Surveillance outcomes of small abdominal aortic aneurysms identified from a large screening program

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Objective: **Surveillance of patients identified with small abdominal aortic aneurysm (AAA) from an AAA screening program poses a challenge for health systems because of numerous patient follow-ups. This study evaluates the surveillance outcomes of patients identified with small AAA from a large screening program.**

Methods: **A retrospective chart review of all patients screened for small AAA (3.0-5.4 cm) from 2007 to 2011 was conducted. Patients with small AAA and no previous history of repair were tracked for follow-up using the 2013 RESCAN follow-up guidelines according to aortic diameter (3.0-3.9 cm, 3 years; 4.0-4.4 cm, 2 years; 4.5-5.4 cm, 1 year). Socioeconomic factors that may influence the follow-up rate and all-cause mortality after screening, including marital status, distance to hospital from residence, estimated household income, and employment disability status, were also evaluated.**

Results: **A total of 568 patients (mean ± standard deviation, 73.4 ± 7.2 years old) with small AAA (3.6 ± 0.6 cm) were analyzed. Patient follow-up rate was 65.1% (n = 370 of 568). Reasons for follow-up failure were lack of the physician's ordering a scan (n = 139; 70.2%), delayed ordering of scans (n = 36; 18.2%), patient no-show (n = 18; 9.1%), or patient death before follow-up (n = 5; 2.5%). Of all patient-specific factors, patients with smaller diameters were unlikely to achieve follow-up scans ($P < .001$). A significantly higher risk of all-cause mortality was found for patients with no ultrasound follow-up scan (hazard ratio [HR], 0.369; $P < .001$), assisted living (HR, 0.381; $P < .001$), older age (HR, 1.04; $P = .001$), and lower household incomes (HR, 0.989; $P = .01$).**

Conclusions: **The follow-up rate of patients with small AAA was poor at 65.1%. The data indicate that socioeconomic factors do not significantly affect follow-up success. Therefore, physician ordering of scans may exert the greatest influence on follow-up rates in patients with small AAA. Automatic ordering of follow-up scans for patients with small AAAs is proposed to improve follow-up rates. (J Vasc Surg 2016;63:55-61.)**

The knowledge gained from the major abdominal aortic aneurysm (AAA) screening clinical trials[1-4] has led to a substantial reduction in AAA-related mortality in the older male population. Overall, AAA screening programs have yielded AAA detection rates of around 4% to 8% of all screened patients.[5] Ultrasound screening is dependable at identifying patients with AAA ≥5.5 cm in maximum aortic diameter, but most diagnosed AAA patients have aneurysms that range from 3.0 to 5.4 cm.[6] The recommended regimen for patients with such small AAAs is surveillance imaging, risk factor modification, and drug therapy.[7] Surveillance guidelines created by the Society for Vascular Surgery in 2009 were developed to assist clinicians with tracking of patients with small AAA.[8] The 2013 RESCAN Collaborators meta-analysis study further refined the surveillance intervals by determining when the risk of AAA rupture reaches 1% by the next follow-up scan.[9] However, an influx of many newly diagnosed AAA patients from a population screening program can pose burdens in any health care system.

Tracking patients with small AAA remains a challenge to clinicians. The RESCAN study revealed that time intervals in performing follow-up imaging scans of patients with small AAA vary globally.[9] An analysis of the Veterans Affairs (VA) Northern California Health Care System (VANCHCS) AAA screening program previously determined that a large number of inappropriate screens were ordered during the first 5 years of implementation, and some detected aneurysms were not given an appropriate follow-up imaging study.[10] We suspect that some physicians are unsure of the current U.S. Preventive Services Task Force AAA screening criteria[11] and may be unfamiliar with current AAA surveillance guidelines. The purpose of this study was to evaluate the surveillance outcomes of patients identified with small AAA from a large screening program.

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METHODS

This study was conducted under an approved, waived informed consent protocol by the VANCHCS Institutional Review Board. An electronic medical record (EMR) retrospective chart review of all veterans screened for AAA between January 1, 2007, and December 31, 2011. A billing code specific to AAA screening was used to obtain a list of all patients screened for AAA. Patients identified from this list with small AAA (3.0-5.4 cm in maximum aortic diameter) with no history of AAA repair were analyzed in this study for follow-up adherence. Patients with previous history of AAA repair were removed from the final analysis.

Clinical follow-up was evaluated using the recommended surveillance time intervals based on aneurysm size from the 2013 RESCAN guidelines.[9] Briefly, imaging surveillance intervals should be 3 years (3.0-3.9 cm), 2 years (4.0-4.4 cm), and 1 year (4.5-5.4 cm). These intervals were based on the rationale of maintaining the risk of AAA rupture <1% from initial screening diameter diagnosis to the next follow-up scan. A follow-up for AAA was achieved if the abdominal aorta was visualized and documented by the radiologist at least once within the defined RESCAN surveillance interval, after the initial AAA screening study. A follow-up imaging study consisted of either an ultrasound or computed tomography (CT) scan of the aorta. Incidental aortic imaging (scans not ordered by a physician specifically for AAA) also counted toward follow-up if this met surveillance time intervals and visualization of the aorta was documented by a radiologist in the medical record.

Follow-up for small AAA is initiated when an EMR clinical reminder is sent to the primary care physician that becomes active at an outpatient clinic appointment, indicating that AAA screening may be appropriate for the patient. This clinical reminder cites age 65 years or older, male gender, and smoking history as indications for such screening. At this point, initial AAA screening may be ordered at the discretion of the primary care physician in consultation with the patient during the clinic visit. Results of the initial AAA screening examination are reported through an EMR alert back to the primary care physician, at whose discretion further follow-up imaging is ordered or not. If a follow-up scan is ordered, a reminder is sent to radiology to perform the scan on the ordered date. For incidental scans, if the radiologist alerts the primary care physician that a patient's AAA diameter requires attention from an incidental finding, follow-up scan ordering is at the choice of the primary care physician. Any vascular consultation for AAA from screening is also at the discretion of the primary care physician.

The effect on follow-up imaging of socioeconomic factors such as race, marital status, distance to the hospital from a patient's residence, estimated household income of zip code residence, and employment disability status was also evaluated. Marital status consisted of single (never married), married, divorced, or widowed. Distance to the hospital (Sacramento VA Medical Center, Mather, Calif) from a patient's residence in miles was measured using Google Map Distance Calculator (Google, Inc, Mountain View, Calif). Estimated household income was ascertained by zip code of residence using American FactFinder from the 2009-2013 U.S. Census Bureau American Community Survey 5-year estimates database.[12] Employment disability status was defined as being "unemployable" in the medical record; a veteran who is unable to work because of physical or mental disability and is compensated at the 100% VA disability rate, even though the service-connected disabilities may not be rated by the VA at the 100% level, is considered unemployable.

Univariate tests were conducted to test associations between patient socioeconomic or clinical characteristics and follow-up rates. χ^2 tests were conducted for categorical covariates, and the Kruskal-Wallis test was used for continuous covariates. Covariates significantly associated at the 0.1 level with failure to follow up would then be included in a multivariate logistic regression model to simultaneously test for associations. A Cox proportional hazards model was fit to test for effects on all-cause mortality. A backward selection procedure of patient clinical and socioeconomic characteristics was used to obtain the final model. The full model was fit with all candidate patient characteristics, and then the covariate with the highest P value was removed one at a time until all remaining covariates were significant at the .05 level. Survival probability was then determined from the final hazard function. All values were considered censored by December 31, 2014, if death was not observed for that subject before this date. Because the minimum time required for follow-up adherence for an AAA patient is 3 years and the final AAA screening could have occurred on December 31, 2011, the analysis period for this study concluded on December 31, 2014. All statistical analyses were performed with SAS software version 9.4 (SAS Institute, Cary, NC). A P value $< .05$ was considered statistically significant.

RESULTS

A total of 568 patients were enrolled in the study, which consisted of 564 men (99.3%) and four women (0.7%), with age (mean ± standard deviation) of 73.4 ± 7.2 years. The race distribution of subjects was 392 (69.0%) white, 50 (8.8%) black/African American, 14 (2.4%) Asian/Pacific Islander, 2 (0.4%) American Indian, and 110 (19.4%) unknown/declined to state. The marital status distribution was as follows: 27 patients (4.8%) were single/never married, 288 patients (50.7%) were married, 166 patients (29.2%) were divorced, 71 patients (12.5%) were widowed, and 16 patients (2.8%) were separated. The average distance to the hospital from a patient's residence was 113.9 ± 239.8 miles. The average estimated household income for each patient was $56,938 ± $19,656. There were 515 patients (90.7%) who rented or owned a home independently and 53 patients (9.3%)