Contrast-induced acute kidney injury and risk of adverse clinical outcomes after coronary angiography: a systematic review and meta-analysis

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CRD summary
This review concluded that contrast-induced acute kidney injury was associated with an increased risk of mortality, cardiovascular events, renal failure and prolonged hospitalisation. However, the association between contrast-induced acute kidney injury and mortality was less strong than previously believed when adjustments were made for patient clinical characteristics. These conclusions appear to be reliable.

Authors' objectives
To examine the association between contrast-induced acute kidney injury after coronary angiography and adverse clinical outcomes.

Searching
MEDLINE and EMBASE were searched up to June 2011 for relevant studies published in English. Search terms were reported. Reference lists of all relevant publications were searched and experts in the field contacted.

Study selection
Observational studies that reported clinical outcome data for those with contrast-induced acute kidney injury and those without (based on serum creatinine concentration) after diagnostic or therapeutic coronary angiography were eligible. Studies that reported outcomes only on the basis of contrast volume or as a ratio of contrast dose to serum creatinine were excluded. Studies needed to report one or more of mortality, cardiovascular events, end stage renal disease or length of hospital stay. The primary outcome was all-cause mortality.

Mean age of patients ranged from 56.4 to 75.4 years of age. Most studies included patients with and without chronic kidney disease at baseline (range 3.2% to 69.6%). A small number of studies included only patients with impaired baseline kidney function or, conversely, only those without elevated serum creatinine at baseline. Percentages of patients with diabetes ranged from 11% to 100%. Most studies involved patients who received percutaneous coronary interventions. Most studies defined contrast-induced acute kidney injury as greater than 25% or 0.5mg/dL increase above baseline. The time period of increase, where stated, ranged from the same day as the procedure up to seven days.

Two reviewers were involved in screening studies for inclusion in the review.

Assessment of study quality
Two reviewers independently assessed study quality using aspects included in guidelines for observational studies: specification of inclusion/exclusion criteria, inclusion of consecutive participants in the cohort, losses to follow-up less than 10% or appropriate handling of losses to follow-up, blinding of exposure status for outcome assessment and statistical adjustment for confounders.

Data extraction
Two reviewers independently extracted data from the included studies. Risk ratios, hazard ratios or odds ratios for the association between contrast-induced acute kidney injury and the dichotomous outcomes of interest were extracted. Means and standard deviations for the continuous outcomes for patients with contrast-induced acute kidney injury and those without were extracted. Adjusted values were used wherever available.

For three studies that categorised severity of contrast-induced acute kidney injury based on magnitude of change in serum creatinine and one that categorised contrast-induced acute kidney injury based on whether it persisted for greater than seven days, study groups were combined into a single exposure group.

Methods of synthesis
Studies were grouped on the basis of short-term (in-hospital or 30 days) or long-term (post-discharge or six months or
Results of the review
Thirty-nine studies were included in the review (152,459 participants). Sample size ranged from 78 to 27,608 participants. Follow-up ranged from hospital discharge to 7.5 years. There were no losses to follow-up in 32 studies, two studies did not report losses to follow-up and six studies reported losses to follow-up that ranged from less than 1% to 36%. All but two studies clearly specified inclusion and exclusion criteria and enrolled consecutive patients in the cohort. Outcome evaluators were blinded to exposure status in only one study. Twenty-three studies adjusted for baseline severity of illness when assessing mortality. Across all outcomes, studies most commonly adjusted for age, diabetes mellitus, severity of coronary artery disease, heart failure and baseline kidney function.

Contrast-induced acute kidney injury was consistently associated with an increased risk of cardiovascular events in 14 studies, end-stage renal disease in three studies and prolonged hospitalisation in 11 studies.

Authors' conclusions
Contrast-induced acute kidney injury was associated with an increased risk of mortality, cardiovascular events, renal failure and prolonged hospitalisation. However, the association between contrast-induced acute kidney injury and mortality was strongly confounded by baseline clinical characteristics that simultaneously predispose to both kidney injury and mortality.

CRD commentary
This review had defined inclusion criteria and was underpinned by a search of a range of sources of information. The restriction to studies in English may have led to the omission of relevant studies but given the number of studies included would be unlikely to change overall conclusions. The review was limited to published studies but assessment was made of publication bias and analysis of its potential effect was undertaken.

Study quality was assessed using appropriate criteria. Two reviewers were involved in the processes of study selection, data extraction and quality assessment which minimised bias. Pooling studies using meta-analysis appeared appropriate and sources of heterogeneity were investigated in further analyses.

The authors stated the limitations of included observational studies which were not designed to prove a causal relationship. Their conclusions appear to be reliable.

Implications of the review for practice and research
Practice: The authors stated that their results suggested the relationships between contrast-induced acute kidney injury and subsequent clinical outcomes were substantially influenced by confounding and that the risk of these outcomes appears to be lower than widely emphasised.

Research: The authors stated that further research was needed to ascertain how patients who develop contrast-induced acute kidney injury were subsequently managed to examine whether there were any disparities in subsequent use of cardiovascular therapies. There was also a need for adequately powered RCTs to determine whether contrast-induced acute kidney injury prevention strategies lead to improved survival or reductions in cardiovascular events or end-stage renal disease. Further research was also needed to determine whether progressive chronic kidney disease mediated the increased long-term risks of cardiovascular events and death associated with contrast-induced acute kidney injury.
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