Surgery in Africa - Monthly Review

Appendicitis

Introduction

Since it was first described in the late 19th century, appendicitis has been the ideal “surgical disease” - a pathologic process, common throughout many locales, populations and cultures, which is potentially life-threatening and for which surgical extirpation, carried out with a very low morbidity, results in a high cure rate, seemingly without any long-term sequelae. It is for these reasons that appendectomy has grown to be performed on up to 15% of the population of the developed world and that Harold Ellis wrote in 1989, “the treatment of acute appendicitis is appendectomy – and the sooner it is done, the better.” (1) The main issues at that time were improvements in diagnostic accuracy in order to reduce the 20% or higher percentage of negative appendectomy.

In the 15 years since that review was published, the surgical literature on appendicitis, primarily from the developed world, has concentrated on the application of advanced imaging techniques, ultrasound and CT scanning, to the diagnosis of appendicitis and of the role of prophylactic antibiotics and laparoscopic appendectomy in its treatment. Recent reviews document these developments. (2 - 4) Jaffe’s chapter in the new edition of Schwartz’s Principles of Surgery is particularly thorough. (5) Although the advanced imaging techniques or laparoscopic appendectomy may seem of little relevance to the African situation, this Review will discuss the results of this research, as well as possible advances in the clinical diagnosis of appendicitis, its epidemiology in Africa, and the treatment of special cases and advanced presentations.

Epidemiology

Appendectomy for appendicitis is well recognized in the developed world as the most common emergency surgical procedure. The rate of appendicitis has been constant across many western countries with an incidence of 10/10000/yr and a lifetime risk of appendectomy for appendicitis of about 7%.

Burkitt is responsible for transmitting the belief that appendicitis is uncommon in Africa or the developing world in general. Despite a paucity of data there no longer appears to be evidence for this belief. Naaeder (6) from Ghana, Mungadi (7) in Nigeria, and Debrew (8) in a review of pediatric surgical emergencies from Ethiopia, all found appendectomy to be the most common surgical emergency in their

hospitals. Awori (9) from Nairobi found that appendicitis was the diagnosis in 63% of males who underwent acute surgical procedures; in women the most common diagnosis was ectopic pregnancy. In the study of Asefa (10) from Ethiopia, appendicitis was the 2nd most common cause of abdominal emergency. On the other hand Bickler's study from the Gambia showed a low incidence of appendicitis. (11) While the rate may decrease somewhat in hospitals where surgery for ectopic pregnancy and caesarean section are included in the statistics (9), there can be no doubt that appendicitis is a common condition in Africa today. In fact appendectomy is one of the procedures for which competence is expected of the non-specialist African doctor.

Appendicitis can affect all age groups but is most common in children, peaking in the second decade of life. It appears to affect males slightly more often than females.

The major difference in the epidemiology of appendicitis between Africa and the developed world lies in the rate of advanced appendicitis (free perforations and abscesses). In Africa these commonly represent 40-50% of all cases (12) and are a reflection of delayed presentation. The proportion of perforated appendicitis in large databases in the West is more like 20%. (10)

There are significant differences in mortality rates between Africa and the West. The case fatality rate for all cases of appendicitis in Sweden in the 1990s was 2.4/1000. (13) This very low rate of less than 0.2% rises proportionally with age. It increases five fold to 0.5% with perforation. The mortality rates for appendicitis in the African articles cited in the reports vary from 0.9 to 4% - certainly higher than in the developed world, even taking into consideration the increased rates of perforation.

Pathology

The inflammatory process in appendicitis begins in the mucosa and progresses into the deeper tissues of the appendiceal wall. Obstruction of the lumen, often with a fecalith, plays an important role in the pathogenesis. Carr (14) is of the view that appendicitis can only be properly diagnosed when there is neutrophilic infiltration of the muscularis. Barcia gives a quantitative measure of the number of neutrophils in the mucosa in the normal appendix.(15) The very high appendectomy rates in Madagascar documented by Langenscheidt (16) are anomalous and are associated with an excessive percentage of normal appendices. This may reflect a lack of histological feedback.

While the pathologic process usually continues unabated culminating in perforation and either free peritonitis or abscess formation, spontaneous resolution may occur.

Diagnosis

(Note: In order to assist those struggling with the statistical analysis in the subsequent articles I have included two evidence-based articles on diagnostic tests.) (17;18)

a. Clinical scoring systems

The diagnosis of appendicitis has rested on two main features: 1. evidence of acute peritoneal irritation in the right lower quadrant by history and physical examination and 2. laboratory signs of inflammation.

The presentation of a temporal progression of acute central abdominal pain shifting to the right lower quadrant, associated with vomiting and subsequent mild fever, and accompanied by signs of peritoneal irritation is diagnostic, but unfortunately absent in a significant percentage of cases. Anorexia is an almost universal feature. Vomiting almost always follows the onset of pain. Reliance on clinical indicators alone results in a negative appendectomy rate of 15% or higher, especially in women. The differential diagnosis is very wide but non-surgical abdominal pain is the most common entity requiring differentiation.

Delay in diagnosis results in increased rates of perforation and increased morbidity and mortality. (19; 20) Early referral for surgical opinion may play an important role in reducing delays.

In an attempt to improve diagnostic accuracy clinical scoring systems have been developed. In a meta-analysis of diagnostic studies, Andersson (21) concluded that, although individual variables had weak discriminatory power, when combined they have strong predictive power. The most powerful variables were laboratory tests of inflammation – high WBC, percentage of neutrophils and C reactive protein levels and clinical indicators such as history of migration of pain and evidence of peritoneal irritation – rigidity and rebound tenderness. The Alvarado score uses 8 simple clinical and laboratory indicators to reflect the risk of appendicitis. (22) Scores less than 5/10 are reflective of a decreased risk of appendicitis and high scores over 8/10 an increased risk. (23) Reports comparing the Alvarado score with clinical diagnosis alone have failed to show a significant advantage. (23)

In cases of suspected appendicitis where the index of suspicion is too low to mandate operation, active observation, comprising admission with serial clinical and laboratory examinations, is an accepted and valuable tool, both in reducing unnecessary appendectomies and preventing missed diagnoses. (24 - 26)

b. Imaging techniques

Plain radiographs of the abdomen are often done, mostly to rule out other causes as their features in appendicitis are non-specific.

In the last 15 years ultrasound and CT scanning have been widely applied to cases of appendicitis. A number of excellent reviews describe the US and CT features of appendicitis and suggest indications for use. (27 - 32) Ultrasound examination is operator dependent, probably less accurate than CT, but avoids the risks of radiation. (33) The thickness and compressibility of the appendix are diagnostic features.

Ultrasound is probably more widely available in Africa. Sensitivity rates of 55-96% and specificity rates of 85-98% have been reported with Ultrasound. CT scanning achieves sensitivity rates of 92-97% and specificity rates of 85-94%. The use of contrast does not appear to be necessary. (34)

Despite the relatively high degree of accuracy of these tests, their role in daily management is unclear. (35 - 38) Cases with high clinical scores can be readily managed surgically without further imaging. Similarly those with low scores can be excluded. Imaging is probably best reserved for those cases in which clinical diagnosis is indefinite. This is particularly relevant to abdominal pain in women where ultrasound and laparoscopy play a greater role in reducing the higher rate of negative appendectomy. *(see below)*.

What is an acceptable rate of negative appendectomy and can it be lowered?

While one might suppose that the accuracy of imaging techniques would result in a reduction in the negative appendectomy rate, I was unable to find any studies which conclusively show such a benefit. Flum (39) retrospectively reviewed 63000 appendectomies over an 11 year period and found that neither a negative appendectomy rate of 15% nor a perforation rate of 25% changed during this period, when advanced imaging techniques were being introduced. Hong's RCT showed no benefit with CT scanning when compared to clinical assessment alone. (30) Martin's study which is retrospective is also negative towards advanced imaging. (32) Jones's article which envisions a reduction in negative appendectomies to 2% with CT scanning is retrospective. (40) Paulson reviews the issue of suspected

appendicitis and gives a treatment algorithm using imaging. (41)

Therapy

a. Antibiotic prophylaxis

A meta-analysis from the prestigious Cochrane Database of Systematic Reviews has concluded that antibiotic prophylaxis reduces post-operative infectious complications (wound infection and intra-abdominal abscess) in appendicitis and should be routine. (42) Single dose regimes were as effective as multiple doses. The timing of medication, (pre, intra or post-operative), was apparently unresolved, but other studies suggest antibiotics should be given before the incision. Whereas no conclusion was made about the specific antibiotics themselves, again other studies suggest that antibiotics, active against the pathogenic organisms present in appendicitis, i.e. aerobic and anaerobic gram-negative bacilli, should be used. A useful regime would be metronidazole and an aminoglycoside such as gentamycin or a third generation cephalosporin with anaerobic activity.

When advanced appendicitis is encountered, antibiotic prophylaxis is often prolonged for 7-10 days. Snelling (43) showed that limiting regimes to 3 days, or when temperature and WBC have normalized, did not appear to increase the risk of post-operative infection.

b. Wound management

Surprisingly, (at least to me), a recent meta-analysis of studies comparing primary closure with delayed primary closure showed no decrease in wound infections with the latter and recommended primary closure for open appendectomy. (44)

c. Laparoscopic appendectomy (LA) versus open appendectomy (OA)

After the widespread introduction of laparoscopic cholecystectomy in the West during the 1990s, the laparoscopic approach began to be applied to appendectomy as well. Reviewing a very large number of reports of LA, Kraemer (45) reported a negative appendectomy rate of 22%, although there may have been a reduced threshold to carry out appendectomy in these cases. He found that compared with pathological examination, surgeons could correctly identify an abnormal appendix laparoscopically with a false negative rate of 3%. Sauerland carried out a meta-analysis of RCTs comparing LA and OA for the Cochrane Database. (46) Wound infection rates for LA were only ½ those of OA. However there was a three fold increased risk of intra-abdominal abscess with LA. The duration of surgery was longer for LA, hospital stay shortened, analgesia requirements less, return to work faster and hospital costs greater. They concluded that there were small but real advantages to LA, particularly in women and obese or employed individuals. A recent meta-analysis of RCTs in children concluded that LA reduced wound infections but was associated with a non-significant increase in intra-abdominal infections. (47)

Whether these results have significant application in Africa is doubtful. However, given the smaller number of cholecystectomies performed in Africa, LA may be a useful procedure on which to teach minimally invasive techniques.

Incidental appendectomy has been generally condemned. While it is routine to remove a normal appendix during open appendectomy so as to avoid subsequent confusion, this is not the case with laparoscopy. Normal appendices found at laparoscopy should be left in situ.

Special cases

a. young children

It is well known that appendicitis developing in children under 3 is almost universally perforated with generalized peritonitis. Alloo (48) reviewed the presentation in this age group with the associated greater morbidity and mortality rates. Karaman (49) reviewed the rare cases of neonatal appendicitis.

b. the elderly

Similarly, appendicitis in the elderly is recognized as causing higher morbidity and mortality. Kraemer (50) found that patients over 50 years old had 35% perforated appendicitis compared with 13% in younger patients and mortality rates of 3% compared with 0.2%. Podnos (51) reviewed intra-abdominal sepsis in the elderly.

c. women of child bearing age

Women suffer an increased risk of misdiagnosis of appendicitis. For this reason imaging techniques particularly US should be more widely applied. In a randomized study Larsson (52) showed that a negative appendectomy rate of 34% with OA could be reduced to 7% through the prior use of laparoscopy. In those patients who did not have appendicitis a definitive gynaecologic diagnosis was made in 73% compared with only 17% who had OA alone. After institution of a clinical practise guideline using laparoscopy, Blisard (53) showed a significant drop in the rate of negative appendectomy in women from 31% to 23%. Pregnant women may develop appendicitis and the diagnosis may be difficult. However appendicitis threatens fetal survival and appendectomy should not be delayed.(54 ;55)

d. appendicitis and AIDS

The incidence of appendicitis and of appendiceal rupture is increased in HIV positive patients. Rupture rates are inversely proportional to CD4 counts. While the clinical symptoms are the same, the WBC may not be elevated. Appendicitis needs to be distinguished from opportunistic infections causing right lower quadrant pain in these patients. Spontaneous peritonitis may result from CMV, tuberculosis, Cryptococcus and strongyloides. Kaposi sarcoma and non-Hodgkins lymphoma may present as inflammatory masses.

Advanced appendicitis

Advanced appendicitis, resulting usually from a delay in presentation, comprises gangrenous appendicitis, appendiceal phlegmon, perforation with abscess formation and free perforation with generalized peritonitis. The first requires appendectomy although infectious complications maybe higher. Similarly the last requires appendectomy, peritoneal lavage and general methods to combat sepsis.

Controversy exists primarily over the management of the appendiceal mass. This occurs in 2-6% of cases, in the older age group and is a not uncommon problem in Africa. The standard recommendation has been to treat with antibiotics and serial observations of the mass. (1) There will be a clinical resolution in a significant percentage of cases. In 9-15% of cases the mass expands or the patient shows deterioration. The appendiceal abscess is then drained and an interval appendectomy carried out in 4-6 weeks.

Okafor (56), from Nigeria, presents his experience with 30 such cases. A variety of techniques were used. Where US and CT scanning are available, they may be used to define the abscess and also drain it

percutaneously. (57) Brown (58) concluded there was an increase in morbidity and hospital stay when immediate appendectomy was performed under these conditions. Friedell (59) reports on 5 cases of interval appendectomy carried out after resolution of an appendiceal mass. Kaminski (60) questioned whether interval appendectomy was justified. In a pediatric study, Samuel (61) found that a significant percentage of children had recurrent symptoms requiring interval appendectomy. Interval appendectomy also allows for assessment of additional pathology such as appendiceal or colonic neoplasm.

Conclusions

1. Those patients, who present to emergency departments with abdominal pain suspicious of appendicitis, should have an early surgical consultation and laboratory investigations including WBC, CRP (if available) and urinalysis.
2. Clinical scoring systems such as the Alvarado score may play a role in differentiating patients with high and low risk of appendicitis.
3. Advanced imaging techniques should not be applied routinely although they may be valuable when the clinical diagnosis is uncertain. Ultrasound is particularly valuable in women.
4. Active observation is an appropriate method for managing uncertain cases.
5. All appendices removed at operation for appendicitis should be submitted to pathological analysis.
6. Rates of negative appendectomies, based on pathologic examination, and perforated appendicitis should be maintained for each hospital.
7. Prophylactic antibiotics should be used routinely in cases of appendicitis.
8. There seems to be no value in the use of delayed primary closure in appendicitis.
9. There are small but definite benefits to laparoscopic appendectomy. It may be contraindicated in cases of advanced appendicitis.
10. Laparoscopy is particularly suitable for women in whom it lowers the negative appendectomy rate and results in a greater yield of alternative diagnosis.
11. The risk of perforation and mortality rates are considerably increased for appendicitis at the extremes of life.
12. Appendiceal mass is best treated expectantly with antibiotics or with abscess drainage alone. Interval appendectomy should probably be carried out 6-10 weeks after the initial illness.

Brian Ostrow MD, FRCS(C)
Guelph, Ontario, Canada

Click here to comment on this article.

Reference List

1. Ellis H. **Appendix**. In: Schwartz & Ellis, editor. Maingot's Abdominal Operations. Norwalk, Conneticut: Appleton & Lange, 1989: 953-977.
2. Birnbaum BA, Wilson SR. **Appendicitis at the millennium**.Radiology 2000; 215(2):337-348. *(481 kb)*
3. Hardin DM, Jr. **Acute appendicitis: review and update.** American Family Physician 1999; 60(7):2027-2034. *(46 kb)*
4. Saidi HS, Adwok JA. **Acute appendicitis: an overview**. East African Medical Journal 2000; 77(3):152-156.
5. Jaffe B&BD. **The Appenidx.** In: Brunicardi FEiC, editor. Schwartz's Principles of Surgery. New York: Mc-Graw Hill Companies Inc., 2005. *(139 kb)*
6. Naaeder SB, Archampong EQ. **Clinical spectrum of acute abdominal pain in Accra, Ghana.** West African Journal of Medicine 1999; 18(1):13-16. *(12 kb)*
7. Mungadi IA, Jabo BA, Agwu NP. **A review of appendicectomy in Sokoto, North-western Nigeria.** Nigerian Journal of Medicine: Journal of the National Association of Resident Doctors of Nigeria 2004; 13(3):240-243. *(13 kb)*
8. Debrew M. 2006. Personal Communication.
9. Awori MN, Jani PG. **Surgical implications of abdominal pain in patients presenting to the Kenyatta National Hospital casualty department with abdominal pain.** East African Medical Journal 2005; 82(6):307-310. (*44 kb)*
10. Asefa Z. **Pattern of acute abdomen in Yirgalem Hospital, southern Ethiopia.**[erratum appears in Ethiop Med J 2001 Jan;39(1):86]. Ethiopian Medical Journal 2000; 38(4):227-235. *(12 kb)*
11. Bickler SW&BS. **Epidemiology of paediatric surgical admissions to a government referral hospital in the Gambia**. Bulletin of the World Health Organization 2000; 78(11):1330-1336. *(277 kb)*
12. Willmore WS, Hill AG. **Acute appendicitis in a Kenyan rural hospital.** East African Medical Journal 2001; 78(7):355-357. *(13 kb)*
13. Blomqvist PG, Andersson RE, Granath F, Lambe MP, Ekbom AR. **Mortality after appendectomy in Sweden, 1987-1996.** Annals of Surgery 2001; 233(4):455-460. *(51 kb)*
14. Carr NJ. **The pathology of acute appendicitis.** Annals of Diagnostic Pathology 2000; 4(1):46-58. *(15 853 kb)*
15. Barcia JJ, Reissenweber N. **Neutrophil count in the normal appendix and early appendicitis: diagnostic index of real acute inflammation.** Annals of Diagnostic Pathology 2002; 6(6):352-356. *(96 kb)*
16. Langenscheidt P, Lang C, Puschel W, Feifel G. **High rates of appendicectomy in a developing country: an attempt to contribute to a more rational use of surgical resources.** European Journal of Surgery 1999; 165(3):248-252. *(56 kb)*
17. Jaeschke RGGSDL. **User Guides to the Medical Literature**. JAMA 1994; 271(5):389-391. *(362 kb)*
18. Jaeschke RGGSDL. **User Guides to the Medical Literature.** JAMA 1994; 271(9):703-707. (*612 kb)*

19. Rothrock SG, Pagane J. **Acute appendicitis in children: emergency department diagnosis and management.** Annals of Emergency Medicine 2000; 36(1):39-51. *(101 kb)*
20. Cappendijk VC, Hazebroek FW. **The impact of diagnostic delay on the course of acute appendicitis.** Archives of Disease in Childhood 2000; 83(1):64-66. *(52 kb)*
21. Andersson RE. **Meta-analysis of the clinical and laboratory diagnosis of appendicitis.** British Journal of Surgery 2004; 91(1):28-37. *(136 kb)*
22. Winn RD, Laura S, Douglas C, Davidson P, Gani JS. **Protocol-based approach to suspected appendicitis, incorporating the Alvarado score and outpatient antibiotics.** ANZ Journal of Surgery 2004; 74(5):324-329. *(147 kb)*
23. Saidi RF, Ghasemi M. **Role of Alvarado score in diagnosis and treatment of suspected acute appendicitis.** American Journal of Emergency Medicine 2000; 18(2):230-231. *(243 kb)*
24. Macklin CP, Radcliffe GS, Merei JM, Stringer MD. **A prospective evaluation of the modified Alvarado score for acute appendicitis in children.** Annals of the Royal College of Surgeons of England 1997; 79(3):203-205. *(13 kb)*
25. Jones PF. **Suspected acute appendicitis: trends in management over 30 years.** British Journal of Surgery 2001; 88(12):1570-1577. *(94 kb)*
26. Bachoo P, Mahomed AA, Ninan GK, Youngson GG. **Acute appendicitis: the continuing role for active observation.** Pediatric Surgery International 2001; 17(2-3):125-128. *(63 kb)*
27. Andersson RE, Hugander A, Ravn H, Offenbartl K, Ghazi SH, Nystrom PO et al. **Repeated clinical and laboratory examinations in patients with an equivocal diagnosis of appendicitis.** World Journal of Surgery 2000; 24(4):479-485. *(120 kb)*
28. Vasavada P. **Ultrasound evaluation of acute abdominal emergencies in infants and children.** Radiologic Clinics of North America 2004; 42(2):445-456. *(728 kb)*
29. Macari M, Balthazar EJ. **The acute right lower quadrant: CT evaluation.** Radiologic Clinics of North America 2003; 41(6):1117-1136. *(1542 kb)*
30. Wijetunga R, Doust B, Bigg-Wither G. **The CT diagnosis of acute appendicitis.** Seminars in Ultrasound, CT & MR 2003; 24(2):101-106. *(5114 kb)*
31. Lee SL, Ho HS. **Ultrasonography and computed tomography in suspected acute appendicitis.** Seminars in Ultrasound, CT & MR 2003; 24(2):69-73. *(485 kb)*
32. Wilson EB. **Surgical evaluation of appendicitis in the new era of radiographic imaging.** Seminars in Ultrasound, CT & MR 2003; 24(2):65-68. *(381 kb)*
33. Sivit CJ. **Imaging the child with right lower quadrant pain and suspected appendicitis: current concepts**. Pediatric Radiology 2004; 34(6):447-453. *(322 kb)*
34. Terasawa T, Blackmore CC, Bent S, Kohlwes RJ. **Systematic review: computed tomography and ultrasonography to detect acute appendicitis in adults and adolescents.** Annals of Internal Medicine 2004; 141(7):537-546. *(758 kb)*
35. Anderson BA, Salem L, Flum DR. **A systematic review of whether oral contrast is necessary for the computed tomography diagnosis of appendicitis in adults.** American Journal of Surgery 2005; 190(3):474-478. *(83 kb)*
36. Stephen AE, Segev DL, Ryan DP, Mullins ME, Kim SH, Schnitzer JJ et al. **The diagnosis of acute appendicitis in a pediatric population: to CT or not to CT.** Journal of Pediatric Surgery 2003; 38(3):367-371. *(67 kb)*
37. Hong JJ, Cohn SM, Ekeh AP, Newman M, Salama M, Leblang SD et al. **A prospective randomized study of clinical assessment versus computed tomography for the diagnosis of acute appendicitis.**[see comment]. Surgical Infections 2003; 4(3):231-239. *(13 kb)*
38. Hagendorf BA, Clarke JR, Burd RS. **The optimal initial management of children with suspected appendicitis: a decision analysis**. Journal of Pediatric Surgery 2004; 39(6):880-885. *(129 kb)*
39. Martin AE, Vollman D, Adler B, Caniano DA. **CT scans may not reduce the negative appendectomy rate in children**. Journal of Pediatric Surgery 2004; 39(6):886-890. *(446 kb)*
40. Flum DR, Morris A, Koepsell T, Dellinger EP. **Has misdiagnosis of appendicitis decreased over time? A population-based analysis**. JAMA 2001; 286(14):1748-1753. *(71 kb)*
41. Jones K, Pena AA, Dunn EL, Nadalo L, Mangram AJ. **Are negative appendectomies still acceptable?** American Journal of Surgery 2004; 188(6):748-754. *(127 kb)*
42. Paulson Eeal. Clinical Practice. **Suspected Appendicitis.** N E J M 2003; 348(3):236-242. *(137 kb)*
43. Andersen BR, Kallehave FL, Andersen HK. **Antibiotics versus placebo for prevention of postoperative infection after appendicectomy.**[update of Cochrane Database Syst Rev. 2003;(2): CD001439; PMID: 12804408]. Cochrane Database of Systematic Reviews 2005;(3):CD001439. *(422 kb)*
44. Snelling CM, Poenaru D, Drover JW. **Minimum postoperative antibiotic duration in advanced appendicitis in children: a review.** Pediatric Surgery International 2004; 20(11-12):838-845. *(194 kb)*
45. Henry MC, Moss RL. **Primary versus delayed wound closure in complicated appendicitis: an international systematic review and meta-analysis.** Pediatric Surgery International 2005; 21 (8):625-630. *(232 kb)*
46. Kraemer M, Ohmann C, Leppert R, Yang Q. **Macroscopic assessment of the appendix at diagnostic laparoscopy is reliable.** Surgical Endoscopy 2000; 14(7):625-633. *(59 kb)*
47. Sauerland S, Lefering R, Neugebauer EA. **Laparoscopic versus open surgery for suspected appendicitis.** [update in Cochrane Database Syst Rev. 2004;(4):CD001546; PMID: 15495014]. Cochrane Database of Systematic Reviews 2004;(1):CD001546. *(458 kb)*
48. Aziz Oea. **Laparoscopic versus Opne Appendectomy in Children - a Meta-Analysis.** Annals of Surgery 2006; 243:17-27. *(763 kb)*
49. Alloo J, Gerstle T, Shilyansky J, Ein SH. **Appendicitis in children less than 3 years of age: a 28-year review.** Pediatric Surgery International 2004; 19(12):777-779. *(158 kb)*
50. Karaman A, Cavusoglu YH, Karaman I, Cakmak O. **Seven cases of neonatal appendicitis with a review of the English language literature of the last century.** Pediatric Surgery International 2003; 19(11):707-709. *(163 kb)*
51. Kraemer M, Franke C, Ohmann C, Yang Q, **Acute Abdominal Pain Study Group. Acute appendicitis in late adulthood: incidence, presentation, and outcome. Results of a prospective multicenter acute abdominal pain study and a review of the literature.** Langenbecks Archives of Surgery 2000; 385(7):470-481. *(59 kb)*
52. Podnos YD, Jimenez JC, Wilson SE. **Intra-abdominal Sepsis in Elderly Persons.** Clinical Infectious Diseases 2002; 35(1):62-68. *(92 kb)*
53. Larsson PG, Henriksson G, Olsson M, Boris J, Stroberg P, Tronstad SE et al. **Laparoscopy reduces unnecessary appendicectomies and improves diagnosis in fertile women. A randomized**

study. Surgical Endoscopy 2001; 15(2):200-202. *(83 kb)*

54. Blisard D, Rosenfeld JC, Estrada F, Reed JF, III. **Institutioning a clinical practice guideline to decrease the rate of normal appendectomies.** American Surgeon 2003; 69(9):796-798. *(583 kb)*
55. Guttman R, Goldman RD, Koren G. **Appendicitis during pregnancy.** Canadian Family Physician 2004; 50:355-357. *(121 kb)*
56. Sivanesaratnam V. **The acute abdomen and the obstetrician.** Best Practice & Research in Clinical Obstetrics & Gynaecology 2000; 14(1):89-102. *(185 kb)*
57. Okafor PI, Orakwe JC, Chianakwana GU. **Management of appendiceal masses in a peripheral hospital in Nigeria: review of thirty cases.** World Journal of Surgery 2003; 27(7):800-803. *(60 kb)*
58. Hogan MJ. **Appendiceal abscess drainage.** Techniques in Vascular & Interventional Radiology 2003; 6(4):205-214. *(861 kb)*
59. Brown CV, Abrishami M, Muller M, Velmahos GC. **Appendiceal abscess: immediate operation or percutaneous drainage?** American Surgeon 2003; 69(10):829-832. *(680 kb)*
60. Friedell ML, Perez-Izquierdo M. **Is there a role for interval appendectomy in the management of acute appendicitis?** American Surgeon 2000; 66(12):1158-1162. *(548 kb)*
61. Kaminski A, Liu IL, Applebaum H, Lee SL, Haigh PI. **Routine interval appendectomy is not justified after initial nonoperative treatment of acute appendicitis.** Archives of Surgery 2005; 140 (9):897-901. *(86 kb)*
62. Samuel M, Hosie G, Holmes K. **Prospective evaluation of nonsurgical versus surgical management of appendiceal mass.** Journal of Pediatric Surgery 2002; 37(6):882-886. *(109 kb)*

Click here to comment on this article.

(Back to Top)

Previous Review Article | Surgery in Africa Home | Next Review Article