

Appendicitis in the Elderly

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The charts of 68 patients from 65 to 99 years of age who underwent appendectomy for appendicitis were reviewed between 1964 and 1976. Thirty-three were men and 35 women. All patients underwent appendectomy. Four patients had normal appendices. The remainder had appendicitis; 74% were ruptured. The duration of symptoms varied greatly, and was related to outcome. The mean duration was 58 hours, but both those who died and those who suffered complications had significantly longer mean duration while those who had an uncomplicated course had a shorter mean duration of symptoms. The incidence of rupture rose from 60% in those seen with symptoms less than 48 hours to 90% in those with symptoms longer than 49 hours. Delay was invariably related to delay in seeking medical treatment. In no case was the patient under the care of another physician for an extended period of time. Pain was the chief complaint in 63 patients, and was present in all. Seventy-four per cent had fever and 78% had leukocytosis. Those with normal appendices had normal white blood cell counts. Right lower quadrant tenderness was present in 80%. Thirty-nine per cent had significant additional medical problems. Most (73%) had operation within six hours of their original evaluation, and yet the overall complication rate was 34% including six deaths. Delay during evaluation did not correlate with unsatisfactory outcome as did delay in seeking medical attention. The most common complications were due to infection. In at least three of the deaths wound infection was associated with sepsis and death. Delay in seeking medical care, advanced age, and underlying problems were the most significant factors in those who died.

REGARDLESS OF VARIATION in presentation, appendicitis usually is diagnosed with sufficient dispatch to minimize morbidity and eliminate mortality. Rates of error in diagnosis may rise to 45%,⁴ but error is usually toward early diagnosis and surgery. Removal of the appendix and examination of the abdominal organs give the diagnosis with apodictic certainty. In most patients, while rupture may be associated with a lengthened hospital stay, few serious complications occur, and mortality usually occurs at the extremes of age.

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Thorbjarnarson and Loehr,⁶ Lewis et al.,⁴ and Hubbell et al.³ have noted the variation in the clinical presentation, the increased incidence of appendiceal rupture and the increase in both number and severity of complications including death in the elderly group. Thorbjarnarson and Loehr⁶ have attributed this to a combination of factors including delay due to the mildness of the prodrome leading to perforation prior to surgery. Goldenberg² has claimed that the natural history of appendicitis in the elderly closely parallels that of disease in younger patients.

A retrospective study of appendicitis in patients over 65 years of age was undertaken to 1) identify the differences and similarities in presentation, including history and physical findings as well as laboratory data in comparison with younger patients, 2) identify the factors associated with morbidity and mortality, 3) to assess the quality of our treatment of this disease, and 4) to seek possible methods to improve our care.

Methods

The charts of 68 patients 65–99 years of age who underwent appendectomy for the diagnosis of appendicitis from January, 1964 to July, 1976 were reviewed. This included four patients whose appendices were normal. Incidental appendectomies were excluded. Operations were done by a number of surgeons from both house staff and attending staff.

Results

This group of patients constituted 4.2% of all admissions for appendicitis during this period. Thirty-five of the patients were men, 33 women. Their mean age was 73.8, the median 72.5 years. In 41 patients who had uncomplicated courses, the mean age was 73.1 (S.D. \pm 7.7 years); in 17 who had nonlethal postoperative complications, 72 (S.D. \pm 6.7 years); in

TABLE 1. Relationship of Age to Complication and Rupture

Age	Number	Uncomplicated	Nonlethal Complications	Deaths	Ruptured	Not Ruptured
65-69	25	72%	28%	0%	68%	32%
70-74	18	72%	22%	6%	66%	34%
75-79	8	50%	25%	25%	87.5%	12.5%
80+	13	46%	23%	23%	77%	23%

six patients who died, 79 (S.D. \pm 4.9 years). Four patients (5.8%) had normal appendices. The mean age of these patients was 72 ± 6 years. The difference in ages between those who died and those who survived was significant ($p = .0003$).

The complication rate was 35%. The death rate was 8.8%. The incidence of nonlethal complications did not rise with age (Table 1), but the incidence of lethal complications did. The per cent incidence of uncomplicated appendicitis therefore fell with increasing age.

The overall incidence of rupture was 73.4%. The increase in incidence that occurred with increasing age was not statistically significant ($.572 < p < .801$). The overall death rate varied from 5% in 41 patients under 74 years to 24% in 21 patients over 75 years.

Most patients sought medical attention because of pain. Pain was the chief complaint in 63 patients and was present in all patients. Right lower quadrant pain was most common, and occurred as the chief complaint in 21 patients and was present in 51 patients. The pain was characterized as periumbilical in 17, diffuse in 10, and as vague and poorly localized in 15. (Table 2).

The duration of symptoms prior to admission varied greatly and was related to outcome. The mean was 58.47 hours; the median was 24 hours. The mean duration was shorter in those who had uncomplicated postoperative courses, 37 ± 36 , (median 24 hours), and longer in those who suffered non-fatal complications, 106 ± 140 hours (median 48 hours) and those who died 86.5 ± 56 hours (median 72

hours). The difference in means was significant at the $p = .05$ level.

The most common physical finding at the time of first physical examination was right lower quadrant tenderness which was present in 55 of 68 (80%). Table 3 illustrates the incidence of the various physical findings. Rebound was present in only 32 or 47%; guarding was noted in 39%, diffuse tenderness in 29%, referred rebound in 25%. Decreased or absent bowel sounds were noted in 19%; distention was noted in 11%; a mass was palpable in 7%, and rectal pain was present in 2.9%.

Fever greater than 37.7° was present in 74% of all patients. The mean temperature was 38° and the range was 36.1 to 40° . The mean temperature in the group of patients who died was 37.4° , but this difference was not significant ($p = .27$).

The mean WBC count was 14,794 (S.D. \pm 5,956/cu. mm.), with a range of 6000/cu mm to 32,700/cu mm. Seventy-nine per cent of all patients had a leukocytosis greater than 10,000/cu mm. Ninety-two per cent of those with no postoperative complications, 70% of those who suffered non-lethal complications, 83% of those who died, and none of those who had normal appendices had leukocytosis. These groups had the following mean counts: those who had uncomplicated postoperative course, 14,500 (S.D. \pm 5096/cu mm) (range 6000-20,000/cu mm), those who had a complicated postoperative course, $13,826 \pm 6,377$ /cu mm), those who died, 18,400 (S.D. \pm 10,400) (range 6100-32,000), and those who had normal appendices,

TABLE 2. Chief Complaints and Presenting Complaints Expressed in Per Cent Incidence and Number

Chief Complaint	Per Cent Incidence	Presenting Complaints	Per Cent Incidence
Pain	63 (92%)	68 (100%)	
Right lower quadrant	21 (30%)	51 (75%)	
Periumbilical	17 (25%)	20 (29%)	
Vague	15 (22%)	15 (22%)	
Diffuse	10 (14%)	10 (14%)	
Nausea	4 (5%)	36 (52%)	
Vomiting	1 (1.4%)	35 (51%)	
Fever		7 (10%)	
Diarrhea		2 (3%)	

TABLE 3. Physical and Laboratory Findings in Appendicitis

	Owens	Lewis, et al.	Mittepunkt and Nora	Goldenberg
RLQ tenderness	80%	99%	97%	96%
Rebound	47%	68-81%		38%
Guarding	39%			
Diffuse tenderness	29%			
Referred rebound	25%			
Decreased bowel sounds	19%	6%		
Distention	11%			
Mass	7%			17%
Rectal pain	2.9%	45%		
Leukocytosis	79%		71%	94%
Fever	74%		20%	82%

TABLE 4. Relation of Delay in Seeking Surgical Consultation to Complications and Rupture

Time/Hours	Number	Not Complicated	Complicated	Dead	Ruptured	Not Ruptured
0-48	47	35 (75%)	10 (21%)	2 (4%)	28 (59%)	19 (41%)
49+	21	9 (42%)	8 (38%)	4 (19%)	19 (90%)	2 (10%)

5700 (S.D. \pm 3000/cu mm). The increase in the WBC of those who died was not statistically significant, but the difference in WBC count between those who had appendicitis and those who did not was significant ($p = .0000004$). Those whose appendices had ruptured ($N = 46$) had a mean WBC count of 15,371 (S.D. \pm 6763/cu mm), while those who had not ruptured ($N = 18$) had a mean WBC count of 14,294 (S.D. \pm 3790/cu mm). Those with normal appendices were excluded. If these were included ($N = 22$), the mean was 12,731 (S.D. \pm 4943/cu mm). All patients had a significant left shift ranging from 59% polymorphonuclear leukocytes with no bands to 96% polymorphonuclear leukocytes. The highest per cent of bands was 61%. The mean differential had 75% polymorphonuclear leukocytes and seven segmented forms. There was no significant difference among the groups.

This elderly group of patients had a significant incidence of major illnesses complicating the appendicitis. Twenty-seven patients had one or more complicating illnesses as would be expected in a group of this advanced age; the mean incidence of complications was 0.5 complications per patient in the survivors as opposed to 2.1 complications in those who died. This was a significant difference ($p = 0.01$). No difference was observed between those who suffered a nonlethal complication and those who had an uncomplicated postoperative course. The complicating illnesses affecting those who died were, in general, more serious as well as more numerous.

Treatment

All patients were operated for appendicitis. Most (73%) had operation within six hours. All of those with normal appendices had surgery within six hours. Seventy-eight per cent of those who had an uneventful; postoperative course, 64% of those who developed nonlethal postoperative complications, and 50% of those who died had surgery without delay. These differences were not significant. Most were explored through a right lower quadrant incision, with a preoperative diagnosis of acute appendicitis or appendicitis with rupture. A few were explored through a right paramedian incision.

Rupture had occurred in 71% overall; 60% in those whose course was not complicated, 74% in those with complications, and in 100% of those who died.

Again, the differences were not statistically significant (Table 4). In no patient was there evidence of rupture while under treatment, *i.e.*, fever spike, increase in leukocytes, *etc.*

The most common postoperative complication was wound infection or abscess which occurred in 12 instances (59% of the complications), nine in the surviving patients. In three or 50% of the patients who died, wound infection was associated with sepsis and death. Two of these suffered dehiscence of a right paramedian incision. Other complications included two instances of small bowel obstruction, three cases of pneumonitis or atelectasis, one fecal fistula, one episode of ventricular tachycardia during operation, two gastrointestinal hemorrhages, and in one patient there was delayed return of gastrointestinal function.

Among the deaths, two followed the dehiscence of a right paramedian incision. One occurred in a 76-year-old man with chronic obstructive pulmonary disease, atrial fibrillation, and atherosclerotic cardiovascular disease. Delay had occurred both prior to presentation and between admission and surgery; the other occurred in an 80-year-old man who had a hemiparesis due to a stroke ten years prior to this illness. One 72-year-old woman, admitted with congestive failure, was operated within six hours of admission. The postoperative course was uneventful until she extubated herself and expired. One patient died of septicemia and respiratory failure, one of congestive heart failure coupled with renal failure. Perhaps both of these were manifestations of sepsis. One patient expired in multisystem failure, including gastrointestinal bleeding. Anemia on admission had delayed operation. Acquired congenital hemolytic anemia, rheumatoid arthritis, and iatrogenic hyperadrenalism as well as advanced age (79 years) were factors in his death. Thus, infection was a significant factor in between 50 and 82.5% of the deaths.

Bacteria

Twenty-eight cultures grew organisms. Twenty were monomicrobial and eight polymicrobial. *E coli* was grown most often, in 19 (68%). *B fragilis* was found in five, Streptococci in three, *S aureus* and Klebsiella, two each, and Enterobacter, Enterococcus, Proteus, Pseudomonas, Clostridia, one each. Almost all were sensitive to a wide variety of antibiotics.

TABLE 5. Relation of Delay in Operating to Rupture and Complication

Time Prior to Surgery (Hours)	Number	Not Complicated	Complicated	Dead	Ruptured	Not Ruptured
0-6	41	28 (68%)	10 (24%)	3 (9%)	27 (67%)	14 (33%)
7+	27	14 (52%)	10 (37%)	3 (11%)	22 (72%)	5 (18%)

There was a significant ($p = .002$) increase in the duration of hospitalization when rupture occurred. The mean duration of hospitalization in those who suffered no complications varied from 7.28 (S.D. ± 2.1 days) in those without rupture to 12.6 (S.D. ± 4.1 days) in those who had rupture ($p = <.001$). The difference was somewhat smaller in those who suffered complications, 14 ± 1 to 17.5 ± 7 days, but was nonetheless significant at the $p < 0.05$ level.

Discussion

Fitz¹ in 1884 identified appendicitis as a disease of young healthy males. Only two, or 1%, of the patients in his series were older than 60 years of age, and 80% were men. Advanced age alters this ratio, as noted by Thorbjarnarson and Loehr,⁶ and Hubbell et al.³ In our series 51% were men, in that of Thorbjarnarson and Loehr, 55%. Thorbjarnarson and Loehr⁶ noted the constancy of the low incidence of elderly patients with appendicitis in 886 patients seen at the New York Hospital from 1932 to 1937, and the subsequent increase in the incidence to 6.8% since 1957. These authors also noted the increasing mortality from appendicitis in the elderly which contrasted with the decreasing incidence of death from appendicitis in the population at large.

The variability in presentation of appendicitis was documented and discussed at length by Fitz,¹ and the tendency for this variation to be more pronounced in the elderly is cherished in the folklore of surgery, and to some extent, documented in the literature. Older patients are expected to have fewer symptoms, a less reliable duration of disease, a lower WBC count, and a lower temperature. The surgeon is expected to treat this disease with the same success that he achieves in the younger patients.

Thorbjarnarson and Loehr⁶ described the anatomical changes in the appendix of the older person to explain these differences. They observed that the appendiceal lumen was "narrowed or obliterated," the mucosa had thinned, and that there was fibrosis and fatty infiltrate of the muscular wall as well as arteriosclerosis, and that all of these factors increased the likelihood of rupture. While the elderly patients in our study suffered an increase in the incidence of rupture with advancing age, this difference was not statistically significant. On the other hand, the older patients had fewer uncomplicated cases and a greater number of deaths, while the in-

cidence of nonlethal complications did not vary (Table 1).

The presentation of the patients in this group was by and large similar to those in younger age groups. Lewis et al.⁴ in a series of 1,000 patients of all age groups with appendicitis noted that pain was the presenting symptom in 99% of their patients, while in our patients, it constituted the chief complaint in 92% and was present in all. Goldenberg² noted abdominal pain in 100% of 129 elderly patients seen at Yale New Haven Medical Center. Mittelpunkt and Nora⁵ found pain in 97.3% of 1,000 cases of appendicitis in all ages.

Longer duration of symptoms, or delay in seeking medical attention, was associated with both an increased incidence of complications ($p = .046$) and of rupture ($p = 0.001$) and a longer duration of hospital stay. This is in contrast to the opinion of Goldenberg that delay in seeking medical care was not related to outcome. Delay in hospitalization showed a greater correlation with poor outcome than did the postadmission delay in which the relation was present but not statistically significant (Table 5).

Physical findings paralleled histories, but were often not as consistently obtainable as in younger patients. Fifty-five of 68, or 88%, of our patients had right lower quadrant tenderness as compared with 99% of Lewis'⁴ patients who had right lower quadrant tenderness. Mittelpunkt and Nora⁵ stated that 95% of their patients had right lower quadrant tenderness, and Goldenberg² found a 96% incidence of right lower quadrant tenderness in his study of appendicitis in elderly patients. These differences may or may not be accurate inasmuch as a retrospective chart review may not detect whether the physician specifically elicited right lower quadrant tenderness in addition to diffuse tenderness associated with peritonitis.

Lewis et al.,⁴ noted the relationship of diffuse tenderness to rupture, but this correlation was not as pronounced in our series in which many patients even with rupture had only right lower quadrant tenderness.

Fever with temperature greater than 37.7° was present in 74%. The mean temperature was 38.0° , (S.D. ± 0.6) and the range was $36.1-40^\circ$. This is comparable to the mean temperature in all patients with appendicitis as noted by Lewis, et al. No differences were noted in mean temperatures between patients with and without appendicitis, nor were there any differences between those whose course was

complicated and those whose course was not. The relative hypothermia in those who died was not statistically significant. There was no difference in mean temperature between those with ruptured and those with intact appendices.

The mean white blood cell count in our series was 14,794 (S.D. \pm 5,956/cu mm) and ranged from 6000/cu mm to 32,700/cu mm. Seventy-nine per cent had a WBC greater than 10,000 cu mm. The mean WBC was comparable to the mean WBC found by Lewis et al.⁴ for all patients with appendicitis. Furthermore, in Goldenberg's² study of appendicitis in the elderly, leukocytosis was present in over 94% of patients while in Mittelpunkt and Nora's⁵ study of 1000 cases of appendicitis only 71.6% had leukocytosis. This data suggests that the expectation that older patients will have lower WBC counts is erroneous. The group of patients with normal appendices at operation had normal counts, and this difference was highly significant ($p < .0000004$).

Perhaps of far greater significance is the difference in complicating illnesses suffered by those stricken by appendicitis. Those patients who died had more complicating illnesses that were more serious. No patient in otherwise good health succumbed. Of seven patients with two more complications preoperatively, four died. All those patients with more than two additional problems died. The incidence of preoperative problems was the same in those with nonlethal complications as in those who had no complications, while it was significantly greater in those who died ($p < 0.01$). The overall death rate in our series was 8.8%. The death rates in other series were: in Hubbell's³ series of 100 patients over age 50 years, 7%; and in Goldenberg's² series of 129 patients over 60 years of age, 9%.

Delay in surgery, as measured by comparing the incidence of delay in the four subgroups, appeared only marginally related to outcome, since the differences in incidence of delay were not significant. Most patients (73%) were operated in less than six hours. In no case was there clinical evidence of rupture during hospitalization. Nevertheless rupture of the appendix occurred in 71% overall. This was related chiefly to delay in seeking care, and, to a lesser extent, to delay in operating following hospital admission and advancing age. Of those patients studied by Mittelpunkt and Nora,⁵ only 28% had surgery within 24 hours, only 60% had surgery in less than 48 hours, and 13% had surgery delayed more than 72 hours.

The rate of perforation in patients over 50 years had been variably reported as 65% by Lewis et al.⁴

49% by Hubbell et al.³ and 37% by Mittelpunkt and Nora.⁵ Thorbjarnarson⁶ and Loehr noted perforation in over 70% of their patients over 60 years of age; and Goldenberg² noted perforation in 66% of patients of 60 years of age.

In these patients, nonlethal complications occurred at rates varying from 22 to 28% through all age groups, but those patients who died of appendicitis were significantly older and sicker than those who survived. Statistically, those who died originated in an entirely different universe of patients.

Elderly patients present an increasing portion of the patients with appendicitis and present in a manner generally similar to the younger patients. Minor variation in the prodrome should be expected, but abdominal pain, especially with right lower quadrant tenderness, which is usually present, is, in this group, just as in the younger group, the symptom complex to seek.

Fever and leukocytosis are variable in appendicitis in all age groups, including the elderly. But the older patients can be expected to have fevers and white blood cell counts similar to the younger patients. A normal white cell count may signal a normal appendix. The white count and differential are of little use in differentiating ruptured appendicitis from appendicitis without rupture.

Delay in seeking medical attention has far more influence in outcome than does postadmission delay. A number of factors pertain here, including errors on the part of the first physician to see the patient, as well as patient factors in delay. However, delay in seeking medical care is the most significant risk factor subject to alteration and related to lethal and nonlethal complications as well as rupture of the appendix and extension of the hospital stay, since age and infirmity are not under the control of the surgeon.

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