Kidney Medicine

Coronary Artery Bypass Grafting Versus Percutaneous Coronary Intervention in Patients Receiving Dialysis: Is CABG Worth the Risk?

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Cardiovascular disease is the leading cause of death among patients receiving dialysis, and an estimated 40% of these patients have ischemic heart disease.[1,2] Although it may seem intuitive that more aggressive coronary interventions would lead to improved outcomes, whether patients receiving dialysis with coronary artery disease benefit from coronary revascularization and which revascularization strategy leads to the best outcomes remain an open question. The most recent American College of Cardiology-American Heart Association guidelines recommend that patients with chronic kidney disease (CKD) receive coronary interventions if they present with an acute coronary syndrome while discouraging revascularization in patients receiving dialysis with stable coronary artery disease.[3] Critically these recommendations are backed by a paucity of data because patients treated by dialysis were almost entirely excluded from all major trials supporting percutaneous coronary revascularization (PCI) and coronary artery bypass grafting (CABG).

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ISCHEMIA-CKD is the largest trial to examine coronary revascularization in patients with CKD. The ISCHEMIA-CKD trial randomized 777 patients with advanced CKD (including 311 with CKD stage 4, 51 with CKD stage 5, and 411 receiving dialysis) with moderate to severe coronary ischemia to receive coronary angiography plus optimized medical therapy versus optimized medical therapy alone. ISCHEMIA-CKD excluded individuals with acute coronary syndrome within the previous 2 months. Optimized medical therapy included lifestyle interventions accompanied by hypertension management, lipid lowering therapy, and antianginal medications.[4] The ISCHEMIA-CKD trial demonstrated no difference in the primary outcome of death or nonfatal myocardial infarction using either strategy (hazard ratio, 1.01; 95% confidence interval, 0.79-1.29; $P = 0.95$) although there was a significant crossover between groups.[4] Critically, only 50% of the invasive strategy group underwent revascularization because a high proportion of participants were found to have nonobstructive coronary artery disease, whereas 20% of the strategy group ultimately received a revascularization procedure, potentially biasing the trial toward the null.

If revascularization of a patient receiving dialysis is considered, it is also unclear what intervention should be performed.[5] An older study using data from the US Renal Data System from 1995 to 1998 demonstrated that CABG was associated with a lower risk of all-cause mortality than PCI among patients receiving dialysis and revascularization procedures.[6] Notably, this study evaluated all patients who underwent revascularization, including those with acute coronary syndromes, and predated drug-eluting stents. A similar study using US Renal Data System data from 1997 to 2009 also demonstrated a relative survival advantage to CABG over PCI in patients receiving dialysis with multivessel coronary disease.[7] Since then, there have been major advances in both drug-eluting stent technology and percutaneous intervention methodologies that require revisiting whether this survival advantage with CABG persists in the dialysis population.

In this issue of *Kidney Medicine*, Pan et al[8] attempt to answer this question in a more modern, national cohort. Using data from the Taiwan National Health Insurance Research Database, they examined records from 1,840 propensity-matched patients receiving dialysis who received either CABG or PCI with a drug-eluting stent between 2009 and 2015. In contrast to findings from the older US Renal Data System data, all-cause mortality was significantly higher among patients who underwent CABG than those who underwent PCI with stent placement at every time point examined up to 5 years from the time of revascularization. Although it is tempting to attribute higher mortality among those who underwent CABG to in-hospital mortality immediately following surgery, when examining the subsets of patients who survived the index hospitalization and were alive 90 days after revascularization, there was still no mortality benefit to CABG over PCI. Of note, PCI with stenting was associated with higher rates of subsequent acute coronary syndrome, repeat revascularization procedures, and repeat hospitalizations when compared with CABG; in models also accounting for death, only repeat revascularization remained significantly more likely among PCI recipients.

There are several limitations to this work. First, given that this is a retrospective study, there are potential biases as to which patients received each revascularization procedure that may not be accounted for in the propensity matching. Second, there are no available data regarding which coronary arteries were treated. It is possible that more patients who underwent PCI received

low-risk single-vessel or 2-vessel interventions, whereas more patients who underwent CABG were treated for a left main coronary artery lesion, potentially biasing the results toward demonstrating higher mortality in the CABG group. The authors also note that surgical or operator expertise could also be causing this effect. Third, patients with both acute coronary syndrome and stable angina are included, although sensitivity analyses excluding those with acute coronary syndromes demonstrated similar results to the whole cohort. Finally, there are no data on which type of stent was deployed other than it being drug eluting. Given the multitude of drug-eluting stents available, it would be helpful to know which ones were used in this study.

Although it may seem that these results contradict previous work demonstrating a survival benefit to CABG over PCI in patients receiving dialysis, it is plausible that these results reflect the improved efficacy of stents and the improved PCI techniques over this period, although the same result has not reliably been demonstrated in the treatment of multivessel disease in the general population.[9] Coronary artery disease in individuals with advanced CKD may have different features than that seen in the general population, with a far greater contribution of nonatherosclerotic mechanisms to ischemia, particularly among patients receiving dialysis. Ischemia in advanced CKD is augmented by high rates of endothelial dysfunction, oxidative stress, vascular stiffness, left ventricular hypertrophy, and microvascular disease that may make potential benefits of surgical revascularization a fundamentally different prospect than in nondialysis patients.[5] Furthermore, given the dramatically higher mortality rates among patients receiving dialysis compared with general population overall, it is also possible that patients receiving dialysis are not surviving long enough to experience benefits from CABG, although Pan et al[8] present robust data through 5 years of follow-up. It is also unclear if the potential harms associated with CABG compared with PCI are specific to patients receiving dialysis in Taiwan or if this result is replicable elsewhere.

In conclusion, the current report from Pan et al[8] represents a careful analysis of extensive data with multiple sensitivity analyses all demonstrating the same result—there is no benefit and potentially even harm associated with CABG compared with PCI in patients receiving maintenance dialysis. Given the high rates of early morbidity after CABG and the high costs of this procedure, with a $35,000 higher cost per quality-adjusted life year associated with CABG,[10] the threshold for recommending CABG compared with PCI should be very high, and potentially limited to cases in which there are no PCI options. Critically, this study does not answer the fundamental question raised by ISCHEMIA-CKD—is there any revascularization strategy of benefit to the stable patient treated with dialysis with CAD compared with medical management? Although we do not have answers to this question, we can certainly use this knowledge generated by Pan et al[8] to minimize the use of CABG in patients receiving dialysis given the potential signal for harm.

ARTICLE INFORMATION

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