Title

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Journal

Journal of Vascular Surgery, 71(6)

ISSN

0741-5214

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Publication Date

2020-06-01

DOI

10.1016/j.jvs.2019.08.252

Peer reviewed

Published in final edited form as:
J Vasc Surg. 2020 June ; 71(6): 1913–1919. doi:10.1016/j.jvs.2019.08.252.

Risk of Developing an Abdominal Aortic Aneurysm after Ectatic Aorta Detection from Initial Screening

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Abstract

Objective: Current abdominal aortic aneurysm (AAA) surveillance guidelines lack any follow up recommendations after initial abdominal aortic screening diameter of less than 3.0 cm. Some reports have demonstrated patients with late AAA formation and late ruptures after initial ultrasound screening detection of patients with an aortic diameter of 2.5 – 2.9 cm (ectatic aorta). The purpose of this study is to determine ectatic aorta prevalence, AAA development, rupture risk, and risk factor profile in patients with detected ectatic aortas in a AAA screening program.

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Conflict of Interest Statement: The authors of this manuscript have no financial interests to declare.

Presented at the 2019 Annual Meeting Vascular and Endovascular Surgery Society, National Harbor, MD, June 12–15, 2019.

Methods: A retrospective chart review of all patients screened for AAA from 1/1/2007 to 12/31/2016 within a regional health care system was conducted. Screening criteria were men 65–75 years of age that smoked a minimum of 100 cigarettes in their lifetime. An ectatic aorta was defined as a maximum aortic diameter from 2.5 to 2.9 cm. An AAA was defined as an aortic diameter ≥3 cm. Patients screened with ectatic aortas who had subsequent follow-up imaging of the aorta with a minimum of 1-year follow-up were analyzed for associated clinical and cardiovascular risk factors. All data were collected through 12/31/2018. A logistic regression of statistically significant variables from univariate and chi-square analyses were performed to identify risks associated with the development of AAA from an initially diagnosed ectatic aorta. A Cox proportional hazard model was used to assess survival data. P<.05 was considered statistically significant.

Results: From a screening pool of 19,649 patients, 3,205 patients (16.3%, 3,205/19,649) (72.1 ± 5.3 years, mean ± standard deviation) were identified to have an ectatic aorta from 1/1/2007 to 12/31/2016. The average screening ectatic aortic diameter was 2.6 ± 0.1 cm. There were 672 patients (73.0 ± 5.7 years, 21.0% total patients) who received subsequent imaging for other clinical indications and 193 of these patients (28.7%, 193/672) with ectatic aortas developed an AAA from the last follow-up scan (4.2 ± 2.5 years). The average observation length of all patients was 6.4 ± 2.9 years. No ruptures were reported, but 27.8% of deaths were of unknown cause. One patient had aortic growth to ≥ 5.5 cm (1/672, 0.15%). Larger initial screening diameter (p<.01), presence of COPD (p<.01), and active smoking (p=.01) were associated with AAA development.

Conclusions: Patients with diagnosed ectatic aortas from screening who are active smokers or have COPD are likely to develop an AAA.

Table of Contents Summary

This retrospective study of the Veterans Affairs AAA screening program 193 of 672 (28.7%) patients with ectatic aorta developed an AAA.Larger initial screening diameter (p<.01), presence of COPD (p<.01), and active smoking (p=.01) were associated with AAA development.

Keywords

Ectatic aorta; AAA screening; AAA

Introduction

National abdominal aortic aneurysm (AAA) screening programs ongoing in Europe[1, 2] and in the United States[3] have been successful in the detection and management of AAAs. In the Multicentre Aneurysm Screening Study (MASS) trial,[4] patients with a detected ectatic abdominal aorta (2.5 – 2.9 cm in aortic diameter) after initial ultrasound screening for AAA developed late AAAs and some were presumed to have subsequent ruptures.[5] These patients did not undergo follow-up surveillance due to their aortic diameter <3.0 cm, so their natural history is unknown. Presently, data regarding the natural history of patients with 2.5 – 2.9 cm aortas is unclear. Early work demonstrated no follow-up for aortic diameters < 3.0 cm, however recent data show 13.8% of patients with 2.6 – 2.9 cm aortic diameters grew to greater than 5.5 cm at 10 years.[6]

The U.S. Department of Veterans Affairs (VA) initiated their national AAA screening program in 2007 under the Screen for Abdominal Aortic Aneurysm Very Efficiently (SAAAVE) Act.[7] The current AAA surveillance guidelines recommend no further follow up for patients after initial abdominal aortic screening of <3.0 cm in maximum aortic diameter.[6, 8] Consequently, there are few data on subsequent AAA development and rupture risk from ectatic aortas initially diagnosed from AAA screening because of the current surveillance guidelines. An analysis of ectatic aortas identified within the current regional AAA screening program[9] may add valuable data to this gap in knowledge. The purpose of this study is to determine ectatic aorta prevalence, AAA development, rupture risk, and risk factor profile in patients with detected ectatic aortas in a AAA screening program.

Methods

AAA Screening

A retrospective review of patients with ectatic abdominal aortas from AAA screening was performed under an approved protocol by the institutional review board (IRB) at the Veterans Affairs Northern California Healthcare System (VANCHCS). An IRB waiver of consent was granted for this study. The AAA screening criteria were men 65–75 years of age who smoked at least 100 cigarettes during their lifetime. Patients that met AAA screening inclusion criteria were sent invitations from the radiology department to participate in AAA screening. An electronic alert in the patient's electronic medical record (EMR) notified primary care physicians when eligible patients in their clinics were due referral for AAA screening. When a patient accepted an invitation for AAA screening, the encounter visit for AAA screening was associated with a specific billing code for AAA screening. A list of patients screened for AAA from January 1, 2007 through December 31, 2016 was generated from the billing code.

Ectatic Aorta and AAA Diagnosis

All patient scans were recorded onto the electronic medical record (EMR) imaging software database (Phillips Intellispace® PACS Enterprise with iSyntax 4.4, Amsterdam, Netherlands). An ectatic abdominal aorta was defined as 2.5 – 2.9 cm in maximum aortic diameter utilizing an outer-wall to outer-wall measurement. An AAA was defined as having a maximum abdominal aortic diameter of 3.0 cm or greater. Patients screened with ectatic aortas who had subsequent follow-up imaging of the aorta with a minimum of 1-year follow-up from either a computerized tomography (CT) scan, ultrasound, or magnetic resonance imaging (MRI) based on other clinical indications were recorded (Figure 1). A radiologist or vascular specialist verified all aortic measurements from the imaging software database and reported findings in the EMR to the nearest 0.1 cm. The maximum aortic diameter from the patient's last follow-up imaging scan was used to determine whether a patient developed an AAA. This scan was performed before the study data collection censor date of December 31, 2018.

Patient Risk Factors

Cardiovascular risk factors were also collected. The patient's most recent blood pressure, body mass index (BMI), hemoglobin A1c (HgbA1c), creatinine, estimated glomerular

filtration rate (eGFR), cholesterol panel, as well as their current diagnosis of hypertension, diabetes, coronary artery disease (CAD), peripheral vascular disease (PVD), chronic obstructive pulmonary disease (COPD), statin use, and current smoking status were evaluated.

Statistical Analysis

Univariate tests were conducted to test associations of collected patient variables between patients that developed into AAAs or remained stable as ectatic aortas. Chi square tests were conducted for categorical covariates and the Kruskall-Wallis test was used for continuous covariates. Those covariates significantly associated at the 0.1 level were then included in a multivariate logistic regression and a Cox proportion hazard model to obtain the final model of significant covariates at the $p<.05$ level. Survival estimates between patients that developed into AAA versus those patients that remained ectatic aortas were calculated using the AAA screening date and date of death, or the censored date of December 31, 2018. All statistical analyses were performed using SAS® software version 9.4 (SAS Institute, Cary, NC). Odds ratios of collected covariates were calculated at the 95% confidence interval. A p-value < 0.05 was considered statistically significant in the final models.

Results

A total of 3,205 patients (mean ± standard deviation, 72.1 ± 5.3 years) with ectatic aortas were detected from 1/1/2007 to 12/31/2016 from a screening population of 19,649 patients (16.3%). The average ectatic aortic diameter from screening was 2.6 ± 0.1 cm. The patient races were distributed as follows: 64.1% White, 18.2% Black or African American, 3.4% Hispanic, 1.7% Asian or Pacific Islander, 0.9% American Indian, and 11.2% unknown or declined to state (Table I).

There were 672 patients (73.0 ± 5.7 years, 21.0% total patients) who received subsequent imaging for other clinical indications at least 1 year from screening. The last follow-up scan to assess aortic expansion rate and most recent aortic diameter were distributed as: CT scan (74.4%), ultrasound (20.5%), and MRI (5.1%) (Table II). The average follow-up period was 4.2 ± 2.5 years from initial screening to the last follow-up scan. The average observation length of all patients in the study was 6.4 ± 2.9 years from screening to the study's censored date of 12/31/2018.

One hundred ninety-three (193/672, 28.7%) patients diagnosed with ectatic aortas developed into an AAA (Table III). The distribution of screened aortic diameters follows as (n, % AAA developed): 2.5 cm (n=203, 20.7%), 2.6 cm (n=175, 24.6%), 2.7 cm (n=118, 28.0%), 2.8 cm (n=98, 39.8%), and 2.9 cm (n=78, 46.2%) (Figure 2). One patient (1/672, 0.15%) had aortic growth >5.5 cm, with an aortic diameter at 5.7 cm in 9.9 years from screening.

There were 133 total patients (19.8%) that died within the analysis period (Table IV). The 3 main causes of death were as follows: cancer (36.1%), cardiopulmonary (30.1%), and unknown cause (27.8%). Patients that died from unknown causes had poor documentation in their medical record for cause of death, other than a death note describing "death from natural causes." Deaths were higher in the stable aorta group versus AAA group, however

they were not statistically different within the average observation time of 6.4 ± 2.9 years (Figure 3, P=.29).

The risk factors associated with AAA development (Table V) were (stable vs. AAA, P-value): larger initial screening diameter (2.6 vs. 2.7 cm, P<.01), presence of COPD (21.3% vs 32.1%, P<.01), and active smoking (18.4% vs. 24.4%, P=.01). Age, total cholesterol, and aortic expansion rate were statistically significant at the univariate level but were not in the final logistic regression model (Table VI).

Discussion

This retrospective study evaluates the outcomes of ectatic aortic diagnosis (2.5–2.9 cm) from initial screening to follow up imaging over an average follow up time of 4.2 years. The screening is based upon an ongoing regional VA AAA screening program that has been continuously in effect since 1/1/2007. We have published previous work on our surveillance outcomes of screened patients over the past 10 years[7, 9–12] and found that over this 10-year time period, 19,649 patients underwent AAA screening and that 3,205 patients or 16.3% (3,205/19,649) were diagnosed with an ectatic aorta. This overall prevalence rate is 4x higher than the prevalence rate of 4.25% (2,705/64,168) reported by Hamel and associates in a 2018 large review of 13 studies pooled together.[13] The limitations of pooling multiple studies were the differing definitions of aortic ectasia (2.5–2.9 cm), measurement methodology (inner wall to inner wall, vs. outer wall to outer wall, vs. transverse and anteroposterior measurements), as well as differing patient inclusion criteria for screening. Given our mature screening program,[9] which includes consistent measurement techniques (outer wall to outer wall) and a singular population base, our data report of 16.3% prevalence of ectatic aorta patients from an AAA screening population is a strength of this study.

There are some important questions that can only be partially resolved by this study from the natural history of patients with an ectatic aorta diagnosis at initial screening: How many of the patients with an initial ectatic aorta diagnosis will become an AAA (≥ 3.0 cm)? Which patients will require AAA repair? Which subset of ectatic aorta patients die from AAA rupture? Based upon 4.2 years of follow up, only 28.7% (193/672) of our patients with ectatic aorta diagnosis progressed to an AAA, 0.15% (1/672) grew to over 5.5 cm requiring surgery, and no aneurysm related deaths were clearly identified in this group.

Our finding of 28.7% over 4.2 years of follow-up is a lower estimate for the natural history of ectatic aortas to AAA development. The overall progression, in a recent review, has been reported to be 58.5% with an overall range to be 9.5% to 88%.[13] D'Audiffret and associates from the Minneapolis VA Medical Center reported 63% progression from ectatic aorta to AAA over a 6 year follow up period.[14] Devaraj and associates from the UK reported an 88% progression rate from ectatic aorta to AAA over a 5.4 year follow up period.[15] However, Wild and associates in 2013 reported the results of an UK multicenter observational study of screened aortic dilation of 2.5–2.9 cm. Of all ectatic aorta identified in initial screening, 59.6% progressed to AAA in a 4.7 year follow up period, and 96% progressed to an AAA in

a 10 year follow up period. More importantly, from this ectatic group, 26.2% developed an AAA ≥5.5 cm.[16]

The strength of our study is the reported associated risk factors of active smoking and COPD diagnosis as significant risk factors for the progression of an ectatic aorta to an AAA. No risk factor analysis is reported in any of the previous reports,[14–17] making comparisons between groups in those studies challenging. In reviewing the patient base from which the screening studies were performed, the overall smoking prevalence rate are similar between US Veterans (27%)[18] and UK Citizens (28%).[19] Our veteran subject pool, via inclusion criteria for screening, have 100% smoking prevalence but a 20.1% current smoking prevalence. This statistic is lower than the overall 27% US Veteran active smoking prevalence rate. Our data sample is limited to the region of Northern California, where smoking prevalence may be lower in the Western United States than any other region in the country.[20] Given the possibility that fewer Veterans are actively smoking in Northern California, relative to the rest of the US and UK, may contribute to the relatively low progression of AAA disease rate.

Furthermore, previous reports[13, 14, 16] include data on patients who were diagnosed from 1992–2000 (15 years prior to the inception of our screening program in 2007). Over the past 15-year period 1995–2010, cardiovascular medical therapy has enjoyed wide spread success.[21] The implementation of statin therapy, ACE Inhibitors, ARBs, beta-blockers, 2nd and 3rd generation anti-platelet agents, and other risk factor reducing medications may continue to make the true incidence and progression of AAA disease difficult to quantify. This improved medical management may continue to mitigate AAA progression.

The data presented regarding overall ectatic aorta progression to AAA is severely limited by 21% of all patients with detected ectatic aortas having an appropriate imaging study more than 1 year after their initial screening. This introduces selection bias that is an estimate of the true percentage of patients with ectatic aortas that develop in AAA and may not accurately represent the general screening population. The low follow up numbers are due to the VA implementation of the US Preventative Task Force guidelines on AAA screening, where a normal screening ultrasound defined as <3.0 cm requiring no further imaging surveillance.[8] From 2007 – 2016, patients with aortic diameters less than 3.0 cm were no longer followed for further surveillance. Only patients incidentally imaged more than 1 year after the initial screening AAA were evaluated in this study. Although not statistically different, a trend towards shorter survival was seen in patients whose aorta remained stable versus those patients that developed to an AAA (Figure 3). Indications for follow up imaging were typically for abdominal pain or the evaluation for metastatic cancer, but due to the limitations of this retrospective review, exact clinical indications are difficult to interpret. However, imaging requests typically portend pathology adversely affecting a patient's overall prognosis. Hence, selection bias may play a role in the study data. A more extensive follow-up of subjects that lack follow-up imaging may be a subject of a future study.

A second limitation is the relatively poor documentation in the VA EMR regarding cause of death noted in the death note. The most common cause of death was from "natural causes." Death from AAA rupture cannot be necessarily ruled out from the 27.8% of patients that

died from unknown causes, making the present surveillance paradigm potentially worrisome.

Another limitation to this study is that we cannot confirm absolute repeatability between follow up scans. The current VANCHCS AAA screening program guidelines call for outer-wall to outer-wall aortic measurements. Because of the retrospective nature of this study, we could only report aortic measurements what was verified at the time of the screening and follow-up scan.

Finally, whether ectatic aortas should undergo surveillance imaging has not been completely resolved. Recent 2018 SVS Guidelines for AAA Care do not make recommendations for follow up surveillance[6] for ectatic aorta, whereas Sweden is the only country where follow up surveillance is recommended at 5 years after the diagnosis of an ectatic aortic (2.5–2.9 cm) from screening.[22] Future recommendations for surveillance of patients diagnosed with ectatic aortas would add cost. Therefore, a cost analysis for the effectiveness in screening and surveillance recommendations are important.[23] Based upon preliminary data collected from our institution's AAA screening program, the overall cost of AAA screening is estimated to be $2,539,451 to screen 19,649 patients over this 10-year period, for an average of $129.65 per ultrasound screening (in 2016 US Dollars). Therefore, the extra cost to perform an additional surveillance imaging study on 3,205 patients with an ectatic aorta would be an additional $415,528, or a 16% budgetary increase. To mitigate overall increase in health care costs, a possible approach may be to perform surveillance imaging on patients who are still actively smoking and carry a COPD diagnosis at the time of initial screening. This selected group of patients could streamline surveillance ultrasound to roughly 30% of patients diagnosed with an initial ectatic aorta. A follow up time interval for ectatic aorta surveillance could be determined after a thorough costutility analysis.

In summary, this study has the strength of a large cohort study of ~20,000 patients over a 10-year period with standardized protocols for AAA screening invitation, consistent aortic imaging, as well as granular patient data regarding risk factors for individual patients. However, due to the retrospective design of prospectively collected clinical data from a large regional VA Medical Center, several limitations exist. First, no follow up data were collected on all patients identified with aorta 2.5–2.9 cm in diameter. Since 2007, all patients with these ectatic aortic diameters were deemed normal and no further surveillance imaging was available for review. Only 21% of patients with ectatic aortas could be identified with at least one subsequent imaging study. Second, 27.8% of patients died of unknown causes (3rd leading cause of death in our study). Whether these patients died from a ruptured AAA is not readily available in a retrospective chart review because chart entries utilize "natural causes" as the cause of death in the death note. Third, of the 19,649 patients screened, 15,212 patients had an ultrasound radiology report deemed as "normal aorta" without reporting actual aortic diameters. Whether all 15,212 patients had an aorta <2.5 cm will require a review of all patient images to confirm a "normal" diameter. Fourth, the VA Regional Medical Center is within Northern California, where smoking prevalence is lower and racial diversity is greater, than the United Kingdom. These differences in patient profiles make it difficult to generalize the data and may underestimate the natural history of an ectatic aorta in other parts of the country and world. However, based upon clinical data

reported here, when should a follow-up scan be ordered for ectatic aorta surveillance cannot be determined. A thorough cost-effectiveness analysis of the entire AAA screening program, including AAA developed from diagnosed ectatic aortas, is needed.

Conclusions

There is a 16.3% prevalence rate of ectatic aortas in patients in a large AAA screening program, 28.7% of all ectatic aorta patients developed an AAA and 0.15% developed an AAA ≥ 5.5 cm. There were no reported aneurysm ruptures, however cause of death is unknown in 27.8% of deaths in the series. Given that only 21.0% of patients with an ectatic aorta had a subsequent imaging study at least 1 year from AAA screening, these numbers may underestimate the true conversion to AAA. Patients with diagnosed ectatic aortas from screening who are active smokers or have COPD are likely to develop an AAA.

Acknowledgments

This work was supported by Merit Award I01 CX001683 from the United States Department of Veterans Affairs Clinical Sciences Research and Development Program, The National Center for Advancing Translational Sciences (NCATS), and The National Institutes of Health (NIH) UL1 TR001860. The authors would like to thank Ashley Schmidt, Kelly Dolan, and Alex Pae for assisting with data collection.

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Article Highlights

Type of Study:

A retrospective cohort study

Key Findings:

From 2007 – 2016, an AAA screening program identified 3,205 patients with ectatic aortas 2.5 – 2.9 cm in diameter; 672 patients had follow-up imaging (ultrasound, CT scan, or MRI) at least 1 year from screening and 193 (28.7%, 193/672) developed an AAA with an average follow-up of 4.2 ± 2.5 years. No ruptures were reported but cause of death was unknown in 27.8% of those who died during follow up. One patient developed an AAA >5.5cm. Larger initial screening diameter ($p<.01$), presence of COPD ($p<.01$), and active smoking ($p=.01$) were associated with AAA development.

Take Home Message:

Patients with ectatic aortas who are active smokers or have COPD are likely to develop an AAA.

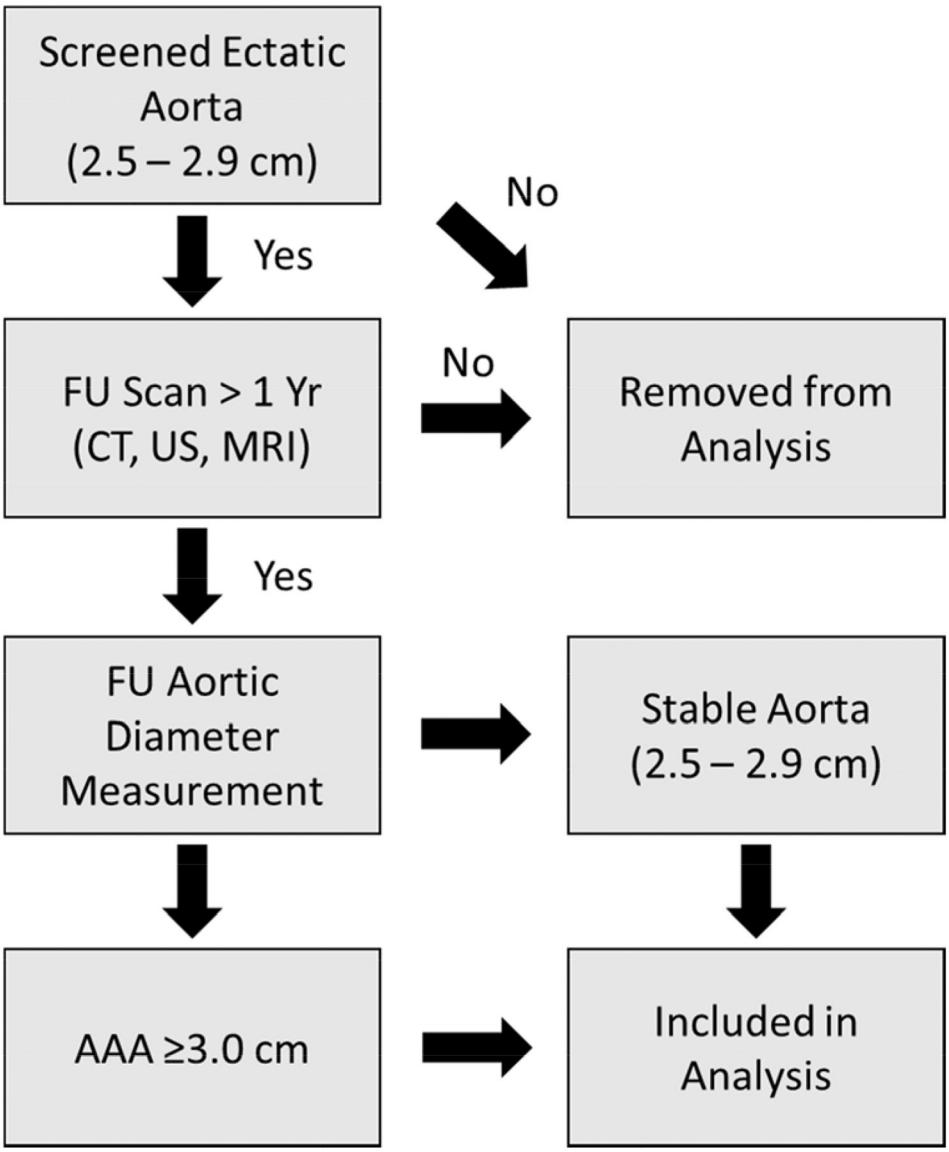

Figure 1.

Patient study flow chart. AAA, abdominal aortic aneurysm; CT, computerized tomography scan; FU, follow-up; MRI, magnetic resonance imaging

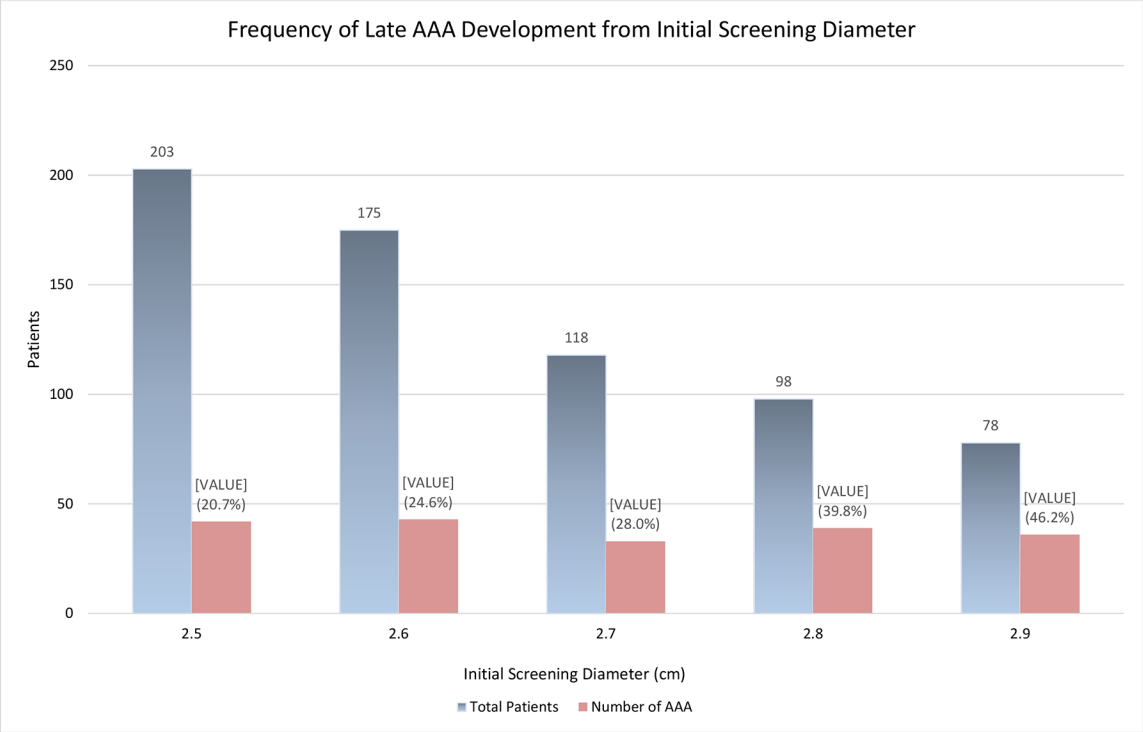

Figure 2.
Distribution of AAA developed from ectatic aorta patients by initial screening diameter.

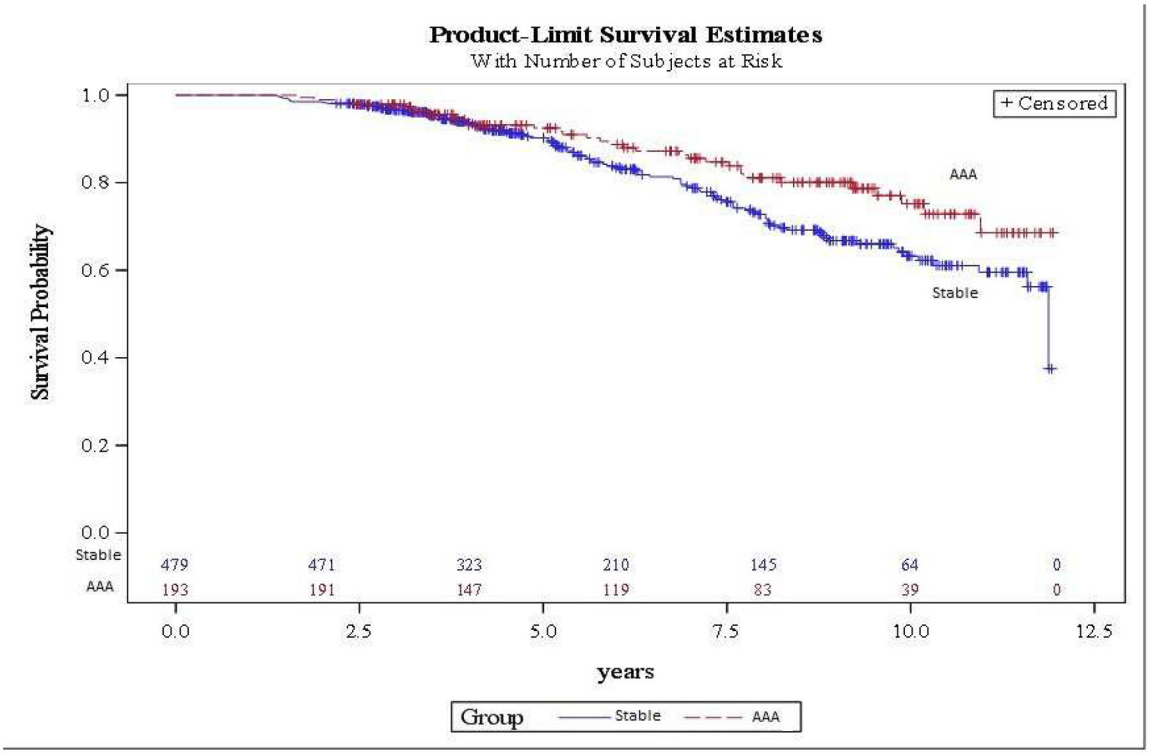

Figure 3.

Survival analysis between patients with diagnosed ectatic aortas that remained stable versus those patients that developed AAA. The average follow-up length between scans was 4.2 ± 2.5 years and the average observation length for each subject was 6.4 ± 2.9 years.

Table I.

Race Distribution Summary

	Total (N=672)	**Stable (N=479)**	**AAA (N=193)**
	N (% Total)	***N (%)***	***N (%)***
White	431 (64.1)	311 (64.9)	120 (62.2)
Black or African American	122 (18.2)	88 (18.3)	34 (17.6)
Asian or Pacific Islander	12 (1.8)	8 (1.7)	4 (2.1)
Hispanic	26 (3.9)	18 (3.8)	8 (4.2)
American Indian	6 (0.9)	5 (1.0)	1 (0.5)
Unknown or declined to state	75 (11.2)	49 (10.2)	26 (13.5)

Table II.

Follow-up Scan Summary

	Total (N=672)	**Stable (N=479)**	**AAA (N=193)**
	N (% Total)	***N (%)***	***N (%)***
CT Scan	500 (74.4)	353 (73.7)	147 (76.1)
Ultrasound	138 (20.5)	101 (21.1)	37 (19.2)
MRI	34 (5.1)	25 (5.2)	9 (4.7)

CT, Computerized Tomography; MRI, Magnetic Resonance Imaging

Table III.

Aortic Diameter Distribution of AAAs (N=193)

Aortic Diameter (cm)	N (%)
3.0 – 3.9	179 (92.7)
4.0 – 4.9	13 (6.7)
>5.0	1 (0.6)

AAA, abdominal aortic aneurysm

Table IV.

Cause of Death for All Patients (n=133)

Cause of Death	N (%)
Cardiopulmonary	**40 (30.1)**
CHF	18 (45.0)
COPD	11 (27.5)
MI	3 (7.5)
Other	8 (20.0)
Cancer	**48 (36.1)**
Lung Cancer	21 (43.8)
Prostate Cancer	5 (10.4)
Other Cancer	22 (45.8)
Stroke	**1 (0.7)**
Infection, Bleeding, Trauma, Other	**5 (3.8)**
Renal Failure	**2 (1.5)**
Suspected Aortic Rupture	**0 (0)**
Unknown	**37 (27.8)**

CHF, congestive heart failure; COPD, chronic obstructive pulmonary disease; MI, myocardial infarction

Table V.

Summary of Univariate Patient Data

	Total (N=672)	Stable (N=479)	AAA (N=193)	
	Mean ± SD	***Mean ± SD***	***Mean ± SD***	**P-Value**
Age (yrs)	73.0 ± 5.7	72.7 ± 5.5	73.8 ± 6.0	0.03
Follow-up Length (yrs)	4.2 ± 2.5	3.8 ± 2.3	5.2 ± 2.6	0.02
Screening AAA Diameter (cm)	2.7 ± 0.1	2.6 ± 0.1	2.7 ± 0.1	<.01
Follow-up AAA Diameter (cm)	2.8 ± 0.4	2.6 ± 0.3	3.3 ± 0.4	0.05
Aortic Expansion Rate (cm/yr)	0.03 ± 0.14	−0.02 ± 0.10	0.14 ± 0.10	<.01
Total Cholesterol (mg/dL)	159.1 ± 39.4	160.6 ± 39.8	155.2 ± 38.1	0.10
HDL Cholesterol (mg/dL)	46.5 ± 14.6	46.9 ± 15.1	45.7 ± 13.0	0.35
LDL Cholesterol (mg/dL)	89.6 ± 32.9	90.3 ± 33.6	87.7 ± 31.2	0.35
Triglycerides (mg/dL)	116.3 ± 67.1	118.9 ± 69.8	109.8 ± 59.7	0.12
Body Mass Index (kg/m^2)	28.8 ± 6.1	29.0 ± 6.2	28.5 ± 6.0	0.53
Creatinine	1.2 ± 0.7	1.2 ± 0.7	1.1 ± 0.5	0.05
Hemoglobin A1c	6.2 ± 1.2	6.2 ± 1.2	6.1 ± 1.0	0.05
Systolic BP (mmHg)	130.8 ± 18.9	130.8 ± 19.2	131.0 ± 18.1	0.88
Diastolic BP (mmHg)	6.2 ± 1.2	70.9 ± 11.1	73.2 ± 11.7	0.02
	N (% Total)	***N (%)***	***N (%)***	**P-Value**
Hypertension	539 (80.2)	378 (78.9)	161 (83.4)	0.18
Diabetes	255 (38.0)	191 (39.9)	64 (33.2)	0.10
Current Smoking	135 (20.1)	88 (18.4)	47 (24.4)	0.08
Statin Use	348 (51.8)	252 (52.6)	96 (49.7)	0.50
Coronary Artery Disease	163 (24.3)	114 (23.8)	49 (25.4)	0.66
Peripheral Vascular Disease	84 (12.5)	56 (11.7)	28 (14.5)	0.32
COPD	164 (24.4)	102 (21.3)	62 (32.1)	<.01
eGFR (<60 mL/min)	184 (27.4)	138 (28.8)	46 (23.8)	0.19
Living Status	539 (80.2)	379 (79.1)	160 (82.9)	0.04

AAA, Abdominal Aortic Aneurysm; BP, Blood Pressure; COPD, Chronic Obstructive Pulmonary Disease; eGFR, Estimated Glomerular Filtration Rate; HDL, High-density Lipoprotein; LDL, Low-density Lipoprotein; SD, Standard Deviation

Table VI.

Final Model of Logistic Regression

Variable	Variable Estimate	Standard Error	P-Value	Hazard Ratio
Initial Screening Diameter (cm)	2.91160	0.64560	<.01	1.695
COPD	−0.78048	0.18972	<.01	0.458
Active Smoking	0.70053	0.28500	0.01	2.015

COPD, Chronic obstructive pulmonary disease