Contrast-induced acute kidney injury in frail older people: What do we learn from the dilemma?

Contrast-induced nephropathy (CIN) is the third leading cause of acute kidney injury (AKI), in part through the mechanisms of renal ischemia and direct toxicity impacting the tubular epithelial cells.\(^1\)\(^-\)\(^4\) CIN is partially mediated by reactive oxygen species, increased perivascular hydrostatic pressure, high viscosity and vasoactive substances such as endothelin, nitric oxide and adenosine.\(^3\)\(^,\)\(^4\) The incidence of CIN ranges from 0.6% to 2.3% in the general population, to 50% in high-risk patients.\(^2\) The first four contrast media (CM) are ionic monomers with high hyperosmolality (1400–1800 mosmol/kg), nonionic monomers with lower osmolality (500–850 mosmol/kg), and nonionic and ionic low osmolality (700 mosmol/kg). The newest nonionic CM, like ioxithannol, is iso-osmolar, with an osmolality of about 290 mosmol/kg.\(^3\)\(^,\)\(^5\) The nephrotoxic properties of these agents vary, and low- and iso-osmolar agents are associated with a low incidence of renal injury among high-risk patients. According to the recommendations of the European Society of Urogenital Radiology and the American College of Radiology, the most important non-modifiable risk factors for CIN include pre-existing renal insufficiency, older age (>70 years), diabetes mellitus (DM), reduced left ventricular systolic function, advanced congestive heart failure, acute myocardial infarction, cardiogenic shock and kidney transplantation. The modifiable risk factors include volume of contrast media, dehydration, low serum albumin level (<35 g/L), use of angiotensin-converting enzyme inhibitors, furosemide and nonsteroidal anti-inflammatory drugs.\(^4\)\(^,\)\(^6\)

The term "frail" tends to be used to refer to an older adult who is physiologically or socially vulnerable. The presence of comorbid conditions, functional decline, cognitive impairment, or inadequate or abusive social situations, suggests that patients of advanced age (>75 years) may be more vulnerable.\(^7\) Geriatric patients are especially prone to developing AKI when critically ill and undergoing invasive procedures.\(^8\) Besides, serum creatinine is an unreliable indicator of glomerular filtration rate (GFR) in individuals with increased age, particularly in those who are sick or malnourished, or both, due to age-related diminution of muscle mass.\(^9\) The estimated GFR (eGFR)-Modification of Diet in Renal Disease (MDRD) formula was based on data from community-dwelling volunteers aged 18–70 years. It has never been validated in an elderly or frail population.\(^10\) The Jelliffe-1973, Cockcroft-Gault, and Hull equations were all considered to be more accurate in their applications to a study group of elderly Chinese chronic kidney disease (CKD) patients, after measuring 99mTc-DTPA renal dynamic imaging for comparison of eGFR.\(^11\)

The ability of risk, injury, failure, loss, and end-stage (RIFLE) classification fails to predict the prognosis of AKI in geriatric, critically ill patients, especially those >76 years of age. Even mild elevations in serum creatinine might be associated with higher rates of mortality in the older-old group.\(^8\) Baraldi et al also reported that an older population (>65 years) in an unselected hospital had a 10-fold increase in the incidence of AKI, prolonged hospital stay, significantly lower rates of renal recovery, and a higher risk of dialysis dependence when compared with patients aged <65 years.\(^12\) A dose >5 mL CM volume/kg of body weight, divided by serum creatinine in mg/dL, strongly predicted CIN requiring dialysis.\(^3\)\(^,\)\(^13\) In patients with eGFR >45 mL/min/1.73 m\(^2\), the risk of CIN was extremely low (approximately 2%), even in the absence of prophylaxis.\(^1\) However, for patients with severe renal dysfunction (eGFR ≤ 30 mL/min), contrast-induced AKI is not simply a "transient, benign creatininopathy", but rather a persistent renal injury and increased risk of cardiovascular events.\(^13\)

In this issue of the Journal, Huang et al have shown the incidence of CIN and its long-term consequences in a cohort of elderly patients who received intravenous CM for CT imaging.\(^14\) The authors restricted their retrospective analyses to elderly individuals with CM-enhanced CT at the emergency room. A simple risk score model showed that DM, precontrast serum creatinine levels >1.5 mg/dL, and acute hypotension, are the risk factors to predict CIN and in-hospital mortality for older people. Further development of the sensitivity test to more effectively validate this risk scoring model is suggested, to prevent frail, elderly people from suffering CIN. Moreover, although eGFR at a cut-off value of 60 mL/min/1.73 m\(^2\) to stratify the patients was arbitrary, it was superior to serum creatinine, due to highly skewed eGFR in the cohort study.

Some points merit clarification in this study. First, the precontrast serum creatinine was > the baseline serum creatinine, which meant that some hospitalized patients already had developed AKI, due to underlying illness, before contrast exposure. Therefore, it is unreliable to elucidate the causal
relationship between CM and AKI in this study. Second, a comprehensive pre-procedural assessment was proposed by Gleeson and Bulugahapitiya, particularly for in-hospital patients undergoing interventional radiology. The integer score is the documented practical tool to predict CIN in the large-scale prospective case-controlled design. However, the risk score model was built in a retrospective design, and it is difficult to test the validity of the risk score model for CIN in this study. Third, CM used for contrast-enhanced computed tomography in this study are mainly nonionic and iso-osmolar, and are quite different from those used for patients undergoing angiography, percutaneous nephrostomy, and cerebral angioplasty in which relatively high osmolar CM are used. The authors followed the previous risk scoring model too rigidly to truly reflect the real situation. We are on the evolutionary path towards more efficacious geriatric medicine. Since health is one of the basic physiological needs in Maslow’s hierarchy of needs, health promotion in the prevention of CIN and AKI should be emphasized, in order to make geriatric care more comprehensive.

References


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