Imaging Redundancy in Screening for Abdominal Aortic Aneurysm: A Case Study

Guangzu Gao, MD, Anita Arora, MD, MBA, Leslie Scoutt, MD, Mahan Mathur, MD

DESCRIPTION OF THE PROBLEM

Overuse of imaging is increasingly recognized as a source of excessive health care spending in the United States, where it has been estimated that 20% to 50% of radiologic tests are unnecessary [1]. In particular, prior studies have demonstrated that the use of ultrasound to screen for abdominal aortic aneurysm (AAA) is frequently redundant, as many patients have undergone previous radiologic tests that visualize the abdominal aorta and are sufficient for screening [2,3]. The US Preventive Services Task Force and American Heart Association recommend that all men aged 65 to 75 years who are prior or current smokers undergo abdominal ultrasound to rule out AAA [2-6]. As a single lifetime screening, AAA ultrasound can provide valuable insights in understanding imaging overutilization.

However, two prior studies that reported on AAA ultrasound redundancy were not designed specifically to investigate this particular problem and were limited because imaging and radiology reports were not reviewed; and inclusion criteria were somewhat arbitrary. Hye et al [2] performed a database search and reported that 48.3% of patients aged 65 to 75 years eligible for AAA screening had undergone prior abdominal imaging studies, defined as any imaging examination within 10 years of the patient's age [2]. It is unclear whether some of the prior imaging studies included by Hye et al were adequate to exclude AAA. Similarly, Ruff et al [3] reported a 31% rate of redundant screening. However, they included imaging studies performed after the age of 50 years and did not include studies that could have excluded AAA, such as MRI and CT of the lumbar spine.

Accordingly, we sought to determine the rate of overuse of screening AAA ultrasound at our institution and elucidate its causes.

WHAT WAS DONE

The human investigation committee at our institution approved this review with a waiver of the requirement to obtain informed consent. We used the Montage radiology search engine (Montage Healthcare Solutions, Philadelphia, Pennsylvania) to obtain all ultrasound reports containing the phrase "screening abdominal aortic aneurysm" in the radiology report text and selected 571 male patients aged 65 to 75 years who underwent screening AAA ultrasound during an 11-year period (January 1, 2005 to December 31, 2015) at our institution (a tertiary care center). Among this group, radiologic examinations that would have sufficiently imaged the aorta were further analyzed. For the purpose of this study, the presence of an AAA was diagnosed if the aortic diameter was 30 mm or more.

On the basis of our experience and a process of trial and error during retrospective inspection of prior examinations for adequacy in imaging the abdominal aorta, the following studies were included as sufficient for excluding an AAA: abdominal CT; abdominal and pelvic CT; chest, abdominal, and pelvic CT; CT angiographic studies that included the abdominal aorta; whole-body PET/CT; CT simulation for procedure planning, such as for prostate radiation therapy; lumbar spinal CT; CT virtual colonoscopy; lumbar spinal MRI; abdominal MRI; and abdominal and pelvic MRI. Of ultrasound studies, only dedicated studies of the aorta were included. At our institution, other ultrasound imaging protocols, such as abdominal ultrasound and renal vascular ultrasound, do not routinely include the entire abdominal aorta and thus cannot exclude an AAA. The prior examination's report was also evaluated to determine whether positive findings, such as the presence of an AAA, or negative findings, such as the absence of an AAA, were appropriately stated.

Among the 571 patients analyzed, the average age was 68.9 ± 2.9 years (range, 65-75 years). Of

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these, 118 (20.7%) had undergone at least one prior examination that already adequately imaged the abdominal aorta and were 65 years of age or older. The time between the initial imaging test and the screening ultrasound study ranged from 2 days to 8.6 years (mean, 2.7 ± 2.2 years). The presence or absence of an AAA was not explicitly mentioned in 77.1% of prior imaging reports (91 of 118), and 72.9% of ultrasound reports (86 of 118) failed to cite any prior imaging as comparison. Table 1 reports the types of examinations that had sufficiently imaged the aorta, the frequency of the presence or absence of AAA described in the radiology report, and the frequency of a prior imaging test being cited as a comparison examination. Two lumbar spinal CT and four lumbar spinal MRI studies were inadequate to exclude AAA because a portion of the aorta was not seen.

Five of 118 patients (4.2%) developed AAA in the time between the initial imaging test and the screening ultrasound study. The sizes of these aneurysms ranged from 3.0 to 3.3 cm, and none of these patients underwent surgical intervention. Table 2 reports the details of these five patients. A number of unexpected findings, such as renal stones, gallstones, prostate enlargement, and stigmata of fatty liver infiltration, were reported by screening ultrasound. Two unexpected findings, both pathologically confirmed renal cell carcinomas, necessitated surgery and critically changed patient management. Four screening ultrasound studies (0.7%) overmeasured the abdominal aorta and inaccurately reported the presence of an AAA, as subsequent examinations showed no aneurysms.

OUTCOMES

We sought to understand imaging redundancy in screening for AAA as per the Preventive Services Task Force guidelines. Of 571 male patients who underwent AAA screening ultrasound at a tertiary care center from January 1, 2005, to December 31, 2015, 20.7% had undergone at least one prior imaging test that sufficiently imaged the abdominal aorta at age 65 years or older. The most common prior imaging test in our patient population was a CT scan of the abdomen and pelvis (42.4%), followed by lumbar spinal MRI (18.6%). Insights gained from our analysis are consistent with the problem of excessive imaging utilization in the United States, where it has been estimated that 20% to 50% of imaging is unnecessary [1]. Imaging examinations are often duplicated when the ordering clinician's efforts to identify previous examinations are inadequate or unproductive [1]. Indeed, only 22.9% of prior imaging specifically reported whether AAAs were present or absent, a finding that could have been potentially used by the ordering providers as evidence for avoiding redundant screening ultrasound. A case in point is a patient who underwent CT angiography that showed a 4.3-cm AAA 3.6 years before undergoing screening ultrasound. Nevertheless, the referring provider wrote in the chart, "I cannot find a record of the patient having being screened for an abdominal aortic aneurysm," and then ordered the ultrasound study.

However, our data indicate that a larger portion of the responsibility for unnecessary imaging might be shared by radiologists. Radiologists can contribute to the overutilization of imaging by failing to review requested examinations for appropriateness before they are conducted or failing to consult with referring clinicians about studies that are being requested [1]. Given that 77.1% of reports did not explicitly state the presence or absence of an AAA, radiologists

Table 1. Prior examinations adequate for imaging the aorta

Type of Examination	Frequency	Number of Reports Mentioned Whether AAA Is Present	Frequency of Prior Imaging Test Being Cited as a Comparison With Screening Ultrasound
Abdominal and pelvis CT*	50	8 (16%)	13 (26%)
Lumbar spinal MRI	22	0	0
AAA screening ultrasound	14	14	11 (79%)
Abdominal MRI	9	0	1
Chest, abdominal, and pelvic CT	8	2	3
Lumbar spinal CT	5	1	0
Whole body PET/CT	5	0	1
Chest and abdominal CT angiography	1	1	1
Abdominal and pelvic CT angiography	1	1	1
Abdominal and pelvic MRI	1	0	0
CT virtual colonoscopy	1	0	0
CT simulation for procedural planning	1	Not reportable	1

Note: AAA = abdominal aortic aneurysm.

*One abdominal and pelvic CT study had no images in the PACS but had a report in the PACS stating that there was atherosclerotic disease of the abdominal aorta without stating whether there was an AAA.