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

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

However, adherence to annual surveillance after EVAR has been suboptimal. Prior reports suggest that nearly half of patients treated with EVAR do not receive the recommended imaging studies within five years after EVAR.^{4,5} In this study, we evaluated patient level characteristics from the Vascular Quality Initiative (VQI) 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.

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Within the VQI, we identified patients who underwent EVAR from 2003 to 2015. We linked these patients to Medicare claims 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 fifteen-month period in which a surveillance imaging study was not obtained (Figure 1, Panel A). We chose fifteen-months to include a three-month grace period in addition to the recommended yearly surveillance interval. Imaging studies were identified using Current Procedural Terminology codes (American Medical Association, Chicago, IL). We included abdominal imaging studies that could plausibly be used to provide surveillance for an indwelling endograft. Imaging modalities included computed tomography (CT), duplex ultrasound, and magnetic resonance imaging (MRI).

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 9,723 patients who underwent EVAR in 168 centers. Most patients were male (80%, n = 7,761) and Caucasian (92%, n = 8,950). 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 CT (64%, n=24,680 studies), followed by duplex ultrasound (35%, n=13,456 studies), and MRI (1%, n=406 studies).

Most patients were initially compliant with surveillance after EVAR, as 93% (n = 9,061) of patients had a surveillance image within the first fifteen 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 three out of four 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 over 85 (hazard ratio [HR] 1.31 [95% confidence interval (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.

In addition to patient-level factors associated with surveillance failure, we also examined state level variation in surveillance failure (Figure). 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 four years of their EVAR operation. Schanzer et. al. found that older age and comorbidities including congestive heart failure, chronic kidney disease, and chronic obstructive pulmonary disease were associated with higher risk of failure, findings echoed in our report.⁵ Garg et. al. demonstrated that dual Medicare and Medicaid eligibility was associated with surveillance failure as well.⁴

Our study has several limitations. Our study was limited to Medicare patients and is an observational study which 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 non-vascular 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 pre-operative 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.

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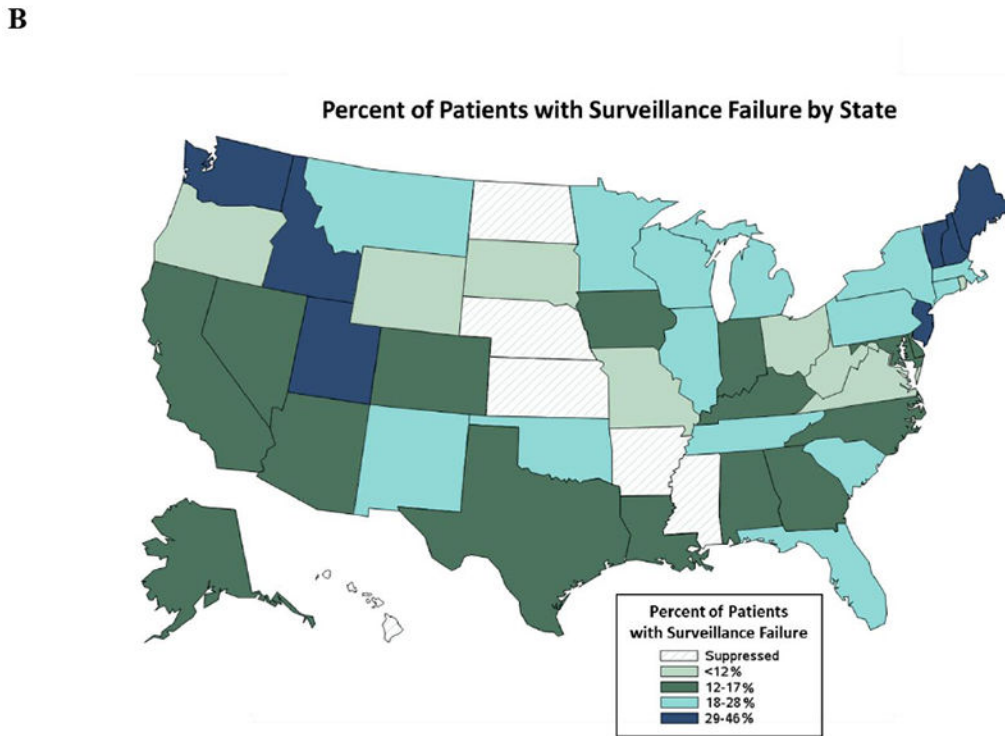
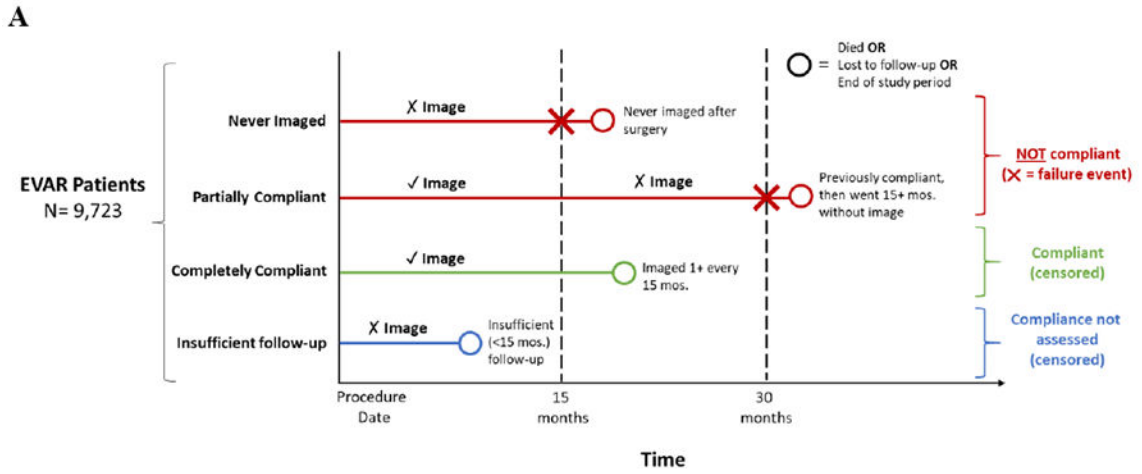


Figure.
 (A) Conceptual model of surveillance failure after EVR. ✓ marks indicate an image was obtained, while ✕ marks indicate no image was obtained. (B) Variation in rates of surveillance imaging failure by state. States with patient volume lower than Centers for Medicare and Medicaid Services reporting rules have been suppressed.