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**Acute right lower abdominal pain in women of reproductive age: Clinical clues**

Hatipoglu S *et al*. Right lower abdominal pain in women

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**Abstract**

**AIM:** To study possible gynecological organ pathologies in the differential diagnosis of the acute right lower abdominal pain in the patients of reproductive age.

**METHODS:** After the clinical trials ethical committee approval the retrospective data consisting of physical examination and laboratory findings of 290 patients that applied to the emergency surgery service between April 2009 and September 2013 with sudden onset right lower abdominal pain and operated under general anesthesia with the diagnosis of acute appendicitis were gathered.

**RESULTS:** A total data of 290 patients was obtained. Two hundred and twenty-four (77.2%) of them had acute appendicitis, whereas 29 (10%) had perforated appendicitis and 37 (12.8%) had gynecological organ pathologies. Of the latter 21(7.2%) had ovarian cyst rupture, 12 (4.2%) had corpus hemorrhagicum cyst rupture and 4 (1.4%) had adnexal torsion. Defense, rovsing sign, increased body temperature and leukocyte count have been found to be statistically significant in the differential diagnosis of appendicitis and gynecological organ pathologies.

**CONCLUSION:** Gynecological pathologies in women of reproductive age mislead us in the diagnosis of acute appendicitis.

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**Key words:** Gynecological pathologies; Appendicitis; Differential diagnosis; Anamnesis; Physical examination

**Core tip:** Gynecological organ pathologies have to be taken into consideration when dealing with acute right lower abdominal pain in the patients of reproductive age. We have evaluated clinical and laboratory clues in the differential diagnosis of gynecological pathologies and acute appendicitis in patients of reproductive age.Defense, rovsing sign, increased body temperature and leukocyte count were statistically significant in the differential diagnosis of appendicitis and gynecological organ pathologies.In women of reproductive age with acute abdominal pain, we should also think the probability of gynecological pathologies, therefore gynecological anamnesis and examination should clearly be fulfilled.

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**INTRODUCTION**

Abdominal pain constitutes 4%-8% of reasons for adult admissions to the emergency service[1,2]. For the patient admitted with right lower quadrant abdominal pain, acute appendicitis is the most frequently considered diagnosis. Appendicitis is a common cause of acute abdominal pain in women of reproductive age (WORA) and appendectomy is the most common of all emergency operations concluded in them[3]. Moreover, suspected appendicitis is one of the most common surgical consultations obtained in the outpatient or emergency room setting.

Appendicitis is an emergency situation with the highest rate of misdiagnosis, notwithstanding that the whole clear diagnosis and treatment have been established since more than a 100 of years[4]. The inconsistency between the disease severity and physical findings is greater in old patients and the WORA relative to other groups. This inconsistency increases further in WORA because of the gynecological pathologies mimicking acute appendicitis[5-10]. The diagnosis and management of WORA with an acute appendicitis remain as one of the most difficult challenges for general surgeons and gynecologists. General surgeons may challenge gynecological pathologies and may have to intervene in these circumstances in women undergoing laparotomy with the diagnosis of acute appendicitis.

A thorough understanding of the anatomy and physiology of the abdomen is essential to properly generate a differential diagnosis and to formulate a treatment plan. Acute appendicitis can lead to unwanted complications if its diagnosis is confused or delayed. Although recent advances in surgical and diagnosis technology can be extremely helpful in certain situations, they cannot replace a surgeon's clinical judgment based upon a good anamnesis and physical examination.

Today, with the medicine becoming more dependent on laboratory and radiological findings the merit of physical examination decreases. It is important to know that painstaking anamnesis and physical examination is important and may be diagnostic for many diseases and especially appendicitis. In our study, we wanted to present and emphasize how definitive anamnesis, physical examination and laboratory findings carry clues for differential diagnosis of acute appendicitis and gynecological obstetric pathologies in WORA.

**MATERIALS AND METHODS**

After the clinical trials ethical committee approval the retrospective data consisting of physical examination and laboratory findings of 290 female patients that applied to the emergency surgery service of Adiyaman University Training and Research Hospital between April 2009 and September 2013 with sudden onset right lower abdominal pain and operated under general anesthesia with the diagnosis of acute appendicitis were gathered. The data were the first findings that were obtained at the admission and comprised of abdominal pain, nausea, vomiting, anorexia for anamnesis; abdominal tenderness, defense, rebound, dunphy sign, obturator sign, psoas sign, rovsing sign for physical examination; and of body temperature, leukocyte count, urine microscopy and abdominal X-ray for laboratory findings. Emergency abdominal ultrasonography (USG) and computerized tomography (CT) had not been routinely done for the patients enrolled because of the insufficiency of radiological consultation out-of-shift.

The first examination and operations of the patients were done by the same general surgeon. Routine preoperative gynecological consultation was made for all the patients. All the patients had received preoperatively a prophylactic dose of 2nd generation cephalosporin (1 g iv.) and undergone open approach appendectomy *via* Mc Burney incision under general anesthesia. Laparoscopic approach had not been done because of technical inadequacy. Appendicitis and gynecological pathology diagnosis had been made by peroperative macroscopic evaluation. Abdominal exploration had been made in all the patients with normal appendix for the exclusion of possible meckel’s diverticulum. Peroperative gynecological consultation had been obtained for the patients with gynecological pathology. Patients with previous abdominal or gynecological operations, patients without normal menstrual cycle and pregnant patients were excluded from the study. Patients with gynecological pathologies had been discharged with a suggestion to have a policlinic control at gynecologist.

***Statistical analysis***

All values were expressed as the mean ± standard deviation. Qualitative data was analyzed by Chi-square test. *P* values less than 0.05 were considered statistically significant. Data were analyzed using the SPSS (Statistical Package for Social Sciences) 9.05 for Windows® statistical package.

**RESULTS**

The mean age of the patients was 21.4 ± 3.6 (12-44). A total data of 290 patients was obtained. Two hundred and twenty-four (77.2%) of them had acute appendicitis, whereas 29 (10%) had perforated appendicitis and 37 (12.8%) had gynecological organ pathologies. Of the latter 21 (7.2%) had ovarian cyst rupture, 12 (4.2%) had corpus hemorrhagicum cyst rupture and 4 (1.4%) had adnexal torsion (Table 1).

All the patients had abdominal pain symptom with right lower abdominal region tenderness and rebound as the first physical examination signs (Figure 1). Defense, rovsing sign, increased body temperature (hyperpyrexia) and leukocyte count (leukocytosis) have been found to be statistically significant in the differential diagnosis of appendicitis and gynecological organ pathologies (Figure 1).

All the patients had undergone appendectomy. Patients with normal appendix at exploration who were found to have ovarian cyst rupture had undergone cauterization, ovary primary suturation and cyst excision with the number of patients of 16 (76.2%), 4 (19%) and 1 (4.8%) respectively. Patients with corpus hemorrhagicum had undergone cauterization, ovary primary suturation and cyst excision with the number of patients of 6 (50%), 2 (16.7%) and 4 (43.3%) respectively. Three patients with adnexal torsion had undergone detorsion and oophoropexy, whereas 1 patient had oophorectomy and salpingectomy (Table 2). No postoperative mortality was observed in the patients. Morbidity was observed in 11 patients (3.8%) with 2 (18.2%) patients with atelectasis and 9 (81.8%) patients with wound infection.

**DISCUSSION**

Acute appendicitis has an important place among causes with acute abdominal pain. The general incidence of appendicitis for all age groups is 7%[11,12]. The incidences for men and women are 8.6% and 6.7% respectively[13]. Appendicitis is most commonly seen between 10-30 years of age[14]. The mean age of the patients in our study was 21.3 ± 3.7. Male and female appendicitis frequency is equal in childhood, whereas the incidence for males increases with age with male/female ration of 3:2 at adulthood[15,16].

The diagnosis of acute appendicitis is made by anamnesis and clinical findings. Although it can vary with age and sex; right diagnosis can be made by 70%-80% *via* anamnesis, physical examination and laboratory findings[17-19]. Accuracy of the diagnosis decreases in WORA, in children and elderly[20]. Laboratory findings and radiological examination can support the diagnosis of appendicitis, but never can rule it out. Symptoms in acute appendicitis generally follow a certain sequence as periumblical pain (visceral, unlocalized), anorexia, nausea and/or vomiting, right lower quadrant abdominal pain and tenderness, hyperpyrexia, leukocytosis. These symptoms have not to be present altogether. Physical findings suggesting appendicitis are Mc Burney tenderness, rebound, roving’s sign, dunphy’s sign, psoas sign, obturator sign and fullness and tenderness in pelvis during digital rectal examination[17-19].

We used dunphy’s sign (increased right lower quadrant pain with coughing), Obturator sign (increased pain with flexion and internal rotation of the hip), Psoas sign (increased pain with passive extension of the right hip can be elicited with the patient lying on the left side), and roving’s sign (increased right lower quadrant pain during palpation in the left lower quadrant) as the most common physical examination findings of appendicitis in our study[21].

Main symptoms in acute appendicitis are frequently periumblical pain preceded by anorexia and nausea. Vomiting is generally seen later. The pain is generally switches to the right lower abdominal quadrant 8 h later following the initial[22]. The Surgical Infection Society and Infectious Diseases Society of America published guidelines that recommend the establishment of local pathways for the diagnosis and management of acute appendicitis[21,23]. According to the guidelines, the combination of clinical and laboratory findings of characteristic acute abdominal pain, localized tenderness, and laboratory evidence of inflammation will identify most patients with suspected appendicitis[21]. We have represented our findings in Figure 1.

Although the clinical presentation of periumblical pain migrating to the right lower abdominal quadrant is classically associated with acute appendicitis, the presentation is rarely typical and the diagnosis cannot always be based on medical history and physical examination alone. Classical appendicitis clinical findings are observed in only 60% of acute appendicitis, whereas 20%-33% displayed atypical clinical and laboratory findings[22]. Regardless of the technological advances in the preoperative diagnosis of acute appendicitis, the right diagnosis can only be made in 76%-92% of the situations[24,25]. On the other hand, 6%-25% of the operations made for acute appendicitis reveal normal appendix and this number can reach 30%-40% for the WORA[26-30]. We have observed a number of 12.8% in our study. Diagnostic errors are common, with over-diagnosis leading to negative appendectomies and with delays in diagnosis leading to perforations. Diagnostic strategies for evaluating patients with acute abdominal pain and for identifying patients with suspected appendicitis should all start with a painstaking anamnesis and physical examination. All of our patients had abdominal pain symptom with right lower abdominal region tenderness and rebound as the first physical examination signs (Figure 1). Defense, rovsing sign, increased body temperature and leukocyte count have been found to be statistically significant in the differential diagnosis of appendicitis and gynecological organ pathologies (Figure 1).

The accurate diagnosis of the acute abdominal pain related to adnexal pathologies is very important in the morbidity and mortality. It is also crucial to choose the right treatment modality that can affect the hospitalization period and so the patients’ contentment. Moreover, the cost of the optimum treatment modality is of importance not to be neglected. The fertilization ability of the patients can be affected poorly when no intervention is done for the gynecological pathologies in negative appendectomy situations[31]. We have observed ovarian cyst rupture, corpus hemorrhagicum rupture and adnexal torsion in our study.

A pelvic pain during the ovulatory cycle may be observed as a result of the small amount of blood drained from the ruptured ovarian follicle to the peritoneal cavity during ovulation. The pain here is mild-to-moderate that limits itself and hemoperitoneum is seldom observed with normal hemostatic parameters. So, there is generally no need for surgical intervention in these circumstances[32]. It is crucial to make early and right diagnosis and to execute careful observation in patients thought to have ovarian cyst rupture if we think that the exploratory surgical intervention can result in infertility in the future. The adnexal masses in adolescents contain functional and physiologic cystic formations on one end of the spectrum, and serious malignant tumors on the other end. The principal clinical approach in these adnexal pathologies is to preserve organs and fertility.

Ovarian cyst rupture emerges with benign or malign cystic lesions of the ovaries. Cyst excision is a convenient treatment choice in young patients. It is important not to remove the whole ovary. Oophorectomy can be applied in older patients. It should be taken into consideration, that young patients with ovarian germ cell tumors may be associated with acute abdomen[5]. Hemodynamic parameters of the patients with ovarian cyst rupture may be impaired because of the amount of blood lost[31,33]. Suturation, cauterization of the bleeding site or cyst excision can be applied for ovarian cyst rupture[33]. We have observed 7.2% ovarian cyst rupture in our study (Table 2). Hemodynamic parameters of all of these patients were stable and there was no need for blood transfusion.

Corpus hemorrhagicum cysts are one of the most common cysts in ovaries. They are formed as a result of hemorrhage into the follicle cyst or corpus luteum cyst in the ovaries during ovulation period[34-38]. Its clinical signs and symptoms are variable and include such patients as asymptomatic cases or patients showing symptoms of acute abdomen[34]. These cysts are commonly seen in a single ovary, either right or left. Rarely are they observed bilaterally. They are more frequently seen in patients having ovulation therapy for pregnancy. They are also seen in patients with bleeding disorders and coagulation problems or those on anticoagulant treatment. Seldom may they lead to operations because of intraabdominal hemorrhage as a result of rupture or torsion[36-38]. In general bleeding can be stopped by excision of the cyst, but sometimes the ovary needs to be taken out. We have observed corpus hemorrhagicum rupture in 4.2% of the patients in our study (Table 1). All the patients had stable hemodynamics and neither required blood transfusion. The patients were in their 20s, being in their active reproductive period and this is in accord with literature[39].

Adnexal torsion is a well known, but difficultly diagnosed cause of acute abdomen because of variable clinical cause and symptoms; and comprises a clinical condition when tuba folds up on itself. Clinical findings are just like acute appendicitis[40-42]. Ovarian torsion is observed in 2%-3% of patients operated on diagnosis of acute appendicitis[40,41,43,44]. We observed a number of 1.4% in our study (Table 1). It is observed 3-fold more on the right compared with the left side[40,41]. It is relatively easier to differentiate ovarian torsion from other acute abdomen causes via ultrasonography during the early period[45,46]. Adnexal torsions without symptoms are dangerous and caution should be taken in these cases. Removal of adnex and eventual infertility risk is likely to happen.

Excision of necrotic tissue is suggested before detorsion, because of pulmonary thromboembolism risk (0.2%), if vividness of ovary is lost and gangrene demarcation line is already formed[47,48]. We have observed one patient in whom the ovary had lost its normal structure and had necrotic appearance in our study and oophorectomy was performed before detorsion. Other three patients with ovarian torsion underwent detorsion and ovarian fixation (Table 2). Cohen *et al*[49] have reported that torsioned, ischemic and hemorrhagic adnexes can be detorsioned laparoscopically with minimal morbidity and complete recovery of ovarian functions.

Diagnosis of ectopic pregnancy can generally be made fast and easy using β-hCG. We have not encountered ectopic pregnancy rupture in our study, which constitutes a significant proportion of gynecological emergencies. The reason for this may have been a painstaking anamnesis of the patients regarding their marriage and odds of pregnancy, β-hCG values and clinical differences between ectopic pregnancy and acute appendicitis.

Abdominal ultrasonography (US) and CT are important in establishing absolute diagnosis of acute appendicitis preoperatively[50-52]. and CT must be used to support the diagnosis and exclude other possible causes after the clinical and laboratory diagnosis. Nevertheless, the ratio of negative appendectomies is quite higher than expected. Abdominal US, being easy applicable, cheap and noninvasive should be the most preferable method among these[50]. Abdominal CT is more valuable than USG in this respect; the credibility of US in the diagnosis of appendicitis is 71%-97% because of the dependence on operator and patient factors like obesity, whereas that of CT is 93%-98%[20]. Emergency abdominal US and CT had not been routinely done for the patients enrolled because of the insufficiency of radiological consultation out-of-shift.

Leukocytosis is observed in 80%-90% of appendicitis cases, but the number is below 18.000 unless any perforation[53]. Yang *et al*[54] have displayed 85% sensitivity and 31.9% specificity for leukocyte count in appendicitis. Leukocyte counts were high in acute and perforated appendicitis with the ratio of 95% and 93% respectively in our study (Figure 1).

Currently, increasing knowledge and experience, together with developing imaging methods and laboratory techniques to evaluate patients with gynecological emergency has facilitated taking necessary general measures to minimize morbidity and mortality.When tailoring management strategies, the development and psychology of the reproductive women should be greatly considered as well as preserving fertility to be the ultimate aim of the treatment. Taking the subsequent therapy into consideration, a multidisciplinary (general surgeon, gynecologist and radiologist) approach should be the basis of the management of the adnexal pathologies.

In conclusion, acute appendicitis is one of the most frequent causes of acute abdomen and is the most frequent abdominal surgical procedure, too. Taking a scrupulous anamnesis and medical examination is very important in diagnosis it. Laboratory findings and imaging techniques could be useful in diagnosis. But, the diagnosis of acute appendicitis is made mainly by clinical history and clinical findings. Laboratory findings and imaging techniques support diagnosis, but never exclude. It should never be forgotten that there may be gynecological pathologies in WORA before establish acute appendicitis diagnosis. Clinical findings aren’t always enough for definitive diagnosis and negative laparotomy is sometimes inevitable for women in fertile period. Moreover, in view of the legal repercussions for general surgeons as a result of erroneous diagnosis and treatment, we think that adequate evaluation of the studies in the emergency surgery service is important and that the radiological investigations (abdominal US and CT) have to be used appropriately and sufficiently.

**COMMENTS**

***Background***

Clinical and laboratory clues in the differential diagnosis of gynecological pathologies that are most likely to be confused with acute appendicitis in patients of reproductive age.In women of reproductive age with acute abdominal pain, we should think of the probability of gynecological pathologies, therefore gynecological anamnesis should be taken and gynecological examination should also be made.

***Research frontiers***

Evaluation of clinical and laboratory clues in the differential diagnosis of gynecological pathologies most likely confused with acute appendicitis in patients of reproductive age.

***Innovations and breakthroughs***

Although recent advances in medicine technology can be extremely helpful in differential diagnosis of acute abdomen, they must not replace a general surgeon's clinical judgment based upon a good anamnesis and physical examination.

***Peer review***

In this study the authors evaluate the acute right lower quadrant abdominal pain in women of reproductive age that continues to be a open problem in general surgery. This original article is very attractive and useful.

**REFERENCES**

1 **Powers RD**, Guertler AT. Abdominal pain in the ED: stability and change over 20 years. *Am J Emerg Med* 1995; **13**: 301-303 [PMID: 7755822 DOI: 10.1016/0735-6757(95)90204-X]

2 **Nelson MJ**, Pesola GR. Left lower quadrant pain of unusual cause. *J Emerg Med* 2001; **20**: 241-245 [PMID: 11267811 DOI: 10.1016/S0736-4679(00)00316-4]

3 **Flum DR**, Koepsell TD. Evaluating diagnostic accuracy in appendicitis using administrative data. *J Surg Res* 2005; **123**: 257-261 [PMID: 15680387 DOI: 10.1016/j.jss.2004.08.020]

4 **Pegoli W**. Acute appendicitis. In: Cameron JL (ed). Current surgical therapy. 6th Edition. St Louis: Mospy, 1998: 263-266

5 **Nakhgevany KB**, Clarke LE. Acute appendicitis in women of childbearing age. *Arch Surg* 1986; **121**: 1053-1055 [PMID: 3741100 DOI: 10.1001/archsurg.1986.01400090083014]

6 **Colson M**, Skinner KA, Dunnington G. High negative appendectomy rates are no longer acceptable. *Am J Surg* 1997; **174**: 723-76; discussion 723-76 [PMID: 9409605 DOI: 10.1016/S0002-9610(97)00183-9]

7 **Espinoza R**, Ohmke J, García-Huidobro I, Guzmán S, Azocar M. [Negative appendectomy: experience at a university hospital]. *Rev Med Chil* 1998; **126**: 75-80 [PMID: 9629757]

8 **Fingerhut A**, Yahchouchy-Chouillard E, Etienne JC, Ghiles E. [Appendicitis or non-specific pain in the right iliac fossa?]. *Rev Prat* 2001; **51**: 1654-1656 [PMID: 11759534]

9 **Kahrau S**, Foitzik T, Klinnert J, Buhr HJ. [Acute appendicitis. Analysis of surgical indications]. *Zentralbl Chir* 1998; **123** Suppl 4: 17-18 [PMID: 9880863]

10 **Khairy G**. Acute appendicitis: is removal of a normal appendix still existing and can we reduce its rate? *Saudi J Gastroenterol* 2009; **15**: 167-170 [PMID: 19636177 DOI: 10.4103/1319-3767.51367]

11 **Lau WY**, Fan ST, Yiu TF, Chu KW, Lee JM. Acute appendicitis in the elderly. *Surg Gynecol Obstet* 1985; **161**: 157-160 [PMID: 4023896]

12 **Horattas MC**, Guyton DP, Wu D. A reappraisal of appendicitis in the elderly. *Am J Surg* 1990; **160**: 291-293 [PMID: 2393058 DOI: 10.1016/S0002-9610(06)80026-7]

13 **Eldrup-Jorgensen J**, Hawkins RE, Bredenberg CE. Abdominal vascular catastrophes. *Surg Clin North Am* 1997; **77**: 1305-1320 [PMID: 9431341 DOI: 10.1016/S0039-6109(05)70619-8]

14 **Shelton T**, McKinlay R, Schwartz RW. Acute appendicitis: current diagnosis and treatment. *Curr Surg* 2003; **60**: 502-505 [PMID: 14972214 DOI: 10.1016/S0149-7944(03)00131-4]

15 **Cueto J**, Díaz O, Garteiz D, Rodríguez M, Weber A. The efficacy of laparoscopic surgery in the diagnosis and treatment of peritonitis. Experience with 107 cases in Mexico City. *Surg Endosc* 1997; **11**: 366-370 [PMID: 9094279 DOI: 10.1007/s004649900365]

16 **Diethelm AG**, Standley RJ. Robbin ML. Texbook of Surgery. 15th ed. Philadelphia: W.B. Saunders, 1997: 825-846

17 **Howell JM**, Eddy OL, Lukens TW, Thiessen ME, Weingart SD, Decker WW. Clinical policy: Critical issues in the evaluation and management of emergency department patients with suspected appendicitis. *Ann Emerg Med* 2010; **55**: 71-116 [PMID: 20116016 DOI: 10.1016/j.annemergmed.2009.10.004]

18 **Ebell MH**. Diagnosis of appendicitis: part 1. History and physical examination. *Am Fam Physician* 2008; **77**: 828-830 [PMID: 18386599]

19 **Humes DJ**, Simpson J. Acute appendicitis. *BMJ* 2006; **333**: 530-534 [PMID: 16960208 DOI: 10.1136/bmj.38940.664363.AE]

20 **Old JL**, Dusing RW, Yap W, Dirks J. Imaging for suspected appendicitis. *Am Fam Physician* 2005; **71**: 71-78 [PMID: 15663029]

21 **Wray CJ**, Kao LS, Millas SG, Tsao K, Ko TC. Acute appendicitis: controversies in diagnosis and management. *Curr Probl Surg* 2013; **50**: 54-86 [PMID: 23374326 DOI: 10.1067/j.cpsurg.2012.10.001]

22 **Ma KW**, Chia NH, Yeung HW, Cheung MT. If not appendicitis, then what else can it be? A retrospective review of 1492 appendectomies. *Hong Kong Med J* 2010; **16**: 12-17 [PMID: 20124568]

23 **Solomkin JS**, Mazuski JE, Bradley JS, Rodvold KA, Goldstein EJ, Baron EJ, O'Neill PJ, Chow AW, Dellinger EP, Eachempati SR, Gorbach S, Hilfiker M, May AK, Nathens AB, Sawyer RG, Bartlett JG. Diagnosis and management of complicated intra-abdominal infection in adults and children: guidelines by the Surgical Infection Society and the Infectious Diseases Society of America. *Surg Infect* (Larchmt) 2010; **11**: 79-109 [PMID: 20163262 DOI: 10.1089/sur.2009.9930]

24 **Andersson RE**, Hugander A, Ravn H, Offenbartl K, Ghazi SH, Nyström PO, Olaison G. Repeated clinical and laboratory examinations in patients with an equivocal diagnosis of appendicitis. *World J Surg* 2000; **24**: 479-85; discussion 485 [PMID: 10706923 DOI: 10.1007/s002689910076]

25 **Walker AR**, Segal I. What causes appendicitis? *J Clin Gastroenterol* 1990; **12**: 127-129 [PMID: 2157745 DOI: 10.1097/00004836-199004000-00002]

26 **Paulson EK**, Kalady MF, Pappas TN. Clinical practice. Suspected appendicitis. *N Engl J Med* 2003; **348**: 236-242 [PMID: 12529465 DOI: 10.1056/NEJMcp013351]

27 **Flum DR**, Koepsell T. The clinical and economic correlates of misdiagnosed appendicitis: nationwide analysis. *Arch Surg* 2002; **137**: 799-804; discussion 804 [PMID: 12093335 DOI: 10.1001/archsurg.137.7.799]

28 **Hardin DM**. Acute appendicitis: review and update. *Am Fam Physician* 1999; **60**: 2027-2034 [PMID: 10569505]

29 **Hoffman D**. Aids in the diagnosis of acute appendicitis. *Br J Surg* 1989; **74**: 774-779 [DOI: 10.1002/bjs.1800760803]

30 **Singhal V**, Jadhav V. Acute appendicitis: are we over diagnosing it? *Ann R Coll Surg Engl* 2007; **89**: 766-769 [PMID: 17999817 DOI: 10.1308/003588407X209266]

31 **Kamin RA**, Nowicki TA, Courtney DS, Powers RD. Pearls and pitfalls in the emergency department evaluation of abdominal pain. *Emerg Med Clin North Am* 2003; **21**: 61-72, vi [PMID: 12630731 DOI: 10.1016/S0733-8627(02)00080-9]

32 **LeMaire WJ**. Mechanism of mammalian ovulation. *Steroids* 1989; **54**: 455-469 [PMID: 2559497 DOI: 10.1016/0039-128X(89)90040-8]

33 **Evsen MS**, Soydinc HE. Emergent gynecological operations: A report of 105 cases. *J Clin Exp Invest* 2010; **1**: 12-15 [DOI: 10.5799/ahinjs.01.2010.01.0003]

34 **Nemoto Y**, Ishihara K, Sekiya T, Konishi H, Araki T. Ultrasonographic and clinical appearance of hemorrhagic ovarian cyst diagnosed by transvaginal scan. *J Nippon Med Sch* 2003; **70**: 243-249 [PMID: 12928726 DOI: 10.1272/jnms.70.243]

35 **CLAMAN AD**. Bleeding from the ovary: graafian follicle and corpus luteum. *Can Med Assoc J* 1957; **76**: 1036-1040 [PMID: 13437248 DOI: 10.1097/00006254-195806000-00050]

36 **Hoyt WF**, Meigs JV. Rupture of the graffian follicle and corpus luteum. *Surg Gynecol Obstet* 1963; **62**: 114-118

37 **Yoffe N**, Bronshtein M, Brandes J, Blumenfeld Z. Hemorrhagic ovarian cyst detection by transvaginal sonography: the great imitator. *Gynecol Endocrinol* 1991; **5**: 123-129 [PMID: 1927577 DOI: 10.3109/09513599109028435]

38 **Bass IS**, Haller JO, Friedman AP, Twersky J, Balsam D, Gottesman R. The sonographic appearance of the hemorrhagic ovarian cyst in adolescents. *J Ultrasound Med* 1984; **3**: 509-513 [PMID: 6392579]

39 **Rapkin AJ**. Pelvic pain and dismenorrea. In: Berek JS, Adashi EY, Hillard PA, editors: Novak’s gynecology, 13th ed. Pennsylvania, 2004: 399-403

40 **Burnett LS**. Gynecologic causes of the acute abdomen. *Surg Clin North Am* 1988; **68**: 385-398 [PMID: 3279553]

41 **Hibbard LT**. Adnexal torsion. *Am J Obstet Gynecol* 1985; **152**: 456-461 [PMID: 4014339 DOI: 10.1016/S0002-9378(85)80157-5]

42 **Nichols DH**, Julian PJ. Torsion of the adnexa. *Clin Obstet Gynecol* 1985; **28**: 375-380 [PMID: 4017325 DOI: 10.1097/00003081-198528020-00015]

43 **Mage G**, Canis M, Manhes H, Pouly JL, Bruhat MA. Laparoscopic management of adnexal torsion. A review of 35 cases. *J Reprod Med* 1989; **34**: 520-524 [PMID: 2530343]

44 **van der Zee DC**, van Seumeren IG, Bax KM, Rövekamp MH, ter Gunne AJ. Laparoscopic approach to surgical management of ovarian cysts in the newborn. *J Pediatr Surg* 1995; **30**: 42-43 [PMID: 7722827 DOI: 10.1016/0022-3468(95)90606-1]

45 **Tepper R**, Zalel Y, Goldberger S, Cohen I, Markov S, Beyth Y. Diagnostic value of transvaginal color Doppler flow in ovarian torsion. *Eur J Obstet Gynecol Reprod Biol* 1996; **68**: 115-118 [PMID: 8886692 DOI: 10.1016/0301-2115(96)02464-5]

46 **Davis LG**, Gerscovich EO, Anderson MW, Stading R. Ultrasound and Doppler in the diagnosis of ovarian torsion. *Eur J Radiol* 1995; **20**: 133-136 [PMID: 7588868 DOI: 10.1016/0720-048X(95)00640-C]

47 **Kurzbart E**, Mares AJ, Cohen Z, Mordehai J, Finaly R. Isolated torsion of the fallopian tube in premenarcheal girls. *J Pediatr Surg* 1994; **29**: 1384-1385 [PMID: 7807331 DOI: 10.1016/0022-3468(94)90121-X]

48 **Stenchever M**, Droegemueller W, Herbst A, Mishell D. Benign gynecologic lesions. In: Comprehensive gynecology, 4th edn. St. Louis, MO: Mosby Publishing Company, 2001: 519-520

49 **Cohen SB**, Oelsner G, Seidman DS, Admon D, Mashiach S, Goldenberg M. Laparoscopic detorsion allows sparing of the twisted ischemic adnexa. *J Am Assoc Gynecol Laparosc* 1999; **6**: 139-143 [PMID: 10226121 DOI: 10.1016/S1074-3804(99)80091-7]

50 **Balthazar EJ**, Birnbaum BA, Yee J, Megibow AJ, Roshkow J, Gray C. Acute appendicitis: CT and US correlation in 100 patients. *Radiology* 1994; **190**: 31-35 [PMID: 8259423]

51 **Dueholm S**, Bagi P, Bud M. Laboratory aid in the diagnosis of acute appendicitis. A blinded, prospective trial concerning diagnostic value of leukocyte count, neutrophil differential count, and C-reactive protein. *Dis Colon Rectum* 1989; **32**: 855-859 [PMID: 2676422 DOI: 10.1007/BF02554555]

52 **Lau WY**, Fan ST, Yiu TF, Chu KW, Wong SH. Negative findings at appendectomy. *Am J Surg* 1984; **148**: 375-378 [PMID: 6476229 DOI: 10.1016/0002-9610(84)90475-6]

53 **Jaffe BM**, Berger DH. Appendics. In: Brunicardi FC. Schwartz's Principles of Surgery. 8th edition. New York: Mc Graw-hill, 2004: 1119-1139

54 **Yang HR**, Wang YC, Chung PK, Chen WK, Jeng LB, Chen RJ. Laboratory tests in patients with acute appendicitis. *ANZ J Surg* 2006; **76**: 71-74 [PMID: 16483301 DOI: 10.1111/j.1445-2197.2006.03645.x]

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**Table 1** **Demographic data of the patients**

|  |  |  |
| --- | --- | --- |
|  | **Patients** (*n* = 290), *n* (%) | **Age (yr)** |
| **Acute appendicitis** | 224 (77.2) | 21 (12-44) |
| **Perforated appendicitis** | 29 (10) | 22 (14-42) |
| **Ovarian cyst rupture** | 21 (7.2) | 24 (15-38) |
| **Corpus hemorrhagicum cyst rupture** | 12 (4.2) | 21 (13-35) |
| **Adnexal torsion** | 4 (1.4) | 24 (19-30) |

Data in the parentheses for patients represents percent of total number, whereas that for age indicates range.

**Table 2** **Treatment procedures of patients with gynecological organ pathologies *n* (%)**

|  |  |  |  |
| --- | --- | --- | --- |
|  | **Ovarian cyst rupture** | **Corpus hemorrhagicum cyst rupture** | **Adnexal torsion** |
| **Cauterization** | 16 (76.2) | 6 (50) | 0 |
| **Primary suturation** | 4 (19) | 2 (16.7) | 0 |
| **Cyst excision** | 1 (4.8) | 4 (43.3) | 0 |
| **Detortion + oophoropexy** | 0 | 0 | 3 (75) |
| **Oophorectomy + salpingectomy** | 0 | 0 | 1 (25) |

**Figure 1 Clinical and laboratory data of the patients.** Hyperpyrexia indicates body temperature ≥ 37.8 oC. Leukocytosis indicates leukocyte count > 9.000 mm3. Defense, rovsing’s sign, hyperpyrexia and leukocytosis were different in groups with acute and perforated appendicitis; and the differences were statistically significant (*P* < 0.05).