were scheduled to undergo any other radiologic procedure using radiographic contrast media from 72 hours before to 7 days after the administration of the study agent. No New York Heart Association Class III or IV congestive heart failure or other medical conditions or circumstances which would have substantially decreased the chances of obtaining reliable data (eg, hypersensitivity to iodine-containing compounds, hyperthyroidism or thyroid malignancies, uncontrolled diabetes, unstable renal function, drug dependence, psychiatric disorders, dementia). Not nursing or pregnant patients, not scheduled to receive any medication to prevent CIN (eg, N-acetylcysteine, theophylline, fenoldopam or other drug).	
Becker, 2013[3]	3	Non-RCT		NR	NR	NR	CT; Serum creatinine < or = 1.4 mg/dl	

Evidence Table 2 - Study characteristics for studies comparing contrast media for the prevention of contrast induced nephropathy (continued).

Author, Year	Key Question	Design	Sub group analysis	Recruitment date	Recruitment setting	Multi or single center	Inclusion criteria	Comments
Bolognese, 2012[4]	4	RCT/ Controlled	Yes	2009 to 2010	Inpatient (including ICU)	Multi-center	PCI; Other Risk factors, excluded those who had investigational drug within previous 30 days, IV or IA admin of iodinated contrast from 7 days to 72 hours before, nephrotoxic medications from 24 hours before or after its admitted with STEMI who underwent primary PCI <12 hours (18 hours in cardiogenic shock cases). Not pregnant, not lactating, no administration of any investigational drug within the previous 30 days, no intra-arterial or intravenous administration of iodinated contrast media from 7 days before to 72 hours after the administration of the study agents, no intake of nephrotoxic medications from 24 hours before to 24 hours after the administration of the study agents, no previous participation in this study, and an ability to give informed consent to participate in the study	
Campbell, 1990[5]	3,4	RCT/ Controlled	No	1989 to 1989	Inpatient (including ICU) Outpatient	Single-center	Non-pregnant patients	
Carraro, 1998[6]	3	RCT/ Controlled trial	No	1995 to 1996	NR	Single-center	>18 years; Intravenous Urography; Other Risk factors,The indications for IVU included: nephrolithiasis, hematuria, urinary tract neoplasms, voiding disorders, genital tract disorders, renal TB. They cannot be pregnant or lactating, or have received iodinated contrast media within 5 days of the study, or have a history of serious reactions to iodinated contrast media, or have severe concomitant disease. They also cannot be taking potentially nephrotoxic drugs; no pregnancy or lactation, no iodinated contrast media administration within 5 days of the study, no history of serious reactions to iodinated contrast media, no severe concomitant disease, and no current assumption of potentially nephrotoxic drugs	
Chuang, 2009[7]	3	RCT/ Controlled	No	2005 to 2006	Inpatient (including ICU)	Single-center	Intravenous pyelography; T2DM; diabetes with or without renal insufficiency; renal insufficiency with or without diabetes, no pregnancy, no volume depletion or fluid overload, no IV-iodinated CM within seven days, no treatment with metformin or NSAID within 48 hours, and nephrotoxic drugs within seven days.	

Evidence Table 2 - Study characteristics for studies comparing contrast media for the prevention of contrast induced nephropathy (continued).

Author, Year	Key Question	Design	Sub group analysis	Recruitment date	Recruitment setting	Multi or single center	Inclusion criteria	Comments
Dillman, 2012[8]	3	RCT/ Controlled	No	2008 to 2010	NR	Single-center	>18years, CT; <1.5, no pregnant patients; no patients with a most recent scr measurement of > 1.5 mg/dl (if no scr measurement was available, patients received contrast material according to departmental guidelines); no patients undergoing therapy with agents purported to reduce the risk of contrast-induced nephropathy (such as N-acetylcysteine or IV hydration); no patients undergoing CT who were administered contrast material with a lower or higher concentration of iodine (for example, 370 mg I/ml contrast material used for CT angiography in our department); no patients who had experienced any prior allergic like reaction to iodinated contrast material; no patients in whom soft-tissue extravasation of contrast material of more than 5 ml occurred (so that it was not possible to determine how much contrast material the patient received as a direct IV injection); no patients who were participating in other investigational drug, contrast material, or device trial	
Feldkamp, 2006[9]	4	RCT/ Controlled	No	NR	NR	NR	>18years, elective coronary angiography; no chronic kidney disease (GFR of 50 ml/min or less assessed by the MDRD formula), acute kidney injury before coronary angiography (assessed by serum creatinine), No pregnancy, myocardial infarction in the last three weeks, decompensated heart failure, mechanical ventilation, and patients with cardiogenic shock	
Hardiek, 2008[10]	4	RCT/ Controlled	No	2001 to 2002	NR	NR	>18 years, undergoing diagnostic or interventional angiography ; Other Risk factors, History of diabetes, Stable serum creatinine levels of <2mg/dl. No hypersensitivity to iodine or contrast media. No urinary obstruction or evidence of dehydration. No dialysis, pregnancy or administration of contrast, theophylline or NAC within 24 hours of procedure.	

Evidence Table 2 - Study characteristics for studies comparing contrast media for the prevention of contrast induced nephropathy (continued).

Author, Year	Key Question	Design	Sub group analysis	Recruitment date	Recruitment setting	Multi or single center	Inclusion criteria	Comments
Hernandez, 2009[11]	3	Non-RCT	No	2005 to 2007	Inpatient (including ICU) Outpatient	Single-center	Coronary angiography, with or without PCI, T2DM; being treated with insulin and/ or oral hypoglycemic agents, no emergency procedure (eg, primary angioplasty) that did not allow for adequate patient hydration; no cardiogenic shock; no previous heart or kidney transplantation or current use of immunosuppressive agents; no renal disease requiring dialysis; no administration of CM within the previous 7 days; no lack of baseline or 72-hour postprocedure scr measurement	Patients enrolled during the first 7 months of the study received ioversol and those enrolled during the following 11 months received iodixanol
Jakobsen, 1996[12]	3,4	RCT/ Controlled	No	NR	NR	NR	Predialytic chronic renal failure, Non-diabetic	
Jevnikar, 1988[13]	4	RCT/ Controlled	No	NR	Inpatient (including ICU)	Single-center	Coronary catheterization, CVD; controlled CHF; Cr >120umol, normal glucose levels, without prior contrast medium reaction	
Jo, 2006[14]	4	RCT/ Controlled	Yes	2004 to 2004	NR	Single-center	>19 years, Other Risk factors, Creatinine Clearance <60ml/min (using Cockscroft-Gault formula), Not pregnant or lactating. Have not received contrast media within 7 days of study entry. No emergent coronary angiography, acute renal failure, end stage renal disease requiring dialysis, hypersensitivity reaction to contrast, cardiogenic shock, pulmonary edema, multiple myeloma, mechanical ventilation, parenteral use of diuretics, use of NAC, use metformin or nonsteroidal anti-inflammatoery drugs within 48 hours of procedure.	
Juergens, 2009[15]	4	RCT/ Controlled	No	2003 to 2006	NR	Multi-center	>18 years coronary angiography or PCI,; Cr >130umol-crcl<60, Exclusion criteria were pregnancy, history of anaphylactic reaction to iodinated contrast medium, treatment with contrast agents within 7 days, known allergies to NAC, cardiogenic shock, current dialysis, conditions or circumstances that precluded adequate hydration or planned post contrast dialysis	
Koutsikos, 1992[16]	3,4	RCT/ Controlled	No	NR	NR	NR	Digital vascular imaging; Other Risk factors, Peripheral or renal arterial vascular disease, non-diabetic, well-hydrated patients with satisfactory renal function (serum creatinine < 130 micromol/l) (and with peripheral or renal arterial vascular disease, as mentioned in the other question)	

Evidence Table 2 - Study characteristics for studies comparing contrast media for the prevention of contrast induced nephropathy (continued).

Author, Year	Key Question	Design	Sub group analysis	Recruitment date	Recruitment setting	Multi or single center	Inclusion criteria	Comments
Kuhn, 2008[17]	3	RCT/ Controlled	Yes	2006 to 2007	Inpatient (including ICU)	Multi-center	>18 years, CT angiography or CT of the brain, head and neck, thorax, abdomen, or pelvis, CVD; NYHA I-III, stable moderate to severe chronic kidney disease (estimated glomerular filtration rate [GFR] = 20–59 ml/ min/1.73 m2), Other Risk factors, controlled Diabetes type 1 or 2, no pregnant or lactating patient, no hypersensitivity to iodine containing compounds, no hyperthyroidism, not received any iodinated contrast agent within 7 days before the administration of the investigational product, not scheduled to receive an iodinated contrast agent within 72 hours after administration of the investigational product, not received any nephrotoxic medication (chemotherapeutic agents, non-steroidal anti-inflammatory drugs other than acetylsalicylic acid up to 325 mg/d) within 24 hours before to 24 hours after the administration of the study agent, no medical condition or circumstances that would have substantially decreased the chances of obtaining reliable data	
Laskey, 2009[18]	3,4	RCT/ Controlled	No	2005 to 2007	Inpatient (including ICU)	Multi-center	>18 years, coronary angiography with or without percutaneous coronary intervention, excluded; CKD of non-acute etiology scr measurement not older than 6 m ≥150 µmol/L (1.7 mg/dl) for men and ≥133 µmol/L (1.5 mg/dl) for women or a creatinine clearance ≤50 ml/min, Other Risk factors, DM I or II, treated with insulin or oral antiglycemics for at least 1 year, non childbearig potential or if of childbearing potential the results of a serum or urine human chorionic gonadotropin pregnancy test, performed at screening, with the result known before contrast media administration, was negative, the subject was not planned to undergo major surgery (coronary artery bypass graft, carotid endarterectomy, vascular surgery) within 3 days after the contrast media administration, the subject was not planned to undergo selective renal angiography, no history of serious hypersensitivity reaction to iodinated contrast media, no history of severe liver or hematologic disease, multiple myeloma, or manifest thyrotoxicosis, severe	

Evidence Table 2 - Study characteristics for studies comparing contrast media for the prevention of contrast induced nephropathy (continued).

Author, Year	Key Question	Design	Sub group analysis	Recruitment date	Recruitment setting	Multi or single center	Inclusion criteria	Comments
Laskey, 2009[18] (cntinued)							heart failure requiring intravenous therapy with diuretics, inotropes, and/or vasodilators, the subject was not planned to receive an intravenous diuretic or intravenous mannitol in connection to the contrast media administration, not hemodynamically unstable prestudy (ie, inability to sustain systolic blood pressure 90 mm Hg within 48 hours before contrast media administration without pressor or balloon support), not on hemodialysis or peritoneal dialysis, and/or was not in acute renal failure, the subject had not undergone kidney transplantation, the subject had not received or would not receive any of the following potentially nephroprotective drugs within 3 days before or 3 days after contrast media administration; N-acetylcysteine, fenoldopam, dopamine or hydration with sodium bicarbonate (Potentially nephroprotective drugs such as Ca-channel blockers, theophylline, etc, were allowed provided they were used for treatment of the subject's chronic underlying disease), the subject had not received or was not planning to receive any of the following nephrotoxic drugs within 7 d before or 3 d after contrast media administration; aminoglycosides, vancomycin, amphotericin B, cyclosporin, methotrexate, cisplatin, the subject had not received or was not planning to receive nonsteroidal anti-inflammatory drugs within 3 d before or 3 d after contrast media administration, with the exception of low doses of acetyl salicylic acid (up to 325 mg/d, and at a single occasion in connection with percutaneous coronary intervention up to 500 mg). However, subjects who were on a stable non-steroidal regimen could be enrolled, the subject had not or was not planning to have the initiation, discontinuation, or change in dose within 3 d before or 3 d after contrast media administration of any of the following: trimethoprim, cimetidine, angiotensin converting enzyme inhibitors, or angiotensin receptor blockers, the subject was not on metformin (eg, Glucophage, Bristol-Meyers- Squibb, New York, NY) at the time of coronary angiography/ intervention. Metformin had to be discontinued according to local guidelines, and stopped no later than the time of CM administration, withheld for at least 48 h, until the subject's scr had been evaluated and it was deemed safe to resume metformin.	

Evidence Table 2 - Study characteristics for studies comparing contrast media for the prevention of contrast induced nephropathy (continued).

Author, Year	Key Question	Design	Sub group analysis	Recruitment date	Recruitment setting	Multi or single center	Inclusion criteria	Comments
Limbruno, 2013[19]	4	RCT/ Controlled	No	NR	NR	NR	Undergoing coronary angiography and/or PCI; Creatinine clearance < or equal to 60ml/min. No allergies to iodinated contrast media. No prior contrast administration 1 month prior. Not currently using non-steroidal anti-inflammatory drugs. No acute ST-elevation myocardial infarction or cardiogenic shock.	
Mehran, 2009[20]	4	RCT/ Controlled	No	2000 to 2002	Inpatient (including ICU)	Single-center	150 consecutive imaging with min 100ml of parenteral CM (both IV and IA; Not pregnant. No contradictions to theophylline or acetylcysteine. Stable renal function with 2day fluctuation below 0.4 mg/dl. No previous examinations within 4 days of procedure.	
Millward, , 1996[21]	3,4	Non-RCT	No	1993 to 1993	NR	NR	>18<80 years. Abdominal aortography- abdominal aortography, renal arteriography- iv ctap- aortography, carotid arteriography. Excluded: non pregnant and non-lactating women.	
Nguyen, 2008[22]	3	RCT/ Controlled	No	2004 to 2006	Inpatient (including ICU)	Single-center	>18 years Clinically indicated Contrast enhanced CT; excluded, Cr >1.5 -GFR <60, No pregnancy; no lactation; no administration of iodinated contrast media within 7 days prior to study entry; no history of anaphylaxis to iodinated contrast medium; no acute renal failure; no heart or kidney transplant or otherwise treated with cyclosporine or tacrolimus; no patients receiving other potentially nephrotoxic drugs; no administration of dopamine, mannitol, or theophylline 24 hours prior to enrollment; and no administration of non-steroidal anti-inflammatory drugs other than aspirin within 48 hours prior to enrollment.	
Nie, 2008[23]	4	RCT/ Controlled	No	NR	Outpatient	Single-center	Elective coronary, carotid or peripheral angiography and/or PTCA and stenting,; serum creatinine concentrations ≥0.13 mmol/l, No allergy to the study medication, absence of unstable renal function (creatinine rising by ≥0.04 mmol/(l day),patients not on dialysis, No uncontrolled asthma, pregnant or breastfeeding.	

Evidence Table 2 - Study characteristics for studies comparing contrast media for the prevention of contrast induced nephropathy (continued).

Author, Year	Key Question	Design	Sub group analysis	Recruitment date	Recruitment setting	Multi or single center	Inclusion criteria	Comments
Rudnick, 2008[24]	4	RCT/ Controlled	Yes	2001 to 2004	NR	Multi-center	>18 years, Cardiac angiography with or without PCI; no end-stage renal disease requiring dialysis or organ transplantation; CKD (≥ 1.7 mg/dl for men and ≥ 1.5 mg/dl for women), Exclusion criteria included acute cause(s) for the elevated serum creatinine (Scr) value or a Scr value unstable by >0.5 mg/dl within 10 days of study entry; hemodynamic instability prestudy; pregnancy; lactation; intravascular administration of iodinated CM within 7 days before study entry; a requirement for additional intravascular iodinated CM for any purpose between 8 and 72 hours after initial CM administration; the scheduling of a major surgical intervention within 72 hours after the study procedure; the administration of theophylline, fenoldopam, or mannitol within 7 days before or 72 hours after contrast administration; the initiation, discontinuation, or change in dose of any of the following — trimethoprim, cimetidine, angiotensin-converting enzyme inhibitor, or angiotensin receptor blocker —within 72 hours before study entry; initiation of nephrotoxic agents, or non-steroidal anti-inflammatory drugs within 72 hours of study entry; current use of metformin; severe liver or hematologic disease; severe heart failure or a history of serious reaction to intravascular iodinated CM	
Serafin, 2011[25]	3	RCT/ Controlled	No	NR	Inpatient (including ICU)	Single-center	>18 years, cerebral angiography or angiography with endovascular embolization egfr>30 ml / min / 1.73 m^2 no history of adverse reactions to any previously administrated iodinated CM, not suspected of hyperthyroidism, not pregnant, no contrast-enhanced imaging within 7 days of the study	
Shin, 2011[26]	4	RCT/ Controlled	No	2000 to 2001	NR	Single-center	>18 years, cardiac angiography; baseline serum creatinine > 1.7 mg/dl.; no patient unable to provide informed consent, no evidence of active atheroembolic disease, including but not limited to blue toes, livedo reticularis or eosinophilia, no known prior insensitivity to acetylcysteine, no severe asthma, no breast feeding women, no severe peptic ulcer disease, or respiratory depression, no women off contraception, no patients with serum creatinine measurements varied by more than 15% in the three days before angiography	

Evidence Table 2 - Study characteristics for studies comparing contrast media for the prevention of contrast induced nephropathy (continued).

Author, Year	Key Question	Design	Sub group analysis	Recruitment date	Recruitment setting	Multi or single center	Inclusion criteria	Comments
Solomon, 2007[27]	4	RCT/ Controlled	Yes	2005 to 2006	NR	Multi-center	>18 years, diagnostic cardiac angiography or percutaneous coronary interventions, moderate to severe CKD, Criteria for exclusion were pregnancy, lactation, administration of any investigational drug within the previous 30 days, intraarterial or intravenous administration of iodinated CM from 7 days before to 72 hours after the administration of the study agents, medical conditions or circumstances that would have substantially decreased the chances to obtain reliable data (New York Heart Association class IV congestive heart failure, hyper-sensitivity to iodine-containing compounds, hyperthyroidism or thyroid malignancies, uncontrolled diabetes mellitus, unstable renal function, drug dependence, psychiatric disorders, dementia), administration of any medication to prevent CIN other than N-acetylcysteine (NAC), or intake of nephrotoxic medications from 24 hours before to 24 hours after the administration of the study agent.	
Solomon, 2009[28]	4	RCT/ Controlled	Yes	2006 to 2008	Reported in CARE study	Multi-center	All listed in CARE	Same protocol as CARE, just after 12 months. All data is the same. The only new data is AEs
Wessely, 2009[29]	4	RCT/ Controlled	Yes	2006 to 2007	NR	NR	>18years, coronary angiography with a possibility of bypass graft or percutaneous intervention, Serum creatinine >1.5mg/dl measured 24 hours before procedure, Not pregnant, not lactating, no intravascular administration of iodine containing contrast within 7 days, no renal transplant, no cardiogenic shock, no end-stage renal disease necessitating hemodialysis, and an ability to give informed consent, not taking nephrotoxic drugs.	
Zo'o, 2011[30]	3	RCT/ Controlled	No	2004 to 2006	NR	Single-center	>18years, coronary angiography; serum creatinine ≥ 1.2 mg/dl or a creatinine clearance < 50 ml/min, no acute inflammatory disease, no medication with NSAID or metformin up to 3 days before entering study, no abnormal findings in physical examinations, e.g. Signs of dehydration or inflammation	

AE=Adverse Events; Ca=Calcium; CARE= Cardiac Angiography in Renally Impaired Patients; CE-MDCT; CHF=Congestive Heart Failure; CIN=Contrast Induced Nephropathy; CKD=Chronic Kidney Disease; CM=Contrast Media; Cr=Creatinine; CT= Computerized Tomography; CVD=Cardiovascular Disease; D=Days; DM=Diabetes Mellitus; eGFR=Estimated Glomerular Filtration Rate; GFR=Glomerular Filtration Rate; H=hours; IA=Intrarterial; ICU=Intensive Care Unit; IV=Intravenous; IVU=Intravenous Urogram; MDCT; MDRD=Modification of Diet in Renal Diseases; Mg/dl=Milligrams per Deciliter; Mg=Milligrams; Micromol/L=Micromoles per liter; Ml/min/1.73m^2=milliliter per minute per 1.73 meters squared; NAC=N-acetylcysteine; NSAID=Non-steroidal Anti-inflammatory Drug; NYHA=New York Heart Association;

PCI=Percutaneous Coronary Intervention; PTCA=Percutaneous transluminal Coronary Angioplasty; RCT=Randomized Controlled Trial; SCr=Serum Creatinine; STEMI=ST Elevated Myocardial Infarction; T2DM=Type 2 Diabetes Mellitus; TB=Tuberculosis

Evidence Table 3 - Interventions for studies comparing contrast media for the prevention of contrast induced nephropathy.

Author, year	ARM	Description	Administration route	Dose, duration, other details	Comment
Aspelin, 2003[1]	1	Iodixanol	IA	Varied and not standardized	All patients well hydrated prior to procedure. Recommended: 500ml hydration orally, and 500ml saline IV before angiography followed by 1 L 0.9 percent saline
	2	Iohexol	IA	Varied and not standardized	
Barrett 2006 [2]	2	Iodixanol	IV	40+/-1.3 gI - 0.6 +/-0.1 gI/kg	
	3	Iopamidol	IV	40+/-1.3 gI - 0.6 +/-0.1 gI/kg	
Becker, 2013 [3]	1	Iopamidol	IV	NR	
	2	Iohexol	IV	NR	
	3	Iopromide	IV	NR	
	4	Iodixanol	IV	NR	
Bolognese, 2012 [4]	1	Iopromide	IA	"as necessary for each patient", N-acetylcysteine used in all pts: 1200 mg IV diluted with 100 ml 5% glucose during procedure and 1,00 mg orally twice daily for next 48 hours after PC; all its underwent hydration with IV isotonic saline (0.9%) at rate of 1 ml/kg/hr for 12 hours or 0.5 ml/kg/hr for 12 hours in cases of overt heart failure	IA balloons, inotropic drugs, abciximab, beta-blockers, ACE inhibitors, diuretics at discretion of interventional and CCU cardiologists
	2	Iodixanol	IA	"as necessary for each patient", N-acetylcysteine used in all pts: 1200 mg IV diluted with 100 ml 5% glucose during procedure and 1,00 mg orally twice daily for next 48 hours after PC; all its underwent hydration with IV isotonic saline (0.9%) at rate of 1 ml/kg/hr for 12 hours or 0.5 ml/kg/hr for 12 hours in cases of overt heart failure	
Campbell, 1990 [5]	1	Ioxaglate	IV, IA	NR	CM given EITHER IV OR IA PER PATIENT. Clinical Outcomes reported only for IA but AEs reported for both (the articles says that the patients were randomized to be given one of the three agents "for a variety of arterial and central and peripheral studies'. ARM 1 is not actually a "control" group. All three arms are treatment groups.
	2	Iohexol	IV, IA	NR	
	3	Iopamidol	IV, IA	NR	

Evidence Table 3 - Interventions for studies comparing contrast media for the prevention of contrast induced nephropathy (continued).

Author, year	ARM	Description	Administration route	Dose, duration, other details	Comment
Carraro, 1998 [6]	2	Iodixanol	IV	600 mgI/kg b. w, , preheated to 37 degrees	
	3	Iopromide	IV	600 mgI/kg b. w, , preheated to 37 degrees	
Chuang, 2009 [7]	2	Iodixanol	IV	About 0.8 mL/kg for each IVP procedure	All patients were hydrated with 0.9% saline 1 mL/kg/hr 8–12 hours before and after IVP
	3	Iohexol	IV	about 0.8 mL/kg f r each IVP procedure	
Dillman 2012 [8]	2	Iopamidol	IA	100-150 ml	
	3	Iohexol	IV	100-150 ml	
Feldkamp 2006 [9]	2	Iodixanol	NR	CM: 320 mg iodine/ ml. All patients received normal saline IV hydration before, during and after procedure	
	3	Iopromide	NR	CM: 320 mg iodine/ ml. All patients received normal saline IV hydration before, during anf after procedure	
Hardiek 2008 [10]	2	Iodixanol	IA	320mg/ml, mean total iodine 46g (SD 20)	
	3	Iopamidol	IA	320mg/ml, mean total iodine 46g (SD 20)	
Hernandez 2009 [11]	2	Ioversol	NR	195.5mls+/-92.1	Prophylactic volume expansion with 1000 mL intravenous normal saline was administered for 6 to 12 hours before the procedure (100 to 150 mL/h) and an oral dose of 1200 mg N-acetylcysteine (NAC) (Fluimucil®, Zambon, Milan, Italy) was administered 6 hours before and 6 hours after the procedure
	3	Iodixanol	NR	195.5mls+/-92.1	
Jakobsen 1996 [12]	2	Iodixanol	NR	Mean: 0.34 g I/kg b.w. (Range: 0.25-0.48)	
	3	Iohexol	NR	Mean: 0.34 g I/kg b.w. (Range: 0.25-0.48)	
Jevnikar 1988 [13]	2	Ioxaglate	IA	0.70+/-0.05 g Iodine/kg/body weight, total iodine 61.5+/-3.2	
	3	Iohexol	IA	0.70+/-0.05 g Iodine/kg/body weight, total iodine 61.5+/-3.2	
	4	Diatrizoate	IA	0.70+/-0.05 g Iodine/kg/body weight, total iodine 61.5+/-3.2	
Jo 2006 [14]	2	Iodixanol	IA	Mean dose: 204.6ml (SD 159.2)	Contrast media dose not set through protocol. Only given mean dosage.
	3	Ioxaglate	IA	Mean dose: 204.6ml (SD 159.2)	

Evidence Table 3 - Interventions for studies comparing contrast media for the prevention of contrast induced nephropathy (continued).

Author, year	ARM	Description	Administration route	Dose, duration, other details	Comment
Juergens 2009 [15]	2	Iopromide	IA	Iodine concentration: 370 mg/ml, , Four doses of NAC were given orally(600 mg b.i.d.),starting the day before contrast administration. Saline (0.9%) was given intravenously so that patients received at least 500 mL before the procedure. atientsalsoreceived130 mL/h for at least 3 h post procedure in addition to liberal oral fluid intake	
	3	Iodixanol	IA	iodine concentration: 370 mg/ml, , Four doses of NAC were given orally(600 mg b.i.d.),starting the day before contrast administration. Saline (0.9%) was given intravenously so that patients received at least 500 mL before the procedure. atientsalsoreceived130 mL/h for at least 3 h post-procedure in addition to liberal oral fluid intake	
Koutsikos, 1992 [16]	2	diatrizoate (also known as Urografin 76%)	IA	103.33+/-45.09 mL (mean iodine content 38.75 +/- 16.91 g)	
	3	Ioxaglate	IA	133.33+/-61.1 mL (mean iodine content 42.66 +/- 19.55 g)	
	4	Iohexol	IA	132.69+/-56.88 mL (mean iodine content 39.81 +/- 17.06 g)	
Kuhn 2008 [17]	2	Iopamidol	IV	mean=106.5 mL, range = 66–185 mL	all patients at risk (deemed clinically necessary or desirable) received prophylaxis for CIN via hydration before, during, or after contrast administration
	3	Iopamidol	IV	mean=106.5 mL, range = 66–185 mL	
Laskey 2009 [18]	2	Iodixanol	IA	NR	
	3	Iopamidol	IA	NR	
Limbruno 2013 [19]	2	Iodixanol	IA	320 mg/ml	All patients given 0.9% saline at 1 ml/kg/h, for 12 hours before and for 12 hours after procedure.
	3	Iobitridol	IA	320 mg/ml	
Mehran 2009 [20]	2	Iodixanol	IA	Mean: 48.1 min (SD 35.5)	Patients received diphenydramine 25 mg IV before procedure as well as intravenous one-half isotonic saline at 100 ml/h for at least 3 to 5 h before the index procedure, throughout the angiographic interventional procedure, and for at least 12 h after CM administration.
	3	Ioxaglate	IA	NR	

Evidence Table 3 - Interventions for studies comparing contrast media for the prevention of contrast induced nephropathy (continued).

Author, year	ARM	Description	Administration route	Dose, duration, other details	Comment
Millward 1996 [21]	2	Ioxaglate	IV, IA	NR	
	3	Ioversol	IV, IA	NR	
Nguyen 2008 [22]	2	Iodixanol	IV	115ml	
	3	Iodixanol	IV	115ml	
Nie 2008 [23]	2	Iodixanol	IA	320 mg I/mL, Patients received prophylactic volume expansion with 1,000 mL intravenous normal saline at a rate of 1.0 to 1.5 mL/kg/hr for 4 hr before and continuing for 6 hr after the procedure	All patients received clopidogrel (300 mg) before the intervention. Clopidogrel (75 mg/day) was continued for 2 weeks in patients who did not undergo PCI, whereas patients who underwent PCI received clopidogrel (75 mg/day) and aspirin (100 to 300 mg/day)for 9 months
	3	Iopromide	IA	370 mg I/mL, patients received prophylactic volume expansion with 1,000 mL intravenous normal saline at a rate of 1.0 to 1.5 mL/kg/hr for 4 hr before and continuing for 6 hr after the procedure	
Rudnick 2008 [24]	2	Iodixanol	IA	320 mg-I/ml, sodium chloride solution (0.9%) was infused intravenously at 125 mL/h for at least 2 hours before and at least 6 hours after CM administration. Oral fluid intake was encouraged ad libitum. Use of NAC was left to the investigator's discretion	
	3	ioversol	IA	320 mg-I/ml, sodium chloride solution (0.9%) was infused intravenously at 125 mL/h for at least 2 hours before and at least 6 hours after CM administration. Oral fluid intake was encouraged ad libitum. Use of NAC was left to the investigator's discretion	
Serafin 2011 [25]	2	Iopromide	IA	151.2 +/- 52.1 mL	
	3	Iodixanol	IA	151.2 +/- 52.1 mL	
Shin 2011 [26]	2	Iodixanol	IA	Mean: 179.0 +/- 127.2	Patients received intravenous normal saline at a rate of 1 ml/kg/hour >/= 8 hours before and after CAG. The use of N-acetylcysteine was allowed at the attending physician's discretion.
	3	Iopromide	IA	Mean: 179.0 +/- 127.2	

Evidence Table 3 - Interventions for studies comparing contrast media for the prevention of contrast induced nephropathy (continued).

Author, year	ARM	Description	Administration route	Dose, duration, other details	Comment
Solomon 2007 [27]	2	Iopamidol	IA	796 mOsm/kg, all patients received prophylactic volume expansion with isotonic sodium bicarbonate solution, administered at 3 mL/kg per hr for 1 hour before angiography, and at 1 mL/kg per hr during angiography and for 6 hours after angiography. Each site chose whether they would administer a prophylactic NAC regimen to all of its patients, a regimen that consisted of an oral dose of 1200 mg twice per day administered on the day before and the day of the study procedure	
	3	Iodixanol	IA	796 mOsm/kg, all patients received prophylactic volume expansion with isotonic sodium bicarbonate solution, administered at 3 mL/kg per hr for 1 hour before angiography, and at 1 mL/kg per hr during angiography and for 6 hours after angiography. Each site chose whether they would administer a prophylactic NAC regimen to all of its patients, a regimen that consisted of an oral dose of 1200 mg twice per day administered on the day before and the day of the study procedure	
Solomon 2009 [28]	1	Iodixanol	IA	NR	
	2	Iodixanol	IA	NR	
	3	Iopamidol	IA	NR	
Zo'o 2011 [30]	2	Iobitridol	IV	2 ml/kg body weight, maximum 100 ml	
	3	Iodixanol	IV	2 ml/kg body weight, maximum 100 ml	

ACE=Angiotensin Converting Enzyme; AE=Adverse Events; b.i.d=Bi-daily; b.w=Bi-weekly; CAG=Coronary angiogram; CCU=Coronary Care Unit; CM=Contrast Media; hr=Hour; IA=Intrarterial; IV=Intravenous; IVP=Intravenous Pyelogram; kg=kilogram; Kg=kilograms; Mg=milligrams; ml=milliliter; mOsm/kg=milliosmoles per kilogram; NAC=N-acetylcysteine; NR=Not Reported; PC=Post Cibum; PCI=Percutaneous Coronary Intervention; Pts=parts; SD=Standard Deviation

Evidence Table 4. Summary of randomized controlled trials comparing low-osmolar contrast media with contrast-induced nephropathy as an outcome.

Author, year	Location	LOCM	Route	N	Population	Procedure	Mean age, y	Females, %	Primary outcome	Risk of bias
Campbell, 1990[5]	N. America	Iohexol, Ioxaglate, Iopamidol	IA	252	General	Peripheral arterio-graphy	58	45	Change in serum creatinine within 72 hours for those with detectable increase	H
Jevnikar, 1988[13]	N. America	Iohexol, Ioxaglate	IA	16	No renal impairment	Coronary	56	17	Change in serum creatinine after 20 hours	H
Koutsikos, 1992[16]	Europe	Iohexol, Ioxaglate	IA	40	No renal impairment	Renal	56	20	Change in serum creatinine after 24 hours	H
Becker, 2013[3]	N. America	Iohexol, Iopamidol, Iopromide	IV	113	No renal impairment	CT	52	54	Change in GFR within 72 hours	M
Dillman, 2012[8]	N. America	Iohexol, Iopamidol	IV	389	No renal impairment	CT	56	52	Development of CIN. Change in serum creatine >0.5mg/dl from baseline in 2 days	L

CT=computerized tomography; GFR=glomerular filtration rate; H=high risk of bias; IA=intra-arterial; IV=intravenous; L=low risk of bias; LOCM=low-osomolar contrast media; M=medium risk of bias; N. America=North America; N=sample size; Y=year

Evidence Table 5a – Comparison between low-osmolar contrast media: prevention of contrast induced nephropathy (categorical data).

Author, year	Outcome	Measure	Subgroup (not a subgroup is column is left blank)	Intervention	ARM	Time Point 1	Time point 1 N analyzed	n (%) with outcome at time point 1	Comparison* statistics at time point 1	Time Point 2	Time point 2 N anlayzed	n (%) with outcome at time-point 2	Com-parison statistics at time point 2
Dillman, 2012[8]	Development of CIN (change in Creatinine or GFR--specify)--short term	Change in serum creatine >0.5mg/dl from baseline in 2 days		Iopamidol	2	2 or 3 days	199	1 (1)	p=0.62				
Dillman, 2012[8]	Development of CIN (change in Creatinine or GFR--specify)--short term	Change in serum creatine >0.5mg/dl from baseline in 2 days		Iohexol	3		190	1 (2)					
Campbell, 1990[5]	Change in Serum creatinine--short term	any rise in serum cr (yes or no) and mean change in serum cr (micromol/L)		Ioxaglate	1	72 hours	161	109					
Campbell, 1990[5]	Change in Serum creatinine--short term	any rise in serum cr (yes or no) and mean change in serum cr (micromol/L)		Iohexol	2		158	96					
Campbell, 1990[5]	Change in Serum creatinine--short term	any rise in serum cr (yes or no) and mean change in serum cr (micromol/L)		Iopamidol	3		159	103					
Campbell, 1990[5]	Change in Serum creatinine--short term	any increase in serum cr (umol/L) (yes or no) and the mean change in serum cr (micromol/L)	intra-arterial injection	Ioxaglate	1	72 hours	95	67 (71)	All arms P >=0.05				

Evidence Table 5a – Comparison between low-osmolar contrast media: prevention of contrast induced nephropathy (categorical data) (continued).

Author, year	Outcome	Measure	Subgroup (not a subgroup is column is left blank)	Intervention	ARM	Time Point 1	Time point 1 N analyzed	n (%) with outcome at time point 1	Comparison* statistics at time point 1	Time Point 2	Time point 2 N anlyzed	n (%) with outcome at time-point 2	Com-parison statistics at time point 2
Campbell, 1990[5]	Change in Serum creatinine--short term	any increase in serum cr (umol/L) (yes or no) and the mean change in serum cr (micromol/L)	intra-arterial injection	Iohexol	2		67	47 (70)					
Campbell, 1990[5]	Change in Serum creatinine--short term	any increase in serum cr (umol/L) (yes or no) and the mean change in serum cr (micromol/L)	intra-arterial injection	Iopamidol	3		90	68 (76)					

%=percent; CIN=contrast induced nephropathy; Cr=creatinine; GFR=glomerular filtration rate; Mg/dl=milligram per decliter; Micromole/L=micromole per liter; n=number of events; N=sample size; P=p-value; Umol/l=micromole per liter

Evidence Table 5b – Comparison between low-osmolar contrast media: prevention of contrast induced nephropathy (continuous data).

Author, yr	Outcome	Measure	Sub-group	Intervention	ARM	Baseline N analyzed	Mean (SD)*	Time Point 1	Time point 1 N analyzed	Mean (SD)*	Com-parison statistics at time point 1†	Time Point 2	Time point 2 N analyzed	Mean (SD)*	Com-parison statistics at time point 2†
Becker, 2013[3]	Change in GFR (eGFR)--short term	%		Iopamidol	1			3 hours		median=+5		72 hours		median=-5	p=>0.18
	Change in GFR (eGFR)--short term	%		Iohexol	2					median=+1				Median=-2.5	
	Change in GFR (eGFR)--short term	%		Iopromide	3					median, +5				median, +10	
	Change in GFR (eGFR)--short term	%		Iodixanol	4					median,				median, +9	
Dillman, 2012[8]	Change in GFR (eGFR)--short term			Iopamidol	2			2 days	199	-1.95 (13.86), (95% CI: -3.98 to 0.09), p=0.055	p=0.16	3 days	199	-1.87 (13.15) (95% CI: -3.82 to 0.09), p=<0.0001	p=0.16
	Change in GFR (eGFR)--short term			Iohexol	3				190	-5.34 (16.74), (95% CI:-7.84 to -2.85)p=<0.0001			190	-3.68(-3.68) (95% CI: -6.12 to -1.24)	
Jevnikar, 1988[13]	Serum creatinine--short term	umol/l		Ioxaglate	2	8	110 (5)	4 hours	8	111 ()	All arms p=NS	20 hours	8	120 (8)	P=ns
	Serum creatinine--short term	umol/l		Iohexol	3	8	110 (5)		8	108 (5)			8	112 (5)	
	Serum creatinine--short term	umol/l		Diatrizoate	4	7	107.5 (8)		7	108 (6)			7	120 (12)	

Evidence Table 5b – Comparison between low-osmolar contrast media: prevention of contrast induced nephropathy (continuous data) (continued).

Author, yr	Outcome	Measure	Sub-group	Intervention	ARM	Baseline N analyzed	Mean (SD)*	Time Point 1	Time point 1 N analyzed	Mean (SD)*	Com-parison statistics at time point 1†	Time Point 2	Time point 2 N analyzed	Mean (SD)*	Com-parison statistics at time point 2†
Koutsikos, 1992[16]	Serum creatinine--short term	micromol/L	Intra venous contrast administration	diatrizoate (also known as Urografin 76%)	2	20	90.17 (3.79)	24 hours	20	93.82 (4.59)	P=NS (compared to baseline)				
				Ioxaglate	3	20	88.53 (4.72)		20	96.64 (6.33)	P=NS (compared to baseline)				
				Iohexol	4	20	82.58 (2.96)		20	82.75 (3.95)	P=NS (compared to baseline)				
Koutsikos, 1992[16]	Serum creatinine--short term	micromol/L	Intra arterial contrast administration	diatrizoate (also known as Urografin 76%)	2	20	76.2(6.45)	24 hours	20	83.2 (4.73)	P=NS (compared to baseline)				
				Ioxaglate	3	20	76.0 (8.88)		20	86.5(8.25)	P=NS (compared to baseline)				
				Iohexol	4	20	68.78 4.1)		20	78.8 (7.14)	P=NS (compared to baseline)				

%=percent, CI=Confidence Interval, CIN=Contrast Induced Nephropathy, ClCr=Creatinine Clearance, cr=Creatinine, eGFR=estimated Glomerular Filtration Rate, H=Hours, Hrs=Hours, Mg/dl=milligrams per deciliter, Ml=milliliter, N=Sample size, NR=Not reported, Ns=Not significant, P=p-value, PCI=percutaneous coronary intervention, SCr=Serum Creatinine, Umol/L=micromole per liter

Evidence Table 6 – Comparison between low-osmolar contrast media reporting on other outcomes.

Author, year	Comparison	Mortality N/n (%)	Adverse events N/n (%)
Campbell, 1990[5]	Arm 2: Iohexol Arm 3: Iopamidol	Death (within a few weeks): Both arms" 320/8 (2.5) P=NR	Hypersensitivity, nausea, vomiting, hives: Arm 2 161/20 (8) Arm 3:159/7 (4.4) P=NR

n=number of events; N=total sample size; NR=not reported; P=p-value

Table 7. Summary of randomized controlled trials comparing iso-osmolar and low osmolar contrast media with contrast-induced nephropathy as a primary outcome.

Author, year	Location	LOCM	Route	N	Population	Procedure	Mean age, y	CIN defin-ition*	IOCM group	LOCM group	P value†	Follow-up, hours	Primary result RR(95%CI)	Study limita-tions
Aspelin, 2003[1]	Europe	Iohexol	IA	129	Renal impairment and diabetes	Coronary, Aortofemoral	71	A2	2/64	17/65	0.0003	72	0.1 (0.0,0.6)	M
Bolognese, 2012[4]	Europe	Iopromide	IA	475	Myocardial infarction	Coronary	66	A1	30/231	23/234	0.3	72	1.3 (0.8, 2.1)	L
Feldkamp, 2006[9]	Europe	Iopromide	IA	83	No renal impairment	Coronary	62	A1	9/105	8/116	0.8	48	1.2 (.5, 3.1)	H
Hardiek, 2008[10]	N. America	Iopamidol	IA	106	Diabetes	Coronary	66	A1	7/54	10/48	0.3	168	0.7 (0.3, 1.6)	L
Hernandez, 2009[11]	Europe	Ioversol	IA	250	Diabetes	Coronary	70	A3	3/118	11/132	0.06	72	0.3 (0.1, 1.1)	H
Jakobsen, 1996[12]	Europe	Iohexol	IA	16	Renal impairment	Aorta, pelvic	55	A1	0/8	1/8	1.0	120	0.4 (0.0, 8.0)	M
Jo, 2006[14]	Asia	Ioxaglate	IA	275	Renal impairment	Coronary	67	A3	11/140	23/135	0.03	48	0.5 (0.3, 1.0)	M
Juergens, 2009[15]	Australia	iopromide	IA	382	Renal Impairment	coronary	70	A3	11/91	15/100	0.7	48	0.8 (0.4, 1.7)	L
Laskey, 2009[18]	Europe, Asia	iopamidol	IA	418	Renal Impairment And Diabetes	coronary	70	A2	24/214	20/203	0.8	72	1.1 (0.6. 2.0)	M
Limbruno, 2013[19]	Europe	iobitridol	IA	113	Renal Impairment	coronary	76	A1	6/57	6/56	1.0	72	1.0 (0.3, 2.9)	H
Mehran, 2009[20]	N. America	ioxaglate	IA	146	Renal Impairment	coronary	71	A3	11/72	18/74	0.2	72	0.7 (0.3, 1.3)	M
Nie, 2008[23]	Asia	iopromide	IA	208	Renal Impairment	coronary	61	A3	6/106	17/102	0.01	72	0.4 (0.2, 0.9)	M
Rudnick, 2008[24]	N. America	ioversol	IA	299	Renal Impairment	coronary	72	A2	34/156	34/143	0.8	72	0.9 (0.6, 1.4)	L
Serafin, 2011[25]	Europe	iopromide	IA	92	Neurosurgical	cerebral	50	A3	8/44	13/48	0.3	72	0.7 (0.3, 1.6)	M
Shin, 2011[26]	Asia	iopromide	IA	420	Renal Impairment	coronary	72	A3	23/215	16/205	0.3	48	1.3 (0.7, 2.5)	L
Solomon, 2007[27]	N. America	iopamidol	IA	414	Renal Impairment	coronary	71	A1	26/210	20/204	0.4	45-120	1.2 (0.7, 2.1)	M
Wessely, 2009[29]	Europe	iomeprol	IA	324	Renal Impairment	coronary	74	A3	36/162	45/162	0.3	NR	0.8 (0.6, 1.2)	M

Table 7. Summary of randomized controlled trials comparing iso-osmolar and low osmolar contrast media with contrast-induced nephropathy as a primary outcome (continued).

Author, year	Location	LOCM	Route	N	Population	Procedure	Mean age, y	CIN defin-ition*	IOCM group	LOCM group	P value†	Follow-up, hours	Primary result	Study limit-ations
Barrett, 2006[2]	Asia	Iopamidol	IV	166	Renal impairment	CT	67	A1	3/76	3/77	1.0	48-72	1.0 (0.2,4.9)	L
Becker, 2013[3]	N. America	Iohexol, Iopamidol, Iopromide	IV	113	No renal impairment	CT	52	NR	NR	NR	NR	NR	NR	M
Carraro, 1998[6]	Europe	Iopromide	IV	64	Renal impairment	IVU	68	A4	1/32	0/32	1.0	24	2.9 (0.1, 68.9)	H
Chuang, 2009[7]	Asia	Iohexol	IV	50	Renal impairment or diabetes	IVU	58	A1	1/25	1/25	1.0	72	1.0 (.1, 15.1)	H
Kuhn, 2008[17]	N. America	iopamidol	IV	248	Renal Impairment And Diabetes	CT	69	A1	6/123	7/125	1.0	72	0.9 (0.3, 2.5)	H
Nguyen, 2008[22]	N. America	iopromide	IV	117	Renal Impairment	CT	64	A1	5/61	15/56	0.01	72	0.4 (0.1, 0.9)	M
Zo'o, 2011[30]	Europe	iobitridol	IV	145	Children	CT	8	B	7/66	3/62	0.3	72	2.1 (0.6, 7.7)	L

CIN=contrast induced nephropathy; CT=computerized tomography; GFR=glomerular filtration rate; H=high; IA=intra-arterial; IOCM=iso-osmolar group; IV=intravenous; IVU=intravenous urogram; L=low; LOCM=low-osomolar contrast media; M=medium; N. America=North America; N=sample size; NR=not reported; pos = positive; RR=relative risk; Y=year

* A = rise in serum creatinine relative to baseline: ≥25% (A1); ≥0.5 mg/dl (A2); ≥25% or ≥0.5 mg/dl (A3); ≥50% (A4). B: >25% reduction in creatinine clearance.
† P value from Fisher exact test calculated from the counts in the preceding two table columns.

Table 8. Comparison between iso- and low-osmolar contrast media: prevention of contrast induced nephropathy , study reporting eGFR only

Author, year	Outcome	Measure	Sub-group (not a subgroup is column is left blank)	Inte rve n-tio n	ARM	Time Point 1	Time point 1 N anal-yzed	n (%) with out-come at time point 1	Comp-arison statistics at time point 1	Time Point 2	Time point 2 N analyzed	N(%) with out-come at time point 2	Com-parison statistics at time point 2	Time Point 3	Time point 3 N anal-yzed	n (%) with out-come at time point 3	Com-parison statistic s at time point 3
Becker, 2013[3]	Change in GFR (eGFR)--short term	%		Iop ami dol	1	3 hours		median =+5		72 hours		median=-5	p=>0.18				
	Change in GFR (eGFR)--short term	%		Ioh exo l	2			median =+1				median=-2.5					
	Change in GFR (eGFR)--short term	%		Iopr omi de	3			median , +5				median, +10					
	Change in GFR (eGFR)--short term	%		Iodi xan ol	4			median ,				median, +9					

%=Percentage, CI=Confidence Interval, eGFR=Estimated Glomerular Filtration Rate, GFR=Glomerular Filtration Rate, Mg/dl=milligram per deciliter, Micromole/L=micromole per liter, Ml/min/1.73m^2=milliliter per minute per 1.73 meter squared, N=Sample Size, NR=Not Reported, NS=Not Significant, p=P-value, PCI=Percutaneous Coronary Intervention, SCr=Serum Creatinine, SD=Standard Deviation, Umol/L=micromole per liter

Table 9. Comparison between iso- and low-osmolar contrast media reporting on other outcomes.

Author, year	Comparison IOCM v LOCM	Need for RRT (%)	Cardiovascular outcomes N/n (%)	Mortality (%)	Adverse events (%)	Diagnostic accuracy
Bolognese, 2012[4]	Arm 2: Iodixanol Arm 3: Iopromide	N=475 Arm 2: (0) Arm 3: (0.8) p=0.49	Cardiac deaths Arm 2: (3.4) Arm 3: (4.7) p=0.5 MACE Arm 2: (5.6) Arm 3: (7.5) p=0.37 Reinfarction Arm 2: (2.5) Arm 3: (2.1) p=0.77 Rehospital-ization for heart failure Arm 2: (0.8) Arm 3: (0.4) p=1	Cardiac death Arm 2: (3.4) Arm 3: (4.6) p=0.5 In-hosptial death Arm 2: (3.0) Arm 3: (3.8) p=0.62		

Table 9. Comparison between iso- and low-osmolar contrast media reporting on other outcomes (continued).

Author, year	Comparison IOCM v LOCM	Need for RRT (%)	Cardiovascular outcomes N/n (%)	Mortality (%)	Adverse events (%)	Diagnostic accuracy
Chuang, 2009[7]					Total allergic reactions Arm 2: (8) Arm 3: (24) p=0.24 Early reaction Arm 2: (0) Arm 3: (12) p=0.23 Burning in throat Arm 2: (0) Arm 3: (4) p=1 Dizziness Arm 2: (0) Arm 3: (8) p=1 Late reactions Arm 2: (8) Arm 3: (12) p=1 Skin rash Arm 2: (8) Arm 3: (12) p=1	

Table 9. Comparison between iso- and low-osmolar contrast media reporting on other outcomes (continued).

Author, year	Comparison IOCM v LOCM	Need for RRT (%)	Cardiovascular outcomes N/n (%)	Mortality (%)	Adverse events (%)	Diagnostic accuracy
Hardiek, 2008[10]					Nausea Arm 2: (3.7) Arm 3: (4.2) p=NR Fever Arm 2: (0) Arm 3: (3.7) p=NR Rash Arm 2: (7.4) Arm 3: (1.9) p=NR ARF Arm 2: (0) Arm 3: (1.9) p=NR	
Jo, 2006[14]	Arm 2: Iodixanol Arm 3: Ioxaglate	N=275 Arm 2: (0.7) Arm 3: (0.7) p=NR			Composite of CV events in-hospital and 30 days post discharge and diagnostic image quality Arm 2: (2.1) Arm 3: (2.2) p=1	
Juergens, 2009[15]	Arm 2: Iodixanol Arm 3: Iopromide		N=70 Arrhythmia* (1.6) Periprocedural * (2.1)MI P=NR		Multiple AEs Arm 2: (NR) Arm 3: (NR) p=	
Kuhn, 2008[17]	Arm 2: Iodixanol Arm 3: Iopamidol	N=248 Arm 2: (0) Arm 3: (0) p=NR		Arm 2: (0) Arm 3: (0) p=NR		
Laskey, 2009[18]	Arm 2: Iodixanol Arm 3: Iopamidol	N=418 Arm 2: (0.7) Arm 3: NR p=NR		Deaths were reported in the intention to treat (ITT) and the per protocol (PP) populations as in hospital deaths n=7 (ITT) and in hospital deaths n=3 (PP). Deaths not stratified or reported by intervention group.		

Table 9. Comparison between iso- and low-osmolar contrast media reporting on other outcomes (continued).

Author, year	Comparison IOCM v LOCM	Need for RRT (%)	Cardiovascular outcomes N/n (%)	Mortality (%)	Adverse events (%)	Diagnostic accuracy
Mehran, 2009[20]	Arm 2: Iodixanol Arm 3: Ioxaglate		MI Arm 2: (0) Arm 3: (1.3) p=1	Arm 2: (27.8) Arm 3: (0) p=0.24	Death, MI, and repeat revascularization Arm 2: (0) Arm 3: (5.4) p=0.12	
Nguyen, 2008[22]				Arm 2: (4.9) Arm 3: (3.6) p=NR		
Nie, 2008[23]	Arm 2: Iodixanol Arm 3: Iopromide		Composite CV outcome* Arm 2: (0.1) Arm 3: (5.9) p=0.025		Emergent PCI Arm 2: (0) Arm 3: (2.0) p=0.24 Abrupt vessel closure Stroke Arm 2: (1) Arm 3: (2) p=0.61 Thombosis Arm 2: (1) Arm 3: (3) p=0.36 Cardiac death Arm 2: (0) Arm 3: (0) p=-- Nonfatal MI Arm 2: (0) Arm 3: (1) p=0.49 CABG Arm 2: (0) Arm 3: (0) p=--	Image quality* Grade 1 =optimal Arm 2: (70.8) Arm 3: (79.4) Grade 2 =suboptimal Arm 2: (20) Arm 3: (13.7) Grade 3 = not diagnostic Arm 2: (9.4) Arm 3: (6.9) p=0.35 (calculated across groups and measures)
Serafin, 2011[25]				(2.2) entire study population p=NR		
Shin, 2011[26]	Arm 2: Iodixanol Arm 3: Iopromide		MACE Arm 2: (2.3) Arm 3: (2.0)			

			p>0.99			

Table 9. Comparison between iso- and low-osmolar contrast media reporting on other outcomes (continued).

Author, year	Comparison IOCM v LOCM	Need for RRT (%)	Cardiovascular outcomes N/n (%)	Mortality (%)	Adverse events (%)	Diagnostic accuracy
Solomon, 2007[27]	Arm 2: Iodixanol Arm 3: Ioppamidol		Serious cardio-vascular events‡ 0 reports			
Wessely, 2009[29]	Arm 2: Iodixanol Arm 3: Iomeprol	N=324 Arm 2: (1.9) Arm 3: (0.6) p=0.31	MI Arm 2: (4.3) Arm 3: (4.3) p=0.77 MACE Arm 2: (8.6) Arm 3: (13.0) p=0.2.1	Arm 2: (3.7) Arm 3: (4.3) p=0.78		
Zo'o, 2011[30]					Pts with at least 1 AE Arm 2: (24) Arm 3: (26) p=NR Serious AEs Arm 2: (6) Arm 3: (6.8) p=NR	Image quality is “good” Arm 2: (89.4) Arm 3: (83.9) p=0.73 Diagnostic efficacy “easy” Arm 2: (98.5) Arm 3: (90.3) p=0.58

* numbers reported are for the entire study population

CIN = contrast-induced nephropathy; CT=computerized tomography; CV=cardiovascular; CV=cardiovascular; H=High risk of bias; HF=heart failure; IA = intra-arterial; IOCM-iso-osmolar contrast media; ITT=intention to treat; IV = intravenous; IVU = intravenous urography; L=low risk of bias; LOCM = low osmolar contrast media; MACE=major adverse cardiac events; MI=myocardial infarction; M-moderate risk of bias; NA = not applicable; NR = not reported; NS = not significant; PCI=percutaneous coronary intervention; PP=protocol population; Pts=patients; RRT = renal replacement therapy;
* numbers reported are for the entire study population

References

1. Aspelin P, Aubry P, Fransson SG, et al. Nephrotoxic effects in high-risk patients undergoing angiography. N Engl J Med. 2003 Feb 6;348(6):491-9. PMID: 12571256.
2. Barrett BJ, Katzberg RW, Thomsen HS, et al. Contrast-induced nephropathy in patients with chronic kidney disease undergoing computed tomography: a double-blind comparison of iodixanol and iopamidol. Invest Radiol. 2006 Nov;41(11):815-21. PMID: 17035872.
3. Becker J, Babb J, Serrano M. Glomerular filtration rate in evaluation of the effect of iodinated contrast media on renal function. AJR Am J Roentgenol. 2013 Apr;200(4):822-6. PMID: 23521455.
4. Bolognese L, Falsini G, Schwenke C, et al. Impact of iso-osmolar versus low-osmolar contrast agents on contrast-induced nephropathy and tissue reperfusion in unselected patients with ST-segment elevation myocardial infarction undergoing primary percutaneous coronary intervention (from the Contrast Media and Nephrotoxicity Following Primary Angioplasty for Acute Myocardial Infarction [CONTRAST-AMI] Trial). Am J Cardiol. 2012 Jan 1;109(1):67-74. PMID: 21943940.
5. Campbell DR, Flemming BK, Mason WF, et al. A comparative study of the nephrotoxicity of iohexol, iopamidol and ioxaglate in peripheral angiography. Can Assoc Radiol J. 1990 Jun;41(3):133-7. PMID: 2354386.
6. Carraro M, Malalan F, Antonione R, et al. Effects of a dimeric vs a monomeric nonionic contrast medium on renal function in patients with mild to moderate renal insufficiency: a double-blind, randomized clinical trial. Eur Radiol. 1998;8(1):144-7. PMID: 9442148.
7. Chuang FR, Chen TC, Wang IK, et al. Comparison of iodixanol and iohexol in patients undergoing intravenous pyelography: a prospective controlled study. Ren Fail. 2009;31(3):181-8. PMID: 19288321.
8. Dillman JR, al-Hawary M, Ellis JH, et al. Comparative investigation of i.v. iohexol and iopamidol: effect on renal function in low-risk outpatients undergoing CT. AJR Am J Roentgenol. 2012 Feb;198(2):392-7. PMID: 22268183.
9. Feldkamp T, Baumgart D, Elsner M, et al. Nephrotoxicity of iso-osmolar versus low-osmolar contrast media is equal in low risk patients. Clin Nephrol. 2006 Nov;66(5):322-30. PMID: 17140161.
10. Hardiek KJ, Katholi RE, Robbs RS, et al. Renal effects of contrast media in diabetic patients undergoing diagnostic or interventional coronary angiography. J Diabetes Complications. 2008 May-Jun;22(3):171-7. PMID: 18413220.
11. Hernandez F, Mora L, Garcia-Tejada J, et al. Comparison of iodixanol and ioversol for the prevention of contrast-induced nephropathy in diabetic patients after coronary angiography or angioplasty. Rev Esp Cardiol. 2009 Dec;62(12):1373-80. PMID: 20038403.
12. Jakobsen JA, Berg KJ, Kjaersgaard P, et al. Angiography with nonionic X-ray contrast media in severe chronic renal failure: renal function and contrast retention. Nephron. 1996;73(4):549-56. PMID: 8856250.
13. Jevnikar AM, Finnie KJ, Dennis B, et al. Nephrotoxicity of high- and low-osmolality contrast media. Nephron. 1988;48(4):300-5. PMID: 3362276.
14. Jo SH, Youn TJ, Koo BK, et al. Renal toxicity evaluation and comparison between visipaque (iodixanol) and hexabrix (ioxaglate) in patients with renal insufficiency undergoing coronary angiography: the RECOVER study: a randomized controlled trial. J Am Coll Cardiol. 2006 Sep 5;48(5):924-30. PMID: 16949481.
15. Juergens CP, Winter JP, Nguyen-Do P, et al. Nephrotoxic effects of iodixanol and iopromide in patients with abnormal renal function receiving N-acetylcysteine and hydration before coronary angiography and intervention: a randomized trial. Intern Med J. 2009 Jan;39(1):25-31. PMID: 18771430.
16. Koutsikos D, Konstadinidou I, Mourikis D, et al. Contrast media nephrotoxicity: comparison of diatrizoate, ioxaglate, and iohexol after intravenous and renal arterial administration. Ren Fail. 1992;14(4):545-54. PMID: 1462006.

17. Kuhn MJ, Chen N, Sahani DV, et al. The PREDICT study: a randomized double-blind comparison of contrast-induced nephropathy after low- or isoosmolar contrast agent exposure. AJR Am J Roentgenol. 2008 Jul;191(1):151-7. PMID: 18562739.

18. Laskey W, Aspelin P, Davidson C, et al. Nephrotoxicity of iodixanol versus iopamidol in patients with chronic kidney disease and diabetes mellitus undergoing coronary angiographic procedures. Am Heart J. 2009 Nov;158(5):822-8 e3. PMID: 19853704.

19. Limbruno U, Picchi A, Micheli A, et al. Refining the assessment of contrast-induced acute kidney injury: The load-to-damage relationship. Journal of Cardiovascular Medicine. 2013.

20. Mehran R, Nikolsky E, Kirtane AJ, et al. Ionic low-osmolar versus nonionic iso-osmolar contrast media to obviate worsening nephropathy after angioplasty in chronic renal failure patients: the ICON (Ionic versus non-ionic Contrast to Obviate worsening Nephropathy after angioplasty in chronic renal failure patients) study. JACC Cardiovasc Interv. 2009 May;2(5):415-21. PMID: 19463464.

21. Millward SF, Burbridge BE, Hartman NG, et al. Nephrotoxicity of ioxaglate and ioversol assessed by glomerular filtration rate: A pilot study. Canadian Association of Radiologists Journal. 1996;47(1):24-9.

22. Nguyen SA, Suranyi P, Ravenel JG, et al. Iso-osmolality versus low-osmolality iodinated contrast medium at intravenous contrast-enhanced CT: effect on kidney function. Radiology. 2008 Jul;248(1):97-105. PMID: 18483232.

23. Nie B, Cheng WJ, Li YF, et al. A prospective, double-blind, randomized, controlled trial on the efficacy and cardiorenal safety of iodixanol vs. iopromide in patients with chronic kidney disease undergoing coronary angiography with or without percutaneous coronary intervention. Catheter Cardiovasc Interv. 2008 Dec 1;72(7):958-65. PMID: 19021282.

24. Rudnick MR, Davidson C, Laskey W, et al. Nephrotoxicity of iodixanol versus ioversol in patients with chronic kidney disease: the Visipaque Angiography/Interventions with Laboratory Outcomes in Renal Insufficiency (VALOR) Trial. Am Heart J. 2008 Oct;156(4):776-82. PMID: 18946896.

25. Serafin Z, Karolkiewicz M, Gruszka M, et al. High incidence of nephropathy in neurosurgical patients after intra-arterial administration of low-osmolar and iso-osmolar contrast media. Acta Radiol. 2011 May 1;52(4):422-9. PMID: 21498279.

26. Shin DH, Choi DJ, Youn TJ, et al. Comparison of contrast-induced nephrotoxicity of iodixanol and iopromide in patients with renal insufficiency undergoing coronary angiography. Am J Cardiol. 2011 Jul 15;108(2):189-94. PMID: 21545991.

27. Solomon RJ, Natarajan MK, Doucet S, et al. Cardiac Angiography in Renally Impaired Patients (CARE) study: a randomized double-blind trial of contrast-induced nephropathy in patients with chronic kidney disease. Circulation. 2007 Jun 26;115(25):3189-96. PMID: 17562951.

28. Solomon RJ, Mehran R, Natarajan MK, et al. Contrast-induced nephropathy and long-term adverse events: cause and effect? Clin J Am Soc Nephrol. 2009 Jul;4(7):1162-9. PMID: 19556381.

29. Wessely R, Koppara T, Bradaric C, et al. Choice of contrast medium in patients with impaired renal function undergoing percutaneous coronary intervention. Circulation. Cardiovascular interventions; 2009. p. 430-7.

30. Zo'o M, Hoermann M, Balassy C, et al. Renal safety in pediatric imaging: randomized, double-blind phase IV clinical trial of iobitridol 300 versus iodixanol 270 in multidetector CT. Pediatr Radiol. 2011 Nov;41(11):1393-400. PMID: 21713440.

Appendix F. Study Limitations

Author, Year	Was the allocation sequence adequately generated?	Was allocation adequately concealed?	Was knowledge of the allocated intervention adequately prevented during the srudy?	Were incomplete oucome data adequately addressed?	Are reports of the study free of suggestion of selective outcome reporting?	Study limitations
Barrett, 2006[1]	Yes	Yes	Yes	Yes	Yes	Low
Becker, 2013[2]	Yes	No	No	Yes	Yes	moderate
Bolognese, 2012[3]	Yes	Yes	Yes	Yes	Yes	Low
Campbell, 1990[4]	Unclear	Unclear	Yes	No	Unclear	High
Carraro, 1998[5]	Unclear	Unclear	Yes	Unclear	Unclear	High
Chuang, 2009[6]	Unclear	Unclear	Unclear	Yes	Yes	high
Dillman, 2012[7]	Yes	Yes	Yes	Yes	Yes	Low
Feldkamp, 2006[8]	Unclear	Unclear	Unclear	Yes	Yes	high
Hardiek, 2008[9]	Yes	Yes	Yes	Yes	Yes	Low
Hernandez, 2009[10]	No	No	No	Yes	Yes	high
Jakobsen, 1996[11]	Unclear	Unclear	Yes	Yes	Yes	moderate
Jevnikar, 1988[12]	Unclear	Unclear	Yes	No	Yes	High
Jo, 2006[13]	Unclear	Unclear	Yes	Yes	Yes	moderate
Juergens, 2009[14]	Yes	Yes	Yes	Yes	Yes	Low
Koutsikos, 1992[15]	Unclear	Unclear	Unclear	Yes	Yes	high
Kuhn,2008[16]	Unclear	Unclear	Unclear	Yes	Yes	high
Laskey, 2009[17]	Unclear	Yes	Yes	Yes	Yes	moderate
Limbruno, 2013[18]	Unclear	Unclear	Unclear	Unclear	Yes	high
Mehran, 2009[19]	Yes	Yes	Yes	Yes	Unclear	Moderate
Nguyen, 2008[20]	Yes	Unclear	Yes	Yes	No	moderate
Nie, 2008[21]	Yes	Unclear	Yes	Yes	Yes	moderate
Rudnick, 2008[22]	Yes	Yes	Yes	Yes	Yes	Low
Serafin, 2011[23]	Yes	Unclear	Yes	Yes	Yes	moderate

Shin, 2011[24]	Yes	Yes	Yes	Yes	Yes	Low
Solomon, 2007[25]	Yes	Unclear	Yes	Yes	Yes	moderate
Solomon, 2009[26]	Unclear	Unclear	Unclear	Yes	Yes	high
Wessely, 2009[27]	Unclear	Unclear	Yes	Yes	Yes	moderate
Zo'o, 2011[28]	Yes	Yes	Yes	Yes	Yes	Low

References

1. Barrett BJ, Katzberg RW, Thomsen HS, et al. Contrast-induced nephropathy in patients with chronic kidney disease undergoing computed tomography: a double-blind comparison of iodixanol and iopamidol. Invest Radiol. 2006 Nov;41(11):815-21. PMID: 17035872.
2. Becker J, Babb J, Serrano M. Glomerular filtration rate in evaluation of the effect of iodinated contrast media on renal function. AJR Am J Roentgenol. 2013 Apr;200(4):822-6. PMID: 23521455.
3. Bolognese L, Falsini G, Schwenke C, et al. Impact of iso-osmolar versus low-osmolar contrast agents on contrast-induced nephropathy and tissue reperfusion in unselected patients with ST-segment elevation myocardial infarction undergoing primary percutaneous coronary intervention (from the Contrast Media and Nephrotoxicity Following Primary Angioplasty for Acute Myocardial Infarction [CONTRAST-AMI] Trial). Am J Cardiol. 2012 Jan 1;109(1):67-74. PMID: 21943940.
4. Campbell DR, Flemming BK, Mason WF, et al. A comparative study of the nephrotoxicity of iohexol, iopamidol and ioxaglate in peripheral angiography. Can Assoc Radiol J. 1990 Jun;41(3):133-7. PMID: 2354386.
5. Carraro M, Malalan F, Antonione R, et al. Effects of a dimeric vs a monomeric nonionic contrast medium on renal function in patients with mild to moderate renal insufficiency: a double-blind, randomized clinical trial. Eur Radiol. 1998;8(1):144-7. PMID: 9442148.
6. Chuang FR, Chen TC, Wang IK, et al. Comparison of iodixanol and iohexol in patients undergoing intravenous pyelography: a prospective controlled study. Ren Fail. 2009;31(3):181-8. PMID: 19288321.
7. Dillman JR, al-Hawary M, Ellis JH, et al. Comparative investigation of i.v. iohexol and iopamidol: effect on renal function in low-risk outpatients undergoing CT. AJR Am J Roentgenol. 2012 Feb;198(2):392-7. PMID: 22268183.
8. Feldkamp T, Baumgart D, Elsner M, et al. Nephrotoxicity of iso-osmolar versus low-osmolar contrast media is equal in low risk patients. Clin Nephrol. 2006 Nov;66(5):322-30. PMID: 17140161.
9. Hardiek KJ, Katholi RE, Robbs RS, et al. Renal effects of contrast media in diabetic patients undergoing diagnostic or interventional coronary angiography. J Diabetes Complications. 2008 May-Jun;22(3):171-7. PMID: 18413220.

10. Hernandez F, Mora L, Garcia-Tejada J, et al. Comparison of iodixanol and ioversol for the prevention of contrast-induced nephropathy in diabetic patients after coronary angiography or angioplasty. Rev Esp Cardiol. 2009 Dec;62(12):1373-80. PMID: 20038403.

11. Jakobsen JA, Berg KJ, Kjaersgaard P, et al. Angiography with nonionic X-ray contrast media in severe chronic renal failure: renal function and contrast retention. Nephron. 1996;73(4):549-56. PMID: 8856250.

12. Jevnikar AM, Finnie KJ, Dennis B, et al. Nephrotoxicity of high- and low-osmolality contrast media. Nephron. 1988;48(4):300-5. PMID: 3362276.

13. Jo SH, Youn TJ, Koo BK, et al. Renal toxicity evaluation and comparison between visipaque (iodixanol) and hexabrix (ioxaglate) in patients with renal insufficiency undergoing coronary angiography: the RECOVER study: a randomized controlled trial. J Am Coll Cardiol. 2006 Sep 5;48(5):924-30. PMID: 16949481.

14. Juergens CP, Winter JP, Nguyen-Do P, et al. Nephrotoxic effects of iodixanol and iopromide in patients with abnormal renal function receiving N-acetylcysteine and hydration before coronary angiography and intervention: a randomized trial. Intern Med J. 2009 Jan;39(1):25-31. PMID: 18771430.

15. Koutsikos D, Konstadinidou I, Mourikis D, et al. Contrast media nephrotoxicity: comparison of diatrizoate, ioxaglate, and iohexol after intravenous and renal arterial administration. Ren Fail. 1992;14(4):545-54. PMID: 1462006.

16. Kuhn MJ, Chen N, Sahani DV, et al. The PREDICT study: a randomized double-blind comparison of contrast-induced nephropathy after low- or isoosmolar contrast agent exposure. AJR Am J Roentgenol. 2008 Jul;191(1):151-7. PMID: 18562739.

17. Laskey W, Aspelin P, Davidson C, et al. Nephrotoxicity of iodixanol versus iopamidol in patients with chronic kidney disease and diabetes mellitus undergoing coronary angiographic procedures. Am Heart J. 2009 Nov;158(5):822-8 e3. PMID: 19853704.

18. Limbruno U, Picchi A, Micheli A, et al. Refining the assessment of contrast-induced acute kidney injury: The load-to-damage relationship. Journal of Cardiovascular Medicine. 2013.

19. Mehran R, Nikolsky E, Kirtane AJ, et al. Ionic low-osmolar versus nonionic iso-osmolar contrast media to obviate worsening nephropathy after angioplasty in chronic renal failure patients: the ICON (Ionic versus non-ionic Contrast to Obviate worsening Nephropathy after angioplasty in chronic renal failure patients) study. JACC Cardiovasc Interv. 2009 May;2(5):415-21. PMID: 19463464.

20. Nguyen SA, Suranyi P, Ravenel JG, et al. Iso-osmolality versus low-osmolality iodinated contrast medium at intravenous contrast-enhanced CT: effect on kidney function. Radiology. 2008 Jul;248(1):97-105. PMID: 18483232.

21. Nie B, Cheng WJ, Li YF, et al. A prospective, double-blind, randomized, controlled trial on the efficacy and cardiorenal safety of iodixanol vs. iopromide in patients with chronic kidney disease undergoing coronary angiography with or without percutaneous coronary

intervention. Catheter Cardiovasc Interv. 2008 Dec 1;72(7):958-65. PMID: 19021282.

22. Rudnick MR, Davidson C, Laskey W, et al. Nephrotoxicity of iodixanol versus ioversol in patients with chronic kidney disease: the Visipaque Angiography/Interventions with Laboratory Outcomes in Renal Insufficiency (VALOR) Trial. Am Heart J. 2008 Oct;156(4):776-82. PMID: 18946896.

23. Serafin Z, Karolkiewicz M, Gruszka M, et al. High incidence of nephropathy in neurosurgical patients after intra-arterial administration of low-osmolar and iso-osmolar contrast media. Acta Radiol. 2011 May 1;52(4):422-9. PMID: 21498279.

24. Shin DH, Choi DJ, Youn TJ, et al. Comparison of contrast-induced nephrotoxicity of iodixanol and iopromide in patients with renal insufficiency undergoing coronary angiography. Am J Cardiol. 2011 Jul 15;108(2):189-94. PMID: 21545991.

25. Solomon RJ, Natarajan MK, Doucet S, et al. Cardiac Angiography in Renally Impaired Patients (CARE) study: a randomized double-blind trial of contrast-induced nephropathy in patients with chronic kidney disease. Circulation. 2007 Jun 26;115(25):3189-96. PMID: 17562951.

26. Solomon RJ, Mehran R, Natarajan MK, et al. Contrast-induced nephropathy and long-term adverse events: cause and effect? Clin J Am Soc Nephrol. 2009 Jul;4(7):1162-9. PMID: 19556381.

27. Wessely R, Koppara T, Bradaric C, et al. Choice of contrast medium in patients with impaired renal function undergoing percutaneous coronary intervention. Circulation. Cardiovascular interventions; 2009. p. 430-7.

28. Zo'o M, Hoermann M, Balassy C, et al. Renal safety in pediatric imaging: randomized, double-blind phase IV clinical trial of iobitridol 300 versus iodixanol 270 in multidetector CT. Pediatr Radiol. 2011 Nov;41(11):1393-400. PMID: 21713440.