Does Selective Use of Computed Tomography Scan Reduce the Rate of "White" (Negative) Appendectomy?

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ABSTRACT: **Background:** Appendectomies are the most common operations performed on an emergency basis. The accepted rate of "white" appendectomies is around 20%. In recent years, computed tomography (CT) scanning has been recognized as a valuable tool with high sensitivity and specificity in the diagnosis of acute appendicitis. The use of CT scans in the management of patients with suspected acute appendicitis is increasing worldwide.

Objectives: To assess whether introducing more liberal use of CT in the management of patients presenting to the emergency room with right lower quadrant pain or suspected acute appendicitis would reduce the rate of "white" appendectomies.

Methods: We conducted a retrospective study of the pathology reports and CT scans of all patients who underwent appendectomy during a 3 year period. We examined the correlation between the rate of CT scans performed and the rate of "white" appendectomies.

Results: Overall, we performed 797 appendectomies during the study period. In 2004, we performed 272 appendectomies and CT in 34 patients (12.5%). In 2005, we performed 275 appendectomies and CT in 83 patients (30.2%). In 2006, we performed 250 appendectomies and CT in 88 patients (35.2%). The percentage of "white" appendectomies decreased from 29% in 2004 to 21.1% in 2005 and to 18.8% in 2006.

Conclusions: It appears that a more selective use of CT scans in the management of suspected appendicitis could reduce the rate of "white" appendectomies.

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KEY WORDS: appendix, white appendectomy, computed tomography (CT), diagnosis, appendicitis

Appendectomies are the most common abdominal operations performed on an emergency basis. Early intervention reduces the risk of perforation and, thus, the associated morbidity and mortality [1]. The accepted rate of "white" appendectomies is around 20% [2]. When advanced age or female gender confounds the usual signs and symptoms, the error rate can reach as high as 40% [3].

History and physical examination remains the cornerstone when evaluating right lower quadrant pain. However, in recent years, computed tomography scanning has been recognized as a valuable tool in the diagnosis of acute appendicitis and its use is increasing worldwide [4–8]. For suspected appendicitis, CT has a sensitivity of 90–100%, specificity 91–99%, positive predictive value 95–97% and accuracy 94–100% [1,3,9]. CT has proved superior to ultrasound in diagnosing appendicitis [10,11].

The aim of this study was to examine whether introducing more liberal use of CT in the management of patients presenting to the emergency room with RLQ pain or suspected acute appendicitis would reduce the rate of "white" appendectomies.

PATIENTS AND METHODS

This was a retrospective study conducted at a single center. The pathology reports of all patients aged 18 years or older who underwent appendectomy during the 3 year period from 1 January 2004 to 29 October 2006 were collected, as were all CT reports on this particular group of patients.

CT was performed according to the judgment of the physician in charge of the emergency room (usually a senior resident). It is important to underline that during this period, guidelines did not exist as to when a CT should or should not be performed. We performed CT in cases where either the diagnosis was uncertain or the clinical picture did not match the physical findings. We recorded the number of performed CT scans, the percentage of "white" appendectomies, and the rate of false positive and negative CTs.

For statistical analysis we used the chi-square test and Fisher's exact test. Statistical analysis was performed at the Department of Statistics of Tel Aviv University. The Institutional Review Board of our medical center approved this study.

RESULTS

Overall, 797 appendectomies were performed during the study period. In 2004, 272 appendectomies were performed while CT was done in 34 patients (12.5%), the corresponding numbers for the other 2 years were 275 appendectomies and CT in 83 patients (30.2%); in 2005, and 250 appendectomies and CT in 88 patients (35.2%) in 2006 [Table 1].

The percentage of "white" appendectomies decreased from 29% in 2004 to 21.1% in 2005 and to 18.8% in 2006. This change was statistically significant [Figure 1].

RLQ = right lower quadrant

Table 1. Number and percentage of computed tomography scans and "white appendectomies" performed

(Total no. of appendectomies)	2004 (n=272)	2005 (n=275)	2006 (n=250)
No. of computed tomography scans	34 (12.5%)	83 (30.2%)	88 (35.2%)
No. of "white" appendectomies	79 (29.0%)	58 (21.2%)	47 (18.8%)

Figure 1. Relation between the number of computed tomography scans performed and the rate of "white"appendectomies

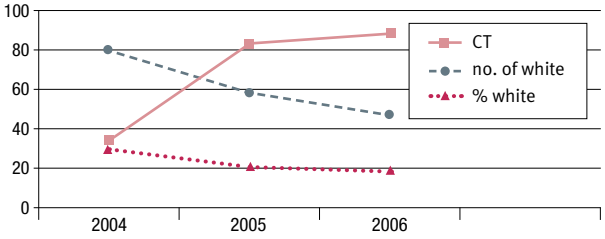
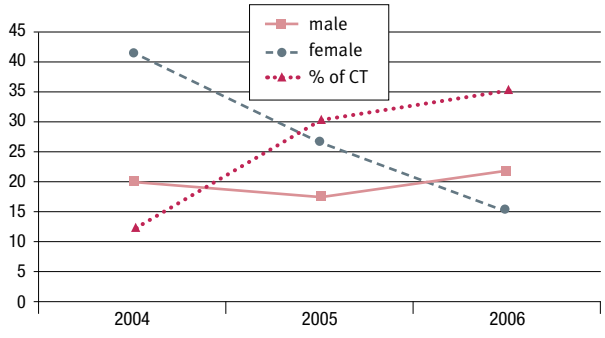


Figure 2. Trends of "white" appendectomies according to gender



The false positive rate of the CT scans in our study was 7% and the false negative rate 35%. The positive predictive value of the CT scan was 92.9% and the negative predictive value 56.3%.

Analyzing the results with respect to gender [Figure 2], one can see that in 2004, 30 of the 152 males (19.7%) who underwent appendectomy had a "white" appendix, as compared to 49 of 119 females (41.2%). The difference was statistically significant.

In 2005, of those who underwent appendectomy a "white" appendix was found in 27 of 155 males (17.4%) and 31 of 118 females (26.3%). The difference was statistically significant. In 2006, the respective numbers were 31 of 143 males (21.7%) and 16 of 107 females (15%). This difference was not statistically significant.

A total of 205 CTs were performed on the 797 patients during the 3 year study period, 99 in males and 106 in females.

DISCUSSION

CT scan is becoming more and more acceptable as a useful diagnostic tool in the management of patients with abdominal pain, and in particular in patients with RLQ pain. The sensitivity and specificity of the CT scan in large series evaluating RLQ pain was as high as 98%, and its superiority over ultrasound has already been established [1,3]. Despite the accumulated data, the effect of a CT scan on the outcome of management, in terms of preventing unnecessary surgery, is controversial [8,12].

Retrospective studies on management decisions and unnecessary appendectomies have had conflicting results. Rao et al. [1] reported that CT has 98% sensitivity, 98% specificity, 98% positive predictive value and 98% negative predictive value, and that a correct diagnosis in 94% of the cases in their study led to a change in treatment strategy in 59% of the patients. They concluded that routine use of CT in suspected appendicitis improves patient care. Wilson and collaborators [13] reported a reduction in the rate of "white" appendectomy from 50% to 17% in women. In their study, the addition of CT did not influence the operative decision in men. Perez et al. [14] demonstrated an increase in the percentage of CTs ordered for suspected appendicitis from 11% in 1994 to 48% in 2000. Despite this increased use, the percentage of "white" appendectomies did not change and the CT scan was accurate in 81% of times. They concluded that preoperative CT did not improve the accuracy of diagnosis.

When considering the added value of CT scans in the evaluation and management of patients with suspected acute appendicitis, two major issues must be taken into account. The first is the amount of radiation to which the patient is exposed and the second is the cost.

Recent studies [4,5,15-18] have clearly shown that CT exerts a harmful radiation exposure effect, and since most patients with suspected appendicitis are in the second and third decades of life, these figures have even stronger validity. One should also keep in mind the issue of irradiation in young people in their child-bearing years.

Performing a CT scan is costly and time consuming [18,19]. This question is even more of a problem in the context of the Israeli medical system because health insurance providers do not pay the hospital specifically for the CT performed but globally for a visit in the emergency department. This obliges us to hospitalize the patient, even if the CT scan is normal, in order to cover the expenses, unlike other countries where the patient is discharged if the CT scan is normal.

According to data of some studies citing a reduction in "white" appendectomies, one would think it beneficial to perform a CT scan in all patients with RLQ abdominal pain presenting to the ED. However, is this really true? What about the patient discharged after a negative CT scan who returns one week later with abdominal pain – would he receive another CT? What about the patient with a normal CT but a clinical

ED = emergency department

picture of acute appendicitis. Should the patient be observed only or taken for a diagnostic laparoscopy? We believe that clinical judgment in such instances should prevail. Thus, taking into account the cost, radiation exposure, and the fact that there is no conclusive evidence regarding the role of CT scans in the management of these patients, the option of selective use of CT is much more appealing.

In a study performed by Wagner et al. [20], the rate of "white" appendectomies decreased from 16.3% in the previous decade to about 5% in the current decade, but the rate of preoperative CT scans increased dramatically from 32% to 95% in this time period. Is this the cost we are prepared to pay for reducing the negative appendectomy rate? Is there a real need to perform a CT scan on all suspected cases?

In the present study, we demonstrated that the growing and more liberal use of the CT scan has led to a decrease in the rate of "white" appendectomies performed in our institute. Patients were all operated on by the same group of surgeons using the same approach. The only change was the addition of a CT scan in cases where there was no clear-cut option of sending the patient home or performing surgery.

The positive predictive value in our study was 92.9%, which correlates well with larger series [1,3], but our negative predictive value (56.3%) was very low compared to other studies [9]. A possible explanation is that most of the CT scans were performed on an emergency basis and interpreted by less experienced radiologists. These data reinforce the argument that there is no replacement for history-taking, physical examination, blood testing, and clinical judgment.

Another important observation is that CT scans have a much more profound effect on the female population by obviating unnecessary operations. The use of CT scans in our series reduced the rate of "white" appendectomies in females from 41.2% in 2004 to 15% in 2006 and in males from 19.7% in 2004 to 17.4% in 2005. This finding correlates well with the findings of Wagner et al. [20]. Paradoxically, the rate of "white" appendectomies in males increased in 2006 to 21.7%. We were unable to explain this finding.

LIMITATIONS

Our study was a single-center retrospective study. During the study period, there were no guidelines as to which patient should undergo a CT scan. We were unable to find an explanation for the increase in the negative appendectomy rate in males in 2006.

CONCLUSIONS

It seems that a more selective use of CT scans in the management of suspected appendicitis could reduce the rate of "white" appendectomies, particularly in females. A positive result on CT scan can be considered diagnostic of acute appendicitis, but a negative result does not rule out acute appendicitis and cannot and should not replace clinical judgment.

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