

EDITORIAL COMMENT

Trends in Lower Limb Revascularization Among Patients With End-Stage Renal Failure



Where Is the Journey Going, and How Far Have We Come?*

Hans-Henning Eckstein, MD,^a Claudius Kuechle, MD,^b Thomas Hans Werner Stadlbauer, MD^a

The introduction of the arteriovenous fistula by Quinton et al. (1) and the native arteriovenous fistula by Brescia et al. (2) in the 1960s lead to the establishment of hemodialysis as the treatment of choice for selected patients with end-stage renal disease (ESRD). At that time, diabetes mellitus had been a major contraindication for hemodialysis. More than half a century later over 3,000,000 patients worldwide are treated with chronic hemodialysis. Presently, more than 30% of these patients have peripheral artery disease (PAD) and more than 60% have diabetes (3,4).

SEE PAGE 2101

Garimella et al. (5) report in this issue of *JACC: Cardiovascular Interventions* about nationwide trends in hospital outcomes after lower limb revascularization in patients on hemodialysis. Their paper addresses important questions, and it is therefore of interest to all vascular specialists including cardiologists and nephrologists.

The study by Garimella et al. (5) is a retrospective observational study using data from the Healthcare Cost and Utilization Project (HCUP) of the National Inpatient Sample files between 2002 and 2012 in the United States. Within this time period, there were

106,605 hospitalizations for PAD revascularization in patients on long-term hemodialysis. Of these, 77,049 (72.3%) were endovascular procedures and 29,556 (26.7%) were surgical procedures. Approximately three-fourths of these patients had diabetes. Adjusted trends showed that endovascular procedures increased within a decade by nearly 3-fold, whereas there was a reciprocal decrease in surgical revascularization procedures. On the one hand, the post-procedural complication rates over time were stable among subjects undergoing endovascular procedures. On the other hand, they nearly doubled after surgery. Surgery was associated with similar mortality rates compared with endovascular procedures but was associated with a 1.8-times odds ratio for complications and 1.6 times the adjusted odds for amputation.

Going into further detail, the percentage of revascularization cases performed endovascularly increased from 44% in 2002 to 84% in 2012. Conversely, there was a significant decrease in revascularizations performed surgically, from 56% in 2002 to 16% in 2012. The incidence of the overall complications with endovascular procedures increased marginally from 12.8% to 13.5%, whereas it nearly doubled with surgical procedures, from 13.7% to 26.7%.

These are the plain facts. What is the underlying cause? Does it only reflect the evolving trend in vascular medicine “endovascular first,” or does it reflect a rational bias in patient selection? Unfortunately, the paper by Garimella et al. (5) does not provide an answer to these questions. Our thoughts from a truly interdisciplinary perspective of vascular surgery, nephrology, and vascular medicine are as follows:

1. The average age of patients on dialysis in the United States has been steadily increasing over the last

*Editorials published in *JACC: Cardiovascular Interventions* reflect the views of the authors and do not necessarily represent the views of *JACC: Cardiovascular Interventions* or the American College of Cardiology.

From the ^aDepartment of Vascular and Endovascular Surgery, Klinikum rechts der Isar, Technical University of Munich, Munich, Germany; and the ^bDepartment of Internal Medicine, Division of Nephrology, Klinikum rechts der Isar, Technical University of Munich, Munich, Germany. Dr. Eckstein has received research funding from Bayer. Dr. Stadlbauer is a speaker for Bayer, Bristol-Myers Squibb, Pfizer, and Daiichi Sankyo. Dr. Kuechle has reported that he has no relationships relevant to the contents of this paper to disclose.

several decades. In 2000, the average age of patients on renal replacement therapy by hemodialysis was 62 years (6). In parallel, the number of patients over 80 years of age initiating dialysis has doubled from 1996 to 2003 (7). Therefore, it is most likely that a different cohort of patients with ESRD and PAD had been treated by lower limb revascularization between 2002 and 2012.

2. With technical advances in endovascular techniques, there is an overall trend for an endovascular first approach (8), even though this is still the subject of significant debate (9). There is still a lack of robust clinical data and a persisting controversy within the field. However, we have to take into account that there is a reality of facts tending toward endovascular treatment.
3. The prevalence of PAD is continuing to increase worldwide. Therefore, it is not surprising that lower limb revascularization procedures are also increasing in the aging hemodialysis population.
4. Patients undergoing open surgery might be more advanced in their stage of PAD. By contrast, endovascular procedures are applied in less advanced disease cases.
5. ESRD and uremia have been known to induce thrombocyte dysfunction and therefore might be the reason for increasing morbidity, but equal mortality among surgically treated patients. Maybe these patients had been on hemodialysis longer.

Some of these points are speculative, but plausible, because they offer an explanation for the trends and facts in revascularization procedures in ESRD patients. A secondary data analysis in this

comprehensive patient cohort will probably answer some of these important questions.

The frequency of cardiac complications, stroke, respiratory complications, and shock is consistently higher among patients undergoing surgery. Yet, we have to realize that the rate of complications has largely been unchanged throughout the study decade, whereas the disease severity has been increasing during this time. This is a strong hint as to the beneficial progress in open surgical techniques and perioperative management. The trend toward endovascular revascularization with its known lower complication rates leads to further benefit for this high-risk population.

Concerning the increased comorbidity and age, it is important to note that the overall mortality for endovascular and open surgery steadily decreased by 50% during this decade. In the same interval, the age of the patient on dialysis increased, and the incidence of diabetes went from 52% to 62%.

Taking these points altogether, the study (5) most indirectly demonstrates that we already have achieved a significant improvement for our patients with PAD on hemodialysis. There is substantial further investigation needed beyond this descriptive analysis. But hopefully, we will find that where the danger is, the savings will grow!

ADDRESS FOR CORRESPONDENCE: Prof. Hans-Henning Eckstein, Department of Vascular and Endovascular Surgery Klinikum rechts der Isar, Technical University of Munich, Ismaninger Strasse 22, Munich 81675, Germany. E-mail: hheckstein@web.de.

REFERENCES

1. Quinton W, Dillard D, Scribner BH. Cannulation of blood vessels for prolonged hemodialysis. *Trans Am Soc Artif Intern Organs* 1960;6:104-13.
2. Brescia MJ, Cimino JE, Appel K, Hurwicz BJ. Chronic hemodialysis using venipuncture and a surgically created arteriovenous fistula. *N Engl J Med* 1966;275:1089-92.
3. Thomas B, Wulf S, Bikbov B, et al. Maintenance dialysis throughout the world in years 1990 and 2010. *J Am Soc Nephrol* 2015;26:2621-33.
4. Garimella PS, Hirsch AT. Peripheral artery disease and chronic kidney disease: clinical synergy to improve outcomes. *Adv Chronic Kidney Dis* 2014;21:460-71.
5. Garimella PS, Balakrishnan P, Correa A, et al. Nationwide trends in hospital outcomes and utilization after lower limb revascularization in patients on hemodialysis. *J Am Coll Cardiol Intv* 2017;10:2101-10.
6. Hansberry MR, Whittier WL, Krause MW. The elderly patient with chronic kidney disease. *Adv Chronic Kidney Dis* 2005;12:71-7.
7. Kurella M, Covinsky KE, Collins AJ, Chertow GM. Octogenarians and nonagenarians starting dialysis in the United States. *Ann Intern Med* 2007;146:177-83.
8. Olin JW, White CJ, Armstrong EJ, Kadian-Dodov D, Hiatt WR. Peripheral artery disease: evolving role of exercise, medical therapy, and endovascular options. *J Am Coll Cardiol* 2016;6:1338-57.
9. Bluemn EG, Simons JP, Messina LM. Endovascular-first treatment of peripheral arterial disease remains controversial. *J Am Coll Cardiol* 2016;68:1492.

KEY WORDS endovascular, end-stage renal failure, lower limb, surgery