

Who's Ordering the CT Anyway? A Study on the Magnitude of CT Scan Use for Suspected Acute Appendicitis.

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The incidence of appendicitis in western countries approaches 8%.

Appendectomy is the most common abdominal surgical emergency in the US, with more than 250,000 operations performed annually [1]. However its presentation leads to a wide differential diagnosis.

Although traditionally a clinical diagnosis, improved imaging techniques using computed tomography (CT) have become commonplace in confirming the diagnosis. CT scan has a sensitivity and specificity of 90% and 80-90% for the diagnosis of acute appendicitis clinically selected patients. Studies have revealed that the use of CT has decreased negative appendectomy rate from 20% to 7% [2]. Although its utility in equivocal cases of appendicitis has been proven, controversy remains regarding routine use of CT to diagnose appendicitis. Recent studies have shown that organ doses corresponding to a routine CT result in an increased risk of cancer, with approximately 0.4% of all cancers in the United States attributable to radiation from CT [3]. By adjusting for current widespread CT use, the aforementioned estimate may be upwards of 2.0% [3]. Furthermore, the FDA estimates that a CT with an effective dose of 10 milliSieverts (mSv), equivalent to a single CT of the abdomen, may be associated with an increased chance of developing fatal cancer for approximately one in 2000 patients [4]. Due to these raised concerns we sought to quantify the number of CTs obtained for patients with suspected acute appendicitis and to identify the ordering physician group.

This is a single institution retrospective chart review of 1579 patients from January 2012 to December 2013. Patients with the following ICD 9 codes were queried: appendicitis, right lower quadrant pain, and abdominal pain. Using these codes, all CT scans performed for patients with acute appendicitis in the differential were captured. Charts were excluded if the patient was under the age of eighteen and patients highly unlikely to have a diagnosis of appendicitis as documented in the physician's note.

Each chart was reviewed to determine which physician ordered a CT scan if in fact one was ordered. The radiology report was accessed to determine the field of the ordering physician and corroborated with the ED physician note.

A total of 1579 patients met the abovementioned search criteria. Using the exclusion criteria, 365 cases were excluded, resulting in 1214 total patients. Of those, 260 were positive for appendicitis and 954 were negative. The positive yield for CT use in the diagnosis for acute appendicitis was 21.4%.

The data was analyzed for the ordering physician. Of the total 1214 charts reviewed, 827 (68.1%) scans were ordered by the ED physician, 302 (24.9%) by the primary physician, and 85 (7%) by the surgeon. Positive and negative CT results for each practitioner group were analyzed. Of the total 827 CTs ordered by the ED, 211 were positive for appendicitis (25.5%) and 616 were negative (74.5%). Of the 85 CTs ordered by surgery, 34 confirmed appendicitis (40%) and 51 were negative (60%). Finally, of the 302 ordered by the primary physician 15 were positive (5%) and 287 were negative (95%).

In analyzing the two-year data, acute appendicitis was found in 21.4% of patients who underwent CT scan for this suspected diagnosis. Therefore, 78.4% or 954 patients

underwent CT scan and were not diagnosed nor treated for the suspected pathology. These results show an overwhelming high use of a radiologic tool with a low positive yield. The diagnostic value is unquestioned; however, increased use leads to growing concern regarding adverse effects associated with radiation from CT scan.

There was a flaw in the data retrieval that most likely influenced the study's percentage of positive CT scans. If a patient's diagnosis is changed in the electronic record then it will no longer be captured under its original differential. An example would be a CT that was done for suspected appendicitis but ended up finding diverticulitis or ovarian pathology would be documented under that code. Hence there were more CTs ordered to rule out appendicitis that would have driven the 21.4% positive rate lower but they were never included. The clinical significance of this is questionable since the patient was still diagnosed and treated with a different process based on the CT.

Most of the quantitative data regarding risks of radiation-induced cancer comes from this cohort of about 25,000 survivors [3]. The low dose of radiation received by atomic bomb survivors is comparable to organ doses associated with diagnostic CT scans. These survivors have been found to have significant increases in cancer incidence and mortality [4]. There are additional supporting studies that estimate radiation-induced cancer risk including a large-scale study of 400,000 nuclear industry workers. These workers were exposed to an average dose of 20 mSv and a significant increase in the risk of cancer was found among workers who received doses between 5 and 150 mSv. Furthermore, a study reviewing CT use from 1991 through 1996 estimated that 0.4% of all cancers in the United States may be attributable to radiation from CT scans. The

authors of this paper adjusted this estimate for CT use in 2007 and obtained an estimate in the range of 1.5 to 2.0% [3].

The other aim of this study was to quantify the CT-ordering physician. The majority of CTs were ordered by the ED physician with a positive percentage of 25.5%, next was the PMD with a positive yield of 5%. Finally surgeons ordered the least with a positive yield of 40%. Although it may be tempting for the authors to extrapolate that the surgical staff had the best predictive value of ordering CT, the surgeon most frequently sees the patient after another physician has evaluated them. This lends itself to a bias of sicker or more complicated patients who most likely require further work up. Another bias involves the number of scans ordered by the ED staff. Although this group ordered the majority of scans they see the most patients on a daily basis.

The authors of this paper are not advocating that the CT be completely abandoned for diagnosing appendicitis, but the dangers of diagnostic radiation must be considered. Different tactics must be used to limit radiation exposure like the use of the newest, low dose CTs. The most obvious means to decrease CT radiation exposure is to simply decrease the number of ordered scans. This could be accomplished with better reliance on physical exam and collaboration between the treating teams.

Acute appendicitis is a very common surgical disease that can become very serious when diagnosis is delayed. The fear of sepsis from a missed appendicitis most likely outweighs that of radiation exposure in the clinician's mind. The important idea is to start to recognize that with advances in technology also come advances in responsibility and the benefit to risk ratio must always be weighed.

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