

Paediatric Appendicitis: An Analysis of 386 Cases

PEDIA TRIK APANDİSİT: 386 OL G UNUN ANALIZI

Hüseyin DİNDAR MD, İ.Haluk GÖKÇORA MD,
Meral BARLAS MD, Selçuk YÜCESAN MD

•Assistant Professor o Paediatric Surgery. * "Professor of Paediatric Surgery
Department of Paediatric Surgery, Ankara Universty Hospital. ANKARA

SUMMARY

386 paediatric patients with a preoperative diagnosis of acute appendicitis were analysed: 84% had acute appendiceal inflammation amongst which 110 had advanced appendicitis. Ages ranged from 2 days to 16yrs (mean: 10.4yrs). 14 % of the cases had no abnormal laparotomy findings. The minor complication rate was 8%; including wound infections and bronchopneumonitis, and the major complication rate was 2%; involving intestinal obstructions, intraabdominal abscesses, wound dehiscences and malignant hyperpyrexia. The overall wound infection rate was 7%. This rate went up to 24.5% in those patients with advanced and/or perforated appendicitis. The mortality rate was 0.8%. The mean duration of abdominal pain was 1.7 days for acute appendicitis, 3.6 days for perforated cases and 1.9 days for wrong diagnoses. 21% of the total had perforated appendicitis. Children less than six had a 59% perforation rate, and those older than ten years 14.9%; indicating that the rate of perforation is higher in young children. The results suggest that early diagnosis and inten'tion may decrease morbidity and mortality.

Key Words: Acute Appendicitis, Paediatrics

TurkJRescMedSci 1991,9:455-460

Geliş Tarihi: 22.1.1990

Kabul Tarihi: 21.7.1990

**Yazışma Adresi: İ.Haluk GÖKÇORA
Şairler Sokağı 6, Çankaya
06700 ANKARA**

ÖZET

Preoperatif akut apendisit tanısı alan 386 olgunun analizinde 110'unun ileri aşamaya ulaştığı %84 akut inflamasyon saptanmıştır. Hastaların yaşları 2 günden 16 yıla kadar değişiyordu (ortalama 10.4 yıl). %14 olguda laparotomide hiçbir patoloji ile karşılaşılma. Toplam %8 olan minör komplikasyonların çoğunluğunu kesi süpürasyon ve bronkopnömoniler, %2 olma majör komplikasyonlar arasında da barsak tıkanıklığı, kanıç abseler, evantrasyon ve malign hiperpireksi yer alıyordu. Toplam kesi enfeksiyonu %7 iken, bu oran ilerlemiş ve/veya perforate apendisitlerde %24.5'e çıkıyordu. Mortalite %0.8 olarak saptandı. Karın ağrısı süresi akut apendisitte 1.7, perforate apendisitte 3.6 ve yanlış lanular için 1.9 gün olarak belirlendi. Küçük yaşta perforasyonların daha fazla olduğunun göstergesi olarak perforasyon hızı altı yaşından küçük çocuklar için %59, on yaşından büyükler için %14.9 olarak saptandı. Bu sonuçlar erken tanı ve cerrahi girişimin morbidite ve mortaliteyi azaltabileceğini göstermektedir.

Anahtar Kelimeler: Akut apendisit, Pediatrik

T Klin Araştırma 1991,9:455-460

INTRODUCTION

In 1886 Fitz published his classic paper, establishing acute appendicitis as a disease entity. Now, more than a century later, this most common of all

surgical diseases can still be a diagnostic problem and often has protean symptoms, more so in infants and children. The symptoms and signs may be confusing and lead to delay in diagnosis and consequently result in rupture with generalized or localized peritonitis and abscess formation (1). Advances in fluid-electrolyte resuscitation and anaesthesia are largely responsible for the 75% reduction in mortality during the last three decades. But still, morbidity rate remains high due to late diagnosis or misdiagnosis and suppression of the inflammation with the un-warranted usage of antibiotics. The aim of this paper is to describe an eight year experience in managing this condition.

PATIENTS AND METHODS -

A retrospective analysis was carried out on 386 patients who underwent appendectomy with a preoperative diagnosis of acute appendicitis during a period of eight years, from Jan. 1980 to Jul. 1988, involving a period of 90 months. Sixteen independent variables were defined for each patient: Age, sex, presenting symptoms and signs, duration of pain upon admission, complete blood counts, urinalysis, radiological and histopathological findings, peritoneal fluid cultures, desoiling of peritoneal cavity with or without irrigation, sites of drainage, primary or delayed wound closures, use of antibiotics, hospital course, and duration hospital stay. All children underwent preoperative resuscitation with intravenous fluids and antipyretics when necessary. The objectives of this initial therapy were to establish an adequate urinary output and to reduce the heart rate and body temperature. Only when clinical findings indicated a possible appendiceal perforation, were preoperative antibiotics administered. Within one to four hours after admission to the ward, satisfactory resuscitative measures were attained. Further examination of the children under general anaesthesia at the operating table led to different abdominal incisions dependent upon findings at deep palpation of the right iliac fossa, the appendix was removed and its stump embedded within the caecal wall in every case. When an appendiceal perforation, periappendiceal inflammation or generalized peritonitis without perforation were encountered; peritoneal irrigation with two penrose drains, were performed in 110 patients. The surgical incisions of the patients with perforated or advanced appendicitis were approximated primarily or by delayed wound closure.

Postoperative antibiotic therapy was continued or commenced in children with perforations, periappendiceal abscesses, generalized peritonitis or advanced acute appendicitis in 277 patients. In patients with advanced peritonitis, clindamycin or ornidazole was used with an aminoglycoside derivative and ampicillin plus sulbactam or tertiary cephalosporins. Wounds that were left open were irrigated with 1% bethadine solution and dressed at least twice a day. These wounds were then closed with 4/0 silk sutures placed at the initial operation or by sterile adhesive strips on the third postoperative day, when there were no wound infections or excessive wound drainage.

RESULTS

Of the 386 children, 234 (61%) were boys and 152 (39%) were girls. Their ages ranged from two days to 16 yrs (mean: 10.4yrs). 46 (12%) were younger than 6yrs and 12 (3%) were younger than 2yrs. The ages of 135 (35%) of the children ranged from 6-10 yrs while 201 (52%) were older than 10 yrs. It is interesting to note that the incidence of appendicitis reached its peak in May and December (Fig.1)

The presenting symptoms were abdominal pain in 374 (97%), fever in 205 (53%), anorexia in 201 (52%), nausea in 170 (44%), vomiting in 124 (32%), diarrhoea in 58 (15%), constipation in 39 (10%), rectal-irritation-tenesmus in 35 (9%), abdominal distention in 27 (7%), and restlessness in 8 (2%). Restlessness was the sole primary symptom in eight infants (Table 1).

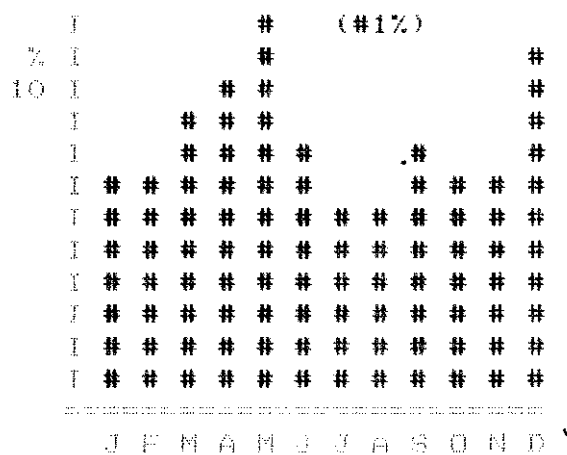


Figure 1. Monthly distribution of Acute Appendicitis patients.

Table 1. Frequently of symptoms in acute appendicitis

Symptoms	No.	Frequency %
Abdominal Pain	374	97
Fever	205	53
Anorexia	201	52
Nausea	170	44
Vomiting	124	32
Diarrhoea	58	15
Constipation	39	10
Rectal Irritation	35	9
Abdominal distention	27	7
Dysuria	19	5
Mass	15	4
Restlessness	8	2

Abdominal tenderness was the most consistent finding and it was generalized in 110 (28%) patients and localized to the right lower quadrant in 276 (72%). Rebound tenderness was considerable in 324 (84%) patients. An inflammatory mass was palpable in 35 (9%) cases, being discovered in 20 (5%) on physical examination and in 15 (4%) during examination under anaesthesia just prior to operation. Abdominal distention was noted in 27 (7%) patients. In 220 (57%) there was pelvic tenderness on rectal digital examination. Signs of upper respiratory tract infection was noted in 30 (8%) cases (Table 2).

The mean leukocyte counts were 9800, 11200, and 16000 mm³ in misdiagnoses, acute and perforated appendicitis cases respectively. Urinalysis showed five or more leukocytes per high power field in 5 patients with normal appendices and 15 cases with acute appendicitis. Urinalysis also showed bacteriuria in 2 patients with normal appendices. On the otherhand, urinalysis also revealed microscopical haematuria in 9 patients with normal appendices, in 12 patients with acute appendicitis and in 16 patients with perforated appendicitis.

Amongst the 386 patients diagnosed as acute appendicitis, 326 (84.4%) had an actual appendiceal inflammation. 70 (21%) of these had perforated appendicitis and 256 (79%) had acute appendicitis with histopathological confirmation. Nine cases (9/386) had other pathologies; including Meckel's diverticulitis; in 2 (0.5%), primary

Table 2. Frequency of signs in acute appendicitis

Signs	No.	Frequency %
Abdominal Tenderness	307	96
Right lower quadrant	193	50
Generalized	174	45
Paraumbilical	4	1
Rebound Tenderness	324	84
Guarding	309	80
Local	370	70
Diffuse	39	10
Mass	35	9
Prior to anaesthesia	20	5
During anaesthesia	15	4
Rectal Tenderness	220	57
Fever	370	96
U.R.T. Infection	30	8

peritonitis; in 4 (1%), Hodgkin's disease; in 1 (0.2%), and ovarian follicular cysts; in 2 (0.5%). 51 cases (14%) had no abnormal laparotomy findings (Table 3).

The duration of pain upon admission with respect to histopathological diagnosis is shown in figure 2. The mean duration of pain was 1.7 days for acute appendicitis, 3.6 days for perforation and 1.9 days for wrong diagnoses.

While children less than six had a 59% perforation rate, those between 6 to 10 yrs had 25%. Those older than 10 yrs had 14.9%. The highest rate of perforation was in the three-year-olds, being 62.5% (Figure 3).

In 46 patients the aerobic peritoneal fluid cultures obtained at the time of surgery revealed E.Coli (46%), Klebsiella (26%) and conforms (11%).

Postoperative complications included 27 wound infections; 6 (1.5%) small intestinal obstructions (five of which required operative lysis of adhesions while one responded with favourable results to conservative measures); 2 (0.5%) complete wound dehiscences (which occurred in patients with perforated appendicitis and paramedian incisions); bronchopneumonitis in 19 (5%), lobar pneumonia in one (0.2%), an activation of collagen tissue disease in a patient with acute appendicitis; two (0.5%) intraabdominal abscesses (one intrapelvic and one between the loops of the small intestine) in two patients with perforated appendicitis, as a result of

Table 3 Age and Appendiceal histopathological findings

Age	Acute Appendicitis		Wrong Diagnosis		Total
	Perforated rate or perforation	Unperforated	A.V.	L.I.L.	
0	1 (50%)	1	0	0	2
1	1 (33%)	2	1	1	5
2	2 (50%)	2	1	1	6
3	5 (62.5%)	3	0	0	8
4	4 (44.4%)	5	1	1	11
5	3 (23.1)	10	1	1	15
6	4 (30.8)	9	3	2	18
7	6 (31.6)	13	8	2	24
8	5 (21.7)	18	2	2	27
9	6 (21.4)	22	2X	2	32
10	6 (18.8)	26	3	2	37
11	5 (20%)	20	3XY	4	32
12	5 (15.2)	28	2Z	2	37
13	6 (15.4)	33	2Z	2	43
14	4 (14.8)	23	4W	3	34
15	4 (15.4)	2	2F	2	30
16	3 (13.6)	19	3F	1	26
Total:	70 (21.5)	256	32	28	386

X: Meckel's Diverticult (2), Y: Hodkin's Disease (1), Z: Bacularia (2), W: Primary Peritonitis (4), F: Follicular Cysts (2)

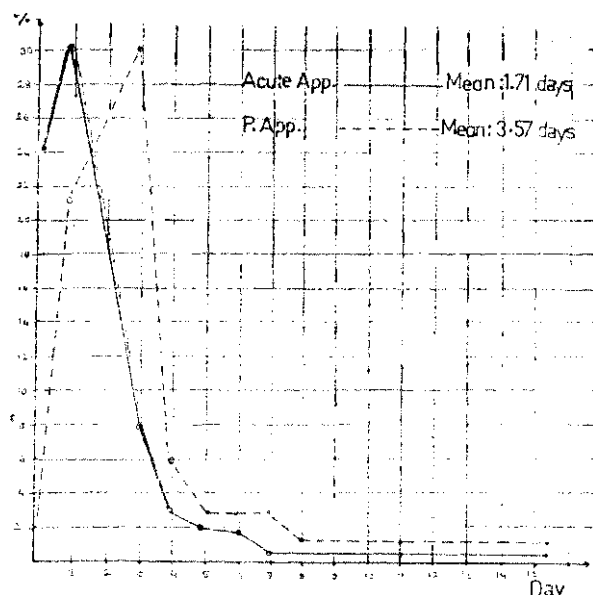


Figure 2. Duration of abdominal pain in Acute and Perforated Appendicitis.

insufficient irrigation of their peritoneal cavities (Table 4).

46 patients with the histopathological diagnosis of normal appendices and 63 patients with acute appendicitis adding up to 109, received no an-

tibiotic treatment. Inflammatory complications were not encountered and the mean hospital stay of these patients was 5.4 days.

The mean hospital stay was 5.8 days for acute appendicitis, 9.4 days for perforated appendicitis, and over-all mean duration of hospital stay was 6.3 days (Table 5).

Three mortalities occurred; one patient with 20 days delay with perforated appendicitis died due to septic shock, while two patients died of malignant hyperpyrexia at operation; leading to a mortality rate of 0.8%.

DISCUSSION

The developments in antibiotic therapy and advances in anaesthesia and fluid-electrolyte resuscitation have produced important reductions in the morbidity and mortality rates due to acute appendicitis. At present, appendicitis stands as the most common cause of abdominal surgery in the paediatric age group (1,2).

Only 12% of the children in the presented series were 6 years of age and younger. Acute appendicitis is more frequently seen in older children. 52% of the patients were older than 10 yrs and 36% of the children were between 6-10 yrs. The age dis-

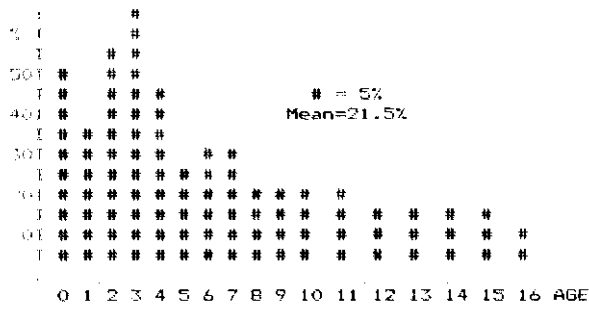


Figure 3. Influence of age on rate of perforation in Acute Appendicitis.

Table 4. Overall complication in acute appendicitis

Complications	No.	Frequency %
Major Complications N: 13		
Intestinal Obstruction	6	15
Intraabdominal Abscess	2	0.5
Wound Dehiscence	2	0.5
Malign Hyperpyrexia	2	0.5
Pneumonitis	1	0.25
No of patients: 8		3.75-2%
Minor Complications N: 47		
Wound Infection	27	7
Bronchopneumonitis	19	5
Activation of Collagen Tissue Disease	1	0.25
No of Patients: 32		12.25-8%

Table 5. Mean Duration of Hospitalization of the Different Groups of Patients

		Range	Mean Duration
Not Drained	N: 276	1-20 days	5.25 days
Drained	N: 110	3-30	8.62
A.Appendicitis	N: 256	1-21	5.79
P.Appendicitis	N: 70	3-30	9.38
Overall	N: 386	1-30	6.27

tribution of the children with acute appendicitis is in accordance with the reported series (3,4,5,6,7).

During the 90 months from Jan. 1980 through Jun. 1988, the cases of appendicitis reached a peak in the months of May and Dec, whilst in the other months there were almost no

variations. In winter and spring the incidence of viral infections is high and this is said to lead to viral gastroenteritis and acute appendicitis (8,9,10).

The presenting symptoms of appendicitis were pain, nausea, anorexia, vomiting, fever and diarrhoea in older children and restlessness, vomiting, fever and pain in infants. In older children and in presenting symptoms (11). Grosfeld (12) and Puri (13) have reported that vomiting was the first symptom of acute appendicitis (11). The high rate of vomiting in Grosfeld's and Puri's reports may be due to the high rate of perforations (80%) (12,13). Restlessness in most aspects can be considered as a subjective symptom but still it is usually an early sign of acute appendicitis. Among infants with acute appendicitis in this series the rate of perforation was 44%. Though this rate is high as well, it may explain the lower occurrence of vomiting. The incidence of diarrhoea was 15% in the presented series. Although the most frequent misdiagnosis is gastroenteritis, it should be stressed that a history of abdominal pain longer than 2 or 3 days and the presence of diarrhoea does not make the diagnosis of appendicitis unlikely. Indeed, what is likely is that perforation may have already occurred (2). The mean duration of pain in non-perforated appendicitis in literature changes from one to two days (1,7). The mean duration of pain in non-perforated appendicitis in the presented series was 1.7 days. These periods are lower than Harrison's (4.4 days) (7), and longer than Gilbert's series (1), 39% in Harrison's (7) and 35% in Janik's (6). In amongst the presented series the rate of perforation is 21% and the rate of advanced appendicitis is 34%. The younger the children the higher seems to be the rate of perforation. The rate of perforation in children is also higher than that in adults (4,11) The walling-off of the inflammatory process prior to perforation is more difficult in younger children, so when the duration of pain is longer in infants and younger children, the inflammatory process results in perforation. The causes of the high rate of perforation in children and infants are the inability of the child to communicate accurately and effectively when there is abdominal pain (14,15,16). Late diagnosis, mis-diagnosis and the suppression of the inflammatory process with antibiotics are also factors to be considered in these events (5,6,7,12)

There were twenty children in the present series who had been wrongly diagnosed and suppressed with antibiotics, all of them having perforations or advanced appendicitis. For the reasons thus stated, the inability to wall-off the inflammatory process may be solved by earlier diagnosis and intervention. This depends largely on increasing professional and public awareness of acute abdominal diseases since late diagnosis mostly results from parental or professional delay (1,5,7,12). This every child with abdominal pain should be admitted to hospital for observation and a thorough investigation carried out till the cause is found. On the other hand, the fear of unnecessary laparotomies should not lead to long observation periods.

In the presented series there were 2% major and 8% minor complications. These figures are in accordance with other reports (1,6,17,18,19). The mean hospital stay is 5.8 days for acute appendicitis, 9.38 days for perforated appendicitis.

The longer duration of hospital stay is the result of complications such as intraabdominal abscess, mechanical ileus caused by adhesions, wound dehiscence and infections, all of which occurred in perforated or advanced appendicitis. There was an average three day difference in hospital stay with these complications and thus led to an increase in the usage of antibiotics, parenteral fluids and total parenteral nutrition; in turn resulting in increased costs.

Whatever the treatment technique, such as delayed wound closure, Peritoneal irrigation and highly effective antibiotics, these are not significantly effective in reducing the complications in advanced and perforated appendicitis cases. Therefore reduction in the morbidity and mortality and also the hospital expenses depend on early diagnosis and intervention (7). The observation period of a suspected acute abdomen case must be limited to a minimum for the prevention of delay in diagnosis.

REFERENCES

- Gilbert SR, mmens RW, Putnam TC: Appendicitis in children. *Surg Gynecol Obstet* 1985. 161:261-5.
- Samclson SL, Reyes HM: Management of perforated appendicitis in children-revised. *Arch Surg* 1987. 122:691-6.
- Condon RE: Appendicitis. In Sabiston DC Jr(ed). *Davis-Chrisopher Textbook of Surgery*(4th ed). WB Saunders Co. NewYork 1977, pp.1109-9.
- Storcr I:II: Appendix. In Schwartz SI, Lillchei RC, Shires GT, Spencer FC; Storer LII (eds). *Principles of Surgery* (61 h ed). Me Graw-Hill Co. Phila. 1974, pp: 1167-76.
- Graham JM, Pokorny WJ, Harberg FJ: Acute appendicitis in preschool age children. *Am J Surg* 1980, 139: 247-50.
- Janik JS, Firor HV: Pediatric appendicitis. A 20-year study of 1640 children at Cook County (Ill.) Hospital. *Arch Surg* 1979. 114:717-9.
- Harrison MW, Finder DJ, Campbell JR, et al: Acute appendicitis in children: Factors affecting morbidity. *Am J Surg* 1984, 147:605-10.
- Brink CF, Prinsloo II, Van Der Poel JS: Die scisoen-voorkoms van akute appendisilis. *S Afr Med J* 1985, 68:156-8.
- Arnbjornsson B: Acute appendicitis and dietary fiber. *Arch Surg* 1983. 118:868-70.
- Burkitt DP: The aetiology of appendicitis. *Brit J Surg* 1971. 58:695-9.
- Kottmcier PK: Appendicitis. In Welch KJ, Randolph JG, Ravitch MM, O'Neill JA Jr, Rowe MI (eds). *Pediatric Surgery* (4th ed). Boston 1986, pp: 989-95.
- Grosfeld J, Weinberger M, Clatworthy II: Acute appendicitis in the first two years of life. *J Pediatr Surg* 1973, 8: 285-31.
- Puri P, O'Donnell B: Appendicitis in infancy. *J Pediatr Surg* 1978. 13: 173-4.
- Brender JD, Marcuse FK, Koepsell TD, et al: Childhood appendicitis: Factors associated with perforation. *Pediatrics* 1985;76:301-6.
- Bower RJ, Bell MJ, Ternberg JL: Controversial aspects of appendicitis management in children. *Arch Surg* 1981. 116:885-7.
- Grosfeld JL, Solit RW: Prevention of wound infection in perforated appendicitis: Experience with delayed primary wound closure.. *Ann Surg* 1968,168:891-5.
- Karp MP, Caldarola VA, Cooney DR, et al: The avoidable excess in the management of perforated appendicitis in children. *J Pediatr Surg* 1986, 21:506-10.
- Powers RJ, Andrassy RJ, Brennan LP, et al: Alternative approach to the management of acute perforating appendicitis in children. *Surg Gynecol Obstet* 1981,152:473-5.
- Raahave D, Friis-Moller A, Bjerre-Jepsen K, et al: The infective dose of aerobic and anaerobic bacteria in postoperative wound sepsis. *Arch Surg* 1986,121:924-9.