Renal Failure After Transcatheter Aortic Valve Implantation

Do We Know the Full Story?*

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Chronic kidney disease (CKD) has long been identified as a risk factor for patients undergoing surgical aortic valve replacement (SAVR). This is relevant not only to the perioperative period, for which it predicts 30-day mortality, but also to the longer-term prognosis. Data from the Society of Thoracic Surgeons database, including more than 145,000 patients who underwent SAVR with or without concomitant coronary bypass grafting, demonstrate that patients with CKD had a ≥50% reduction in median survival over a period of 15 years (1). In addition, acute kidney injury (AKI) after SAVR, even if patients recover from the acute event, predicts poor outcomes in the long term. For octogenarians who undergo isolated SAVR, survival decreases from 6.4 years without AKI to 3.4 years with AKI and down to only 0.7 years median survival if patients needed dialysis during the perioperative course (1).

Transcatheter aortic valve implantation (TAVI) has been identified as an alternative treatment option in patients who are at high risk or unsuitable for SAVR (2,3). The improved outcomes in these patients are seen as a result of the reduction of surgical trauma and inflammatory response, as these procedures are performed without cardiopulmonary bypass and cardiac arrest. The question remains whether these potential advantages change the post-TAVI risks of patients with specific comorbidities such as CKD.

In this issue of the Journal, Yamamoto et al. (4) present the outcomes of 642 consecutive patients treated with TAVI at their institution. Patients were divided into 4 groups according to the degree of CKD, determined using their estimated glomerular filtration rate (eGFR) before TAVI, while patients on dialysis were excluded. Patients with severe CKD presented with lower body mass indexes and body surface areas but had significantly higher logistic European System for Cardiac Operative Risk Evaluation and Society of Thoracic Surgeons scores. The investigators found that patients with CKD grade 4 (eGFR <30 ml/min/1.73 m²) had higher 30-day mortality and that the presence of CKD grades 4 and 3b (eGFR <45 ml/min/1.73 m²) predicted higher mortality 1 year after the procedure. Indeed, CKD grades 4 and 3b, in addition to the logistic European System for Cardiac Operative Risk Evaluation score, were found to be the only independent predictors of 1-year mortality after TAVI.

In 2 recently published reports on this subject, investigators were unable to identify severe CKD (according to eGFR) as an independent predictor of mortality after TAVI (5,6). However, given data from registries on the predictive value of the serum creatinine (7,8) and the fact that this new analysis was performed on a larger number of patients and with a more sophisticated subdivision of CKD grades, the results are not surprising from the clinical point of view. With the results from SAVR in mind, it would have been interesting had Yamamoto et al. (4) analyzed the prognosis of patients without CKD who undergo TAVI and experience post-interventional AKI (in this study, nearly 15%), but this was not the focus of their study. In addition, it would have been favorable had the investigators provided more procedural information, such as the duration of rapid pacing, pre-dilation of the native aortic valve, as well as intraoperative hypotension and perioperative use of inotropic support, all known as potential risk factors for post-TAVI AKI.

Nevertheless, the questions remain as to what kinds of complications patients with CKD experience directly after TAVI as well as their final causes of death early and 1 year after the procedure. In this context, it is quite surprising to read that for patients with CKD grade 4 in this investigation, the need for acute dialysis after the initial TAVI procedure was quite low at only 4.9%. This is in contrast to previously published reports on TAVI, in which the need for dialysis in the total cohort, including the small group of patients with CKD grade 4 but also all other patients with mild or no pre-TAVI CKD, has been reported at 3% to 9.3% (3,9,10). In addition, although the incidence of dialysis in patients with CKD grade 4 was the highest, the difference from the other 3 groups did not reach statistical significance, but this may be a result of small patient numbers.

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This raises 2 questions. First, do Yamamoto et al. (4) use a particularly effective medical management strategy to prevent AKI? Second, if severe AKI is not the cause of death in patients with CKD, why do they do badly in terms of survival? The first question has been answered by the investigators, as they mention that they only used pre-hydration begun 12 h before the procedure. They also endeavored to reduce the volume of radiopaque contrast used during TAVI to prevent AKI in patients with severe CKD, although the volumes of contrast do not differ from those used in other studies. The second question is left more open, as the investigators unfortunately do not provide specific data on the causes of death of their patients. From the Edwards SAPIEN Aortic Bioprosthesis European Outcome registry (8), it is well known that CKD is among the strongest independent predictors of 1-year mortality. Among noncardiac causes of death after TAVI, the incidence of death from renal failure is 12.5%, the second most commonly observed behind pulmonary diseases (23.8%) (8). But in the context of the investigation by Yamamoto et al. (4), it may be of interest that patients with CKD grades 3b and 4 showed a trend toward increased stroke risk, with 4.4% and 8.2% of strokes reported.

These findings raise the question of whether patients with CKD are at higher risk for post-operative complications as a result of other comorbidities, such as small vessel disease affecting their cerebral, myocardial, and general perfusion and function, or malnutrition and frailty. Is CKD merely a surrogate marker for more widespread and advanced macrovascular and microvascular disease? The individual baseline characteristics seem to indicate that the groups are quite comparable in this respect, but the logistic European System for Cardiac Operative Risk Evaluation and Society of Thoracic Surgeons scores are higher in patients with severe CKD, which is not explained by the concomitant kidney disease itself. The answers to these questions are not fully known, and it is therefore obvious that we need more sophisticated data on these kinds of patient cohorts (including data on frailty or discrimination of coexistent coronary disease) to identify their differences.

In patients with severe CKD, concomitant pre-existing small vessel disease may play a particular role in this respect. As cardiac function has been found to be impaired early after TAVI (11), small vessel disease in these patients may increase the risk for organ malperfusion. Although this may not always result in serious easily identifiable events such as strokes, myocardial infarcts, or dialysis, which are currently counted as serious complications in TAVI studies, organ malperfusion may result in moderate organ dysfunction and increased inflammatory response. This, in combination, may increase perioperative stress and prolong recovery and mobilization, which, particularly in this elderly group of patients, will cause additional complications.

To find answers to these questions, it is of vital importance that we get more “organ-specific” information on the various effects of TAVI and identify periprocedural changes that may contribute to the renal insult. Although it was sufficient during the early TAVI experience to focus on clinical outcomes, it is now time to get a better understanding of the specific (and perhaps more subtle) side effects of the procedure. In this respect, it is of vital importance to understand how cardiac function is directly affected by the procedure. What happens during and immediately after the procedure in terms of not only inflammatory response, organ malperfusion, and cerebral but also renal artery embolization, and how do these phenomena predict perioperative complications? Fortunately, we have tools such as real-time hemodynamic monitoring and sensitive biomarkers available to perform sophisticated investigations to obtain this vital information. During the early years, we (as “heart teams” of interventional cardiologists and surgeons) developed the technical principals of TAVI while device technology rapidly advanced in parallel. This resulted in a reliable and reproducible technique with high procedural success rates.

In the next phase of evolution of TAVI, we need to obtain more detailed information on the side effects of TAVI to fully understand what predicts outcomes in specific groups of patients such as those with CKD. This will improve our patient selection and enable us to tailor interventional and surgical treatment to individual patients, ultimately improving the outcome of this exciting new treatment option.

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