Circulation

RESEARCH LETTER

Characterization of Endovascular Abdominal Aortic Aneurysm Repair Surveillance in the Vascular Quality Initiative

Zachary J. Wanken, MD
Spencer W. Trooboff, MD, MBA
Barbara Gladders, MS
Jesse A. Columbo, MD, MS
Niveditta Ramkumar, MPH
Andrea M. Austin, PhD
David H. Stone, MD
Matthew W. Mell, MD, MS
Art Sedrakyan, MD, PhD
Philip P. Goodney, MD, MS

Each year in the United States, >30 000 patients undergo endovascular abdominal aortic aneurysm repair (EVAR).[1] Guidelines from the Society for Vascular Surgery and American College of Cardiology Foundation/American Heart Association, and guidance from the Food and Drug Administration, as well, all recommend regular follow-up imaging after endograft placement.[2,3]

However, adherence to annual surveillance after EVAR has been suboptimal. Previous reports suggest that nearly half of patients treated with EVAR do not receive the recommended imaging studies within 5 years after EVAR.[4,5] In this study, we evaluated patient-level characteristics from the Vascular Quality Initiative linked with longitudinal follow-up from Medicare claims to better understand when and why surveillance failures occur after EVAR. We also examined geographic variation in surveillance failure by state.

Within the Vascular Quality Initiative, we identified patients who underwent EVAR from 2003 to 2015. We linked these patients to Medicare claims by using individual identifiers. The initial EVAR was designated as the index operation, and further procedures related to the EVAR were defined as reinterventions. We excluded patients who died during the index operation or were not enrolled in Medicare fee-for-service.

Surveillance failure was defined as any 15-month period in which a surveillance imaging study was not obtained (Figure A). We chose 15 months to include a 3-month grace period in addition to the recommended yearly surveillance interval. Imaging studies were identified using *Current Procedural Terminology* codes (American Medical Association). We included abdominal imaging studies that could plausibly be used to provide surveillance for an indwelling endograft. Imaging modalities included computed tomography, duplex ultrasound, and magnetic resonance imaging.

Kaplan-Meier survival analysis was used to assess freedom from surveillance failure. Patients were censored at the end of the study period or at death. Cox proportional hazards regression with backward, stepwise elimination was used to identify factors associated with surveillance failure. Informed consent was waived by the Committee for the Protection of Human Subjects at Dartmouth College.

Our cohort included 9723 patients who underwent EVAR in 168 centers. Most patients were male (80%, n=7761) and white (92%, n=8950). A total of 38 524 surveillance imaging studies were identified during 23 177 person-years of follow-up for an average rate of 1.7 imaging studies per person-year. The most common method of postoperative imaging was computed tomography (64%, n=24 680 studies), followed by duplex ultrasound (35%, n=13 456 studies) and magnetic resonance imaging (1%, n=406 studies).

Key Words: aortic aneurysm, abdominal ■ endovascular procedures ■ guideline adherence

https://www.ahajournals.org/journal/circ

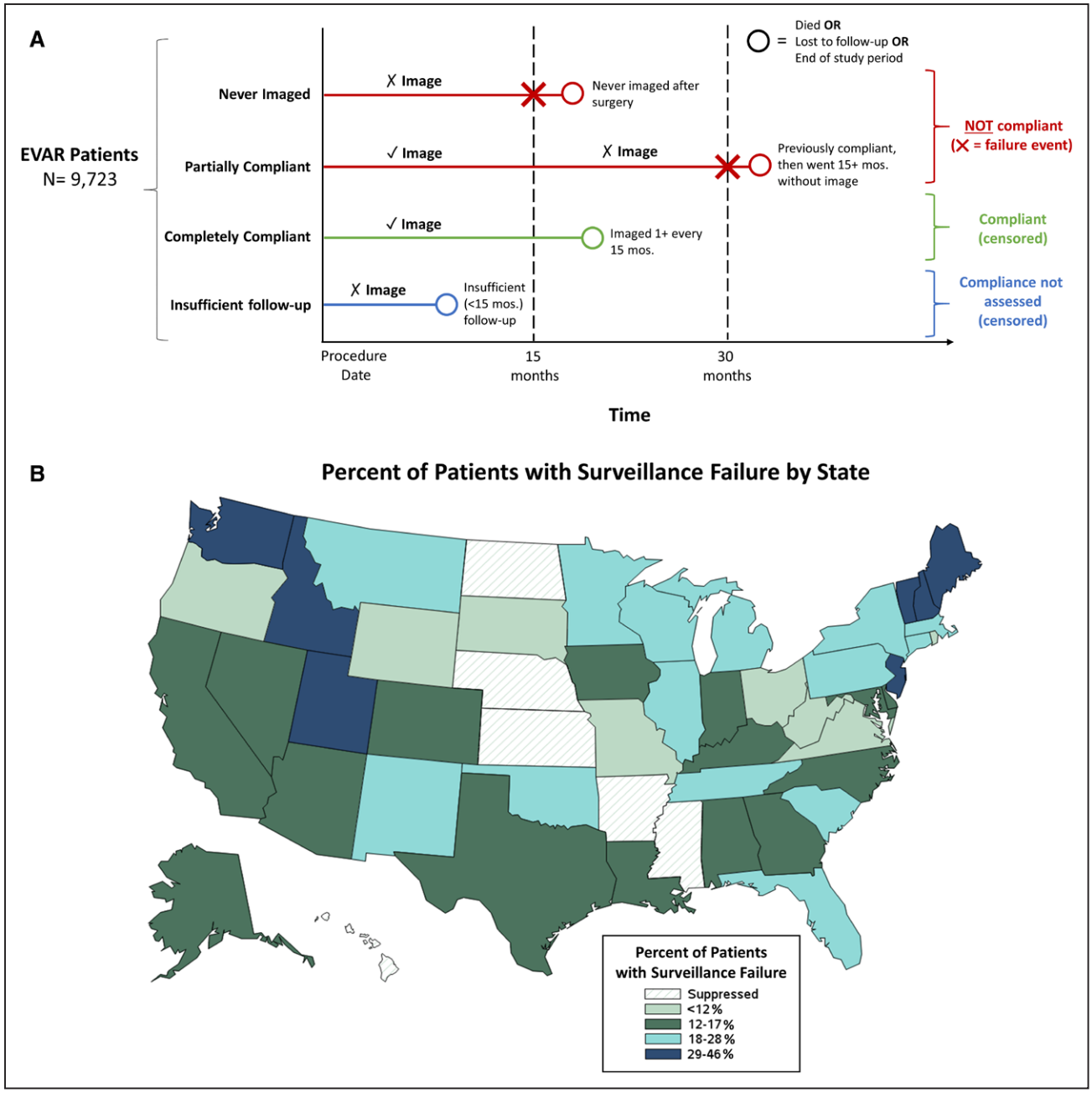

Figure. Characterizing surveillance failure and geographic distribution.
A, Conceptual model of surveillance failure after EVAR. ✓ marks indicate that an image was obtained, whereas χ marks indicate that no image was obtained. **B**, Variation in rates of surveillance imaging failure by state. States with patient volumes lower than the Centers for Medicare and Medicaid Services reporting rules have been suppressed. EVAR indicates endovascular abdominal aortic aneurysm repair.

Most patients were initially compliant with surveillance after EVAR, because 93% (n=9061) of patients had a surveillance image within the first 15 months after surgery. However, surveillance failure steadily increased over time. Kaplan-Meier survival analysis demonstrated that 50% of patients at risk experienced a surveillance imaging failure by 4.19 years, and 3 of 4 patients (75%) at risk experienced a surveillance imaging failure by 6.35 years.

Cox proportional hazards regression identified several factors associated with surveillance failure. Age >85 (hazard ratio [HR], 1.31 [95% CI, 1.14–1.50]), dual Medicare/Medicaid eligibility status (HR, 1.40 [95% CI, 1.24–1.58]), chronic kidney disease (HR, 1.16 [95% CI, 1.03–1.30]), and a diagnosis of dementia (HR, 1.55 [95% CI, 1.20–2.01]) were all associated with a higher risk of a surveillance failure. Alternatively, having a reintervention procedure (HR, 0.80 [95% CI, 0.72–0.90]), peripheral artery disease (HR, 0.79 [95% CI, 0.66–0.93]), or diagnosis of cancer (HR, 0.85 [95% CI, 0.76–0.95]) were associated with a lower likelihood of a surveillance failure.

CORRESPONDENCE

In addition to patient-level factors associated with surveillance failure, we also examined state-level variation in surveillance failure (Figure B). States in the Northeast and Northwest exhibited the highest rates of surveillance failure, and states in the Midwest exhibited lower rates.

Follow-up surveillance after EVAR continues to pose a challenge for patients, proceduralists, and regulators. Half of the patients in our study experienced a surveillance failure within 4 years of their EVAR operation. Schanzer et al[5] found that older age and comorbidities, including congestive heart failure, chronic kidney disease, and chronic obstructive pulmonary disease, were associated with a higher risk of failure, findings echoed in our report. Garg et al[4] demonstrated that dual Medicare and Medicaid eligibility was associated with surveillance failure as well.

Our study has several limitations. Our study was limited to Medicare patients and is an observational study that relies on clinical event detection identified from billing claims. Surveillance imaging studies were defined broadly, and we were unable to isolate vascular-specific imaging from studies for nonvascular indications.

In summary, surveillance failures are common and persistent after EVAR. Before performing EVAR, proceduralists and patients should carefully consider risk factors for surveillance failure, and thorough preoperative discussion is critical to ascertain patient preferences related to the need for surveillance. For those patients with a high risk of surveillance failure, open repair may be considered a favorable approach.

ARTICLE INFORMATION

Data sharing: We would be happy to discuss data, methods, and study materials with any interested parties. Requests can be made to the corresponding author by email.

Presented in the poster session at the Society for Vascular Surgery, Vascular Research Initiatives Conference 2019 (May 13, 2019) and American Heart Association, Vascular Discovery 2019 (May 14, 2019).

Correspondence

Zachary J. Wanken, MD, Section of Vascular Surgery, Dartmouth-Hitchcock Medical Center, One Medical Center Dr, Lebanon, NH 03766. Email zwanken@gmail.com

Affiliations

Section of Vascular Surgery, Dartmouth-Hitchcock Medical Center, Lebanon, NH (Z.J.W., J.A.C., D.H.S., P.P.G.). The Dartmouth Institute for Health Policy and Clinical Practice, Lebanon, NH (Z.J.W., S.W.T., B.G., J.A.C., N.R., A.M.A., P.P.G.). Section of Vascular Surgery, UC Davis Health, Sacramento, CA (M.W.M.). Weill Cornell Medical Center, New York, NY (A.S.).

Sources of Funding

This work was supported by American Heart Association Grant 18SFRN33900147, 2018. Population Health Project (to Dr Goodney), and Food and Drug Administration Grant 1U01FD005478-01 (to Dr Sedrakyan). Dr Wanken is an American Heart Association Strategically Focused Research Networks Fellow funded under Dr Goodney.

Disclosures

None.

REFERENCES

1. Dua A, Kuy S, Lee CJ, Upchurch GR Jr, Desai SS. Epidemiology of aortic aneurysm repair in the United States from 2000 to 2010. *J Vasc Surg*. 2014;59:1512–1517. doi: 10.1016/j.jvs.2014.01.007
2. Anderson JL, Halperin JL, Albert NM, Bozkurt B, Brindis RG, Curtis LH, DeMets D, Guyton RA, Hochman JS, Kovacs RJ, et al. Management of patients with peripheral artery disease (compilation of 2005 and 2011 ACCF/AHA guideline recommendations): a report of the American College of Cardiology Foundation/American Heart Association Task Force on Practice Guidelines. *Circulation*. 2013;127:1425–1443. doi: 10.1161/CIR.0b013e31828b82aa
3. Chaikof EL, Brewster DC, Dalman RL, Makaroun MS, Illig KA, Sicard GA, Timaran CH, Upchurch GR Jr, Veith FJ. SVS practice guidelines for the care of patients with an abdominal aortic aneurysm: executive summary. *J Vasc Surg*. 2009;50:880–896. doi: 10.1016/j.jvs.2009.07.001
4. Garg T, Baker LC, Mell MW. Adherence to postoperative surveillance guidelines after endovascular aortic aneurysm repair among Medicare beneficiaries. *J Vasc Surg*. 2015;61:23–27. doi: 10.1016/j.jvs.2014.07.003
5. Schanzer A, Messina LM, Ghosh K, Simons JP, Robinson WP, Aiello FA, Goldberg RJ and Rosen AB. Follow-up compliance after endovascular abdominal aortic aneurysm repair in Medicare beneficiaries. *J Vasc Surg*. 2015;61:16-22.e11. doi: 10.1016/j.jvs.2014.06.006