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Original Article

# Does a normal screening ultrasound of the abdominal aorta reduce the likelihood of rupture in emergency department patients?☆,☆☆,★

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ABSTRACT

**Introduction:** Abdominal aortic aneurysm (AAA) development is a multifactorial process that is more prevalent among people ≥65 years of age. Major risk factors are obesity, male sex, history of smoking (at least 100 cigarettes in a person's lifetime), and history of AAA in a first-degree relative. The United States Preventative Task Force has recommended a one-time ultrasound screening for men aged 65–75 years. Based on studies, negative results on a single ultrasound examination around the age of 65 years appear to virtually exclude the risk for future AAA rupture or death. While ultrasonography (US) is the confirmatory study of choice, computed tomography (CT) can also be used in the diagnosis of AAA. The goal of this study is to determine if AAA rupture can reliably be excluded in individuals with abdominal pain who have had a normal caliber aorta on CT or US after the age of 65 years.
**Materials and methods:** A retrospective study (approved by institutional review board) of emergency department (ED) patients in an urban academic center was performed. Subjects were included if they met the following criteria: age ≥65 years; an initial CT or US as an ED patient, inpatient, or outpatient for any indication, which identified an abdominal aorta <3 cm; and a second CT or US during an ED visit. The incidence of ruptured AAA on the second CT or US with a history of normal aortic caliber was identified.
**Results:** During the study period, 606 subjects were enrolled. Demographic data are listed in Table 1. Three subjects (0.5%) exhibited an abnormal-sized aorta on ED evaluation. None of these three subjects had an AAA intervention. The average size of the abnormal aorta in these three subjects was 3.3 cm (S.D. 0.17).
**Conclusion:** Based on these results, it appears that AAA and rupture may reliably be excluded in ED patients with abdominal pain who have previously had a normal caliber aorta on CT or US after the age of 65 years. A prospective, multicenter study would help validate these findings.

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## 1. Introduction

Abdominal aortic aneurysm (AAA) development is a multifactorial process of vascular wall deterioration, which against the background of age is a pertinent clinical issue to physicians caring for older population strata. AAA is more prevalent among persons over age 65 years; prevalence lies between 5% and 10% in men and between 0.5% and 1.3% in women [1], but it appears to increase 2–4% per decade thereafter. Risk factor identification and understanding of possible modifiable risk factors for this disease through randomized control trials and clinical series have helped improve AAA management and treatment. These studies have typically shown associations with history of smoking, older age, white race, hypertension, history of vascular disease, or a history of surgery for AAA in a first-degree relative with prevalent AAA development and progression [1,2]. The most significant risk factor for AAA is a history of cigarette smoking. Studies have revealed smoking as strong predictor of aortic aneurysmal development and expansion with the duration of exposure rather than the level of exposure determining the risk [3]. Additionally, women over the age of 65 years with cardiovascular disease who smoke are at a comparable risk to the male population over the age of 65 years in developing AAA [4,5].

Approximately one third of AAAs (as defined by ≥3 cm) develop into significant AAAs that rupture if left untreated. The risk of rupture of AAAs measured less than 4 cm is negligible; however, that risk increases exponentially once the aortic diameter reaches equal to or greater than 5 cm [6]. The prognosis associated with rupture is dismal; the operative mortality for emergent repair is high with only 10–25% of those surgical patients surviving until hospital discharge [1].

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☆☆ The study was approved by the Staten Island University Hospital Institutional Review Board.
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The United States Preventative Task Force has recommended a one-time ultrasound screening based on evidence revealing that this diagnostic modality offers a significant protective effect against AAA-related deaths for individuals aged 65–75 years. Screening offers early detection, affords the patient time for elective intervention, and significantly lowers overall mortality [7,8]. A single normal ultrasonographic scan at age 65 years rules out significant aneurysm disease for life in men.

While ultrasonography (US) is the confirmatory study of choice, computed tomography (CT) and magnetic resonance imaging (MRI) can also be used in the diagnosis of AAA. CT imaging offers detailed anatomical information that can be used to narrow the differential for patients presenting with nonspecific abdominal symptoms. Though it is highly sensitive and specific for identifying AAA, CT is more costly and not appropriate for follow-up due to serial exposure to contrast and ionizing radiation. MRI provides detailed anatomical imaging of vasculature with or without contrast enhancement, but despite its ability to demonstrate aortic abnormalities, patient exposure to contrast material makes MRI a less practical method for screening abdominal aneurysmal disease. US not only offers the distinct advantage of safety and cost but also is noninvasive, quick, less technically demanding, and accurate [9].

Although AAA is present in a defined population, the presenting symptoms cannot be definitively attributed to the aorta and can masquerade as other disease processes. The pathognomonic triad of pulsatile abdominal mass, pain, and hypotension is present only in a minority of symptomatic AAA patients. Other common symptoms such as unexplained lower back pain, groin pain, or flank pain [10] can mimic acute conditions such as renal colic, diverticulitis, pancreatitis, biliary tract disease, and mesenteric ischemia. For patients with a known AAA, progressive symptoms of syncope, claudication, or nausea can be indicative of the aortic expansion and imminent rupture. Physical examination and diagnostic evaluation through laboratory and imaging studies are often necessary in the emergency department (ED) for those suspected of AAA.

The goal of this study is to determine if in a population of elderly patients, defined as greater than 65 years of age, who presented to the ED with abdominal pain and history of a negative imaging study of the aorta, aortic enlargement, and AAA rupture, can reliably be excluded.

## 2. Materials and methods

We conducted a retrospective, observational study. The study was conducted at XXXXX, a 700-bed, tertiary-care teaching hospital in XXXXX. The adult ED has a census of 85,000 patients per year and abdominal pain is the presenting complaint in approximately 10% cases. This study was approved by the XXXXX Institutional Review Board.

An electronic radiology database was queried for the time period between January 1, 2004 and June 1, 2013 to identify potential subjects. This timeframe was utilized because the electronic database was initiated in 2004. Study inclusion criteria were (1) age ≥65 years and (2) received imaging studies of their aorta at two separate visits: (Visit 1) an initial CT or US as an ED patient, inpatient, or outpatient, which identified a normal abdominal aorta and (Visit 2) a second CT or US during an ED visit. The initial CT (Visit 1) may have been performed for any indication and may have been performed with or without contrast since the aortic caliber can be accurately assessed by either method.

Participants were excluded if (1) CT results from either visit were unavailable for review, (2) repeat CT or US (Visit 2) occurred during the same patient encounter (either same ED visit or inpatient stay) was also excluded, or (3) subjects were younger than age 65 years at the time of the initial study (Visit 1). If subjects had more than one CT or US after the age of 65 years, the study that offered the longest time difference between studies was used.

Each record was reviewed by a trained research associates and subsequently by a single board-certified, emergency physician. Radiographic diagnoses were obtained from computerized reports. All reports are dictated by a board-certified attending radiologist. Reports were categorized by study staff as either positive or negative. All data collected were recorded on a standardized case report form. The incidence of ruptured AAA on the second CT or US (Visit 2), with a documented history of normal aortic caliber (Visit 1), was identified.

The primary objective of the statistical analysis was to estimate the proportion of enrolled subjects who, based upon the CT/US for the current episode, do not have AAA. It was hypothesized that this proportion will be high.

Based on a review of data at XXXXX for the period 1/1/04 through 6/1/13, there were 1340 patients who met the following conditions: ≥65 years old with acute abdominal pain, referred for CT/US for this episode, previous CT/US performed at age ≥65 years, and results of previous CT/US are available during ED episode. Of these 1340 subjects, a subset of patients were enrolled based on a sample size calculation.

## 3. Results

During the study period, 1340 patients were identified. Each subject was assigned a consecutive number and randomly selected using an online list randomizer (https://www.random.org/lists/). A randomized selection of the patient population was performed as described per Kaji et al. [11] in order to reduce bias in retrospective studies. If any subject met one of the exclusion criteria, the next subject in the randomized list was selected. A total of 139 subjects were excluded based on predetermined criteria (Fig. 1).

A total of 606 subjects were included in the final analysis. The following was identified at Visit 2: the median [mean, S.D.] amount of time between radiographic studies was 392 days [658, 684]. The average age of subjects was 78 years. A total of 408 subjects (67%) were female. A total of 401 subjects (66%) had at least one major risk factor for AAA. Complete demographic data and AAA risk factors are displayed in Table 1.

A total of 50 subjects had a time between studies of >5 years. The median [mean, S.D.] amount of time between radiographic studies was 6 years [15, 8]. In this subgroup, average age of subjects was 78 years. Demographic characteristics and risk factors were similar in this subgroup as compared to the entire population.

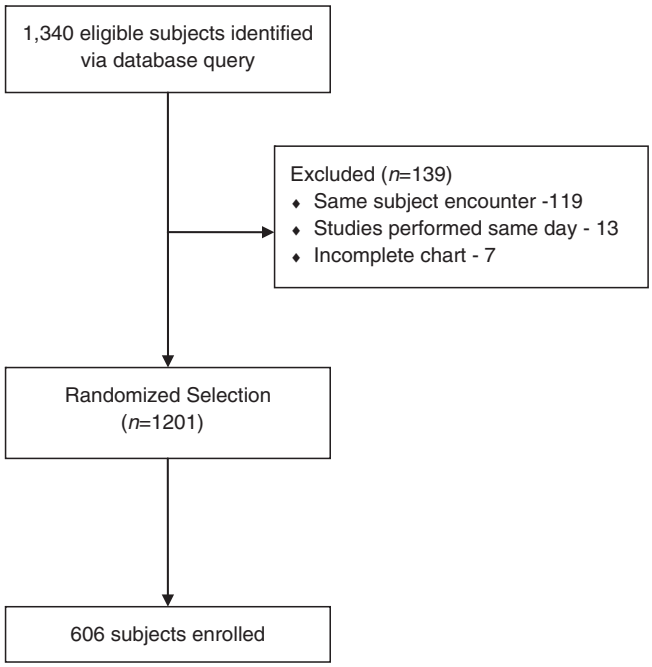


**Fig. 1.** Flow chart demonstrating subject identification and enrollment.

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