

# Clinical and Laboratory Findings in Acute Appendicitis in the Elderly

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**Background:** Early diagnosis and surgery are important factors by which the morbidity and mortality of acute appendicitis in elderly patients can be lowered. This study was conducted to determine clinical and laboratory results that are commonly associated with acute appendicitis in elderly patients.

**Methods:** A retrospective chart review was conducted of patients aged 60 years or older who underwent appendectomy or laparotomy for suspected acute appendicitis during a 5-year period in a metropolitan county. Acute appendicitis was confirmed by the pathology report.

**Results:** Elevated band cells and right lower quadrant pain were predictors of acute appendicitis in clinically suspected cases. Band cells greater than 6 percent had an excellent positive predictive value, as all patients with elevated band cells had acute appendicitis. With increasing white cell count and temperature, specificity increased, sensitivity decreased, and the positive predictive value remained high.

**Conclusions:** It is essential to have a high degree of suspicion to recognize acute appendicitis in an afebrile elderly patient who has abdominal pain, a mildly elevated white cell count, and band cells in the upper limits of normal. (J Am Board Fam Pract 1996;9:75-8.)

Acute appendicitis is described as acute inflammation of the vermiform appendix and is treated surgically. Despite the improvement in management, morbidity and mortality remain higher in the elderly.<sup>1-9</sup> More rapid and aggressive progression of inflammation, early perforation, and abscess formation are common.<sup>4,8,10,11</sup> Because early diagnosis and surgery are important factors by which the morbidity and mortality can be lowered,<sup>10</sup> clinical findings and simple laboratory tests with high positive and negative predictive values would be very useful for the clinician when working with elderly patients suspected of having acute appendicitis.

A relatively high frequency of bacterial infections in elderly patients with fever has been reported.<sup>12,13</sup> Not all elderly patients with infection have an elevated temperature, however.<sup>13-15</sup> White cell count and differential, toxic granulations, vacuolization, and Döhle bodies can be useful in predicting bacterial infection in elderly patients.<sup>13,16-20</sup> An increase in perforated or gan-

grenous acute appendicitis has been reported in patients who had a temperature higher than 38°C, a white cell count greater than 9000/ $\mu$ L, and an estimated sedimentation rate of more than 20 mm/h.<sup>21</sup> This study was undertaken to determine clinical and laboratory findings that are commonly associated with acute appendicitis in the elderly.

## Methods

A chart review was done for all patients aged 60 years or older who underwent primary appendectomy or laparotomy for suspected acute appendicitis in Sedgwick County, Kansas. Patient records were selected from all five hospitals in the county during the period from 1 January 1987 to 31 December 1991 using the *Ninth Revision, International Classification of Disease (ICD-9)*<sup>22</sup> codes. Each case of acute appendicitis was defined by the diagnosis on the pathology report. Charts were reviewed and data collected for age, sex, pathology report diagnosis, initial white cell count, initial temperature, presence of right lower quadrant pain, rigidity, rebound, and vomiting. The data were analyzed using the Probit regression model technique<sup>23</sup> (and confirmed by a stepwise regression analysis) that allowed for distinct categorical outcomes in the dependent variable,

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which in this analysis was the pathology report diagnosis of acute appendicitis. The independent variables included in the model were white cell count, band cell count, temperature, right lower quadrant pain, rigidity, rebound, and vomiting.

## Results

Seventy-four patients aged 60 years or older underwent appendectomy or laparotomy for suspected acute appendicitis during the study period. Of these patients 44 (60 percent) were men and 30 (40 percent) were women. The mean age was 68.9 years. Thirty-nine (53 percent) of the patients were 60 to 69 years old, 28 (38 percent) were 70 to 79 years old, and 7 (10 percent) were 80 years old or older. A total of 65 (88 percent) had a pathology report confirming the diagnosis of acute appendicitis. Five (7 percent) had negative findings on the pathology report (ie, normal appendix and no other diagnosis). Four (5 percent) had a normal appendix, but another diagnosis, such as Meckel's diverticulum, mucinous cystadenoma, mesenteric adenitis, and intestinal pneumatosis cystoides. The pathology report for one case, however, was missing.

Sixty (81 percent) of the study population had right lower quadrant pain. Of these 60 patients, 54 had acute appendicitis. In 11 of the 65 confirmed cases of acute appendicitis (17 percent), however, the patient did not have right lower quadrant pain.

A white cell count of greater than 10,000/ $\mu$ L was reported in 58 patients (78 percent). Of these patients, 53 had acute appendicitis. Twelve of the 16 patients with a white cell count of less than 10,000/ $\mu$ L also had acute appendicitis. Thirty-one patients (42 percent) had a band cell count of greater than 6 percent, and all had acute appendicitis. Forty-three patients (58 percent) had less than 6 percent band cells, including 34 with acute appendicitis, 5 with a normal appendix and no other diagnosis, and 4 with a normal appendix and another diagnosis.

Forty-four patients (60 percent) had a temperature greater than 37°C; of these patients, 39 had acute appendicitis. Only 17 patients (23 percent) had a temperature higher than 38°C, a temperature usually used to define fever; of these patients, 15 had acute appendicitis.

Rebound tenderness was reported in 35 patients (47 percent), including 31 with acute ap-

pendicitis. Rigidity was reported in only 2 (3 percent) of the patients, both of whom had acute appendicitis. Vomiting was noted in 20 patients (27 percent), including 18 with acute appendicitis.

Table 1 displays the sensitivity, specificity, and positive and negative predictive values for temperature, white cell count, band cells, right lower quadrant pain, rebound, rigidity, and vomiting. A temperature greater than 37°C, temperature greater than 38°C, white cell count greater than 10,000/ $\mu$ L, a white cell count greater than 14,000/ $\mu$ L, band cells greater than 6 percent, right lower quadrant pain, rebound, rigidity, and vomiting, all have a high positive predictive value but a low negative predictive value. With increasing temperature and white cell count, the specificity increases and sensitivity decreases.

Temperature, white cell count, band cell count, and right lower quadrant pain were analyzed for correlations. Significant correlations existed between band cells and white cell count greater than 10,000/ $\mu$ L (Pearson  $r = 0.31$ ;  $P = 0.04$ ) and band cells and white cell count greater than 14,000/ $\mu$ L (Pearson  $r = 0.55$ ;  $P = 0.007$ ). Some correlation existed between right lower quadrant pain and band cells, but the relation was not statistically significant (Pearson  $r = 0.365$ ;  $P = 0.09$ ). The Probit regression model technique revealed that band cells ( $P = 0.03$ ) and right lower quadrant pain ( $P = 0.016$ ) were significant predictors of acute appendicitis even though the overall model, when testing all seven variables, was not significant. A stepwise regression model confirmed these results for band cells ( $P = 0.017$ ) and right lower quadrant pain ( $P = 0.014$ ).

## Discussion

Successful management of acute appendicitis depends on early diagnosis and surgical intervention. Although the diagnosis of acute appendicitis can be a difficult problem in elderly patients, a correct preoperative diagnosis was made in 88 percent of the study population. A more virulent pathologic course in elderly patients with acute appendicitis has been reported.<sup>10,24</sup> The high accuracy rate in this and other studies<sup>10,24</sup> could be due to a high awareness of the likelihood of this condition in the elderly.

This study was designed to describe clinical and laboratory findings associated in patients who had acute appendicitis definitively diagnosed.

**Table 1. Sensitivity, Specificity, and Positive and Negative Predictive Values for Temperature, White Cell Counts, Band Cells, Presence of Right Lower Quadrant Pain, Rebound, Rigidity, and Vomiting in Acute Appendicitis**

Clinical Characteristics	Sensitivity	Specificity	Positive Predictive Value	Negative Predictive Value
Temperature (°C)				
>37.0 (n = 44)	0.60	0.44	0.89	0.13
>38.0 (n = 17)	0.23	0.78	0.88	0.12
White cell count				
>10,000/ $\mu$ L (n = 58)	0.82	0.44	0.91	0.25
>14,000/ $\mu$ L (n = 33)	0.46	0.67	0.91	0.15
Band cells > 6% (n = 31)	0.48	1.0	1.0	0.21
RLQ pain (n = 60)	0.83	0.33	0.9	0.21
Rebound (n = 35)	0.48	0.56	0.89	0.13
Rigidity (n = 2)	0.03	1.0	1.0	0.13
Vomiting (n = 20)	0.28	0.78	0.90	0.13

RLQ - right lower quadrant.

These findings were not investigated in patients who had undifferentiated acute abdominal pain. As a result, the value of these clinical and laboratory findings in diagnosing acute appendicitis in patients with undifferentiated abdominal pain is unknown at this time. Nevertheless, the results provided useful data to assist the clinician when acute appendicitis is suspected.

Temperature alone was a poor predictor of acute appendicitis in the elderly patient. Being alert to the possibility of appendicitis and reviewing other parameters for high risk are necessary in this age group.

Mild elevation in white cell count could be important in the elderly patient and requires careful clinical correlation to avoid delay in diagnosis and resulting complications. A white cell count greater than 10,000/ $\mu$ L and greater than 14,000/ $\mu$ L was observed in 82 percent and 46 percent, respectively. These results are similar to those reported by Hall and Wright,<sup>25</sup> Coran and Wheeler,<sup>5</sup> and Pieper and colleagues.<sup>26</sup> They differ from a study by Lau and colleagues,<sup>24</sup> where only 42 percent had a white cell count greater than 10,000/ $\mu$ L.

High awareness of the probability of acute appendicitis in elderly patients with band cells greater than 6 percent is important, because an elevated band cell count has excellent positive predictive value. Band cells of less than 6 percent should be correlated clinically with other parameters, because of low sensitivity (0.48) and negative

predictive value (0.21).

The classic physical finding of right lower quadrant pain was present in 83 percent of acute appendicitis cases, a slightly higher rate than the 76 percent reported by Hall and Wright.<sup>25</sup> Right lower quadrant pain, similar to the band cell count, had an excellent positive predictive value. Band cells and the right lower quadrant pain were significant predictors of acute appendicitis. On the other hand, the clinician must be cautious, because 17 percent of patients with acute appendicitis did not have right lower quadrant pain, and 40 percent did not have temperature greater than 37°C.

In summary, a mildly elevated white cell count and band cells of 6 percent or more might not be diagnostic in nature, but they point the clinician in a direction that facilitates diagnosis in the afebrile elderly patient. A high degree of suspicion is crucial to avoid delay in diagnosis and complications in an afebrile elderly patient with abdominal pain and a mildly elevated white cell count and band cells.

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