Review article

Acute Appendicitis: From Pediatrics to Geriatrics

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Abstract

Acute appendicitis is one of the most frequent surgical emergencies. However, its clinical presentation can vary significantly across patient populations. This review summarizes the clinical presentation of acute appendicitis in children, adults, pregnant women, and older adults. While classic symptoms such as abdominal pain that migrates to the right lower quadrant, anorexia, nausea and vomiting are well recognised in the general adult population, they are often absent or altered in children, pregnant women and older adults. In children, symptoms may be nonspecific and and resemble a viral infection, and difficulties in describing pain often contribue to delayd diagnosis and increased risk of perforation. In pregnancy, anatomical displacement of abdominal organs reduce the accuracy of physical examination, complicating decision-making. Older adults commonly present with poorly defined abdominal discomfort, minimal tenderness and reduced inflammatory response due to comorbidities and age-related immune dysfunction, resulting in increased complications and mortality rates. Awareness of these population-specific differences and careful clinical evaluation are essential to prevent diagnostic delays and improve outcomes.

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Introduction

Acute appendicits is one of the most common causes of acute abdominal pain requiring surgery. Its annual incidence ranges from 6 to 50 cases per 100,000 people, with the highest rates in young adults aged 20-30 years (1). Despite advances in imaging and laboratory diagnostics, diagnosis remains challenging because no single clinical, laboratory, or radiological finding is definitive for all patients (2). Historically, appendicits was diagnosed almost entirely on the basis of clinical assessment, although modern practice now incorporates imaging and laboratory investigations (1). The classical presentation with periumbilical pain that migrates to the right lower quadrant with anorexia, nausea, and vomiting, is well known, but may be absent or atypical even in young, otherwise healthy individuals (3,4). For this reason, acute appendicitis is often referred to as the „chameleon of surgery" (5).

Atypical or nonspecific presentations are even more common in children, pregnant woman, and older adults, increasing the risk of delayed diagnosis, missed presentations, and subsequent complications (6–8). In children, symptoms can be unclear and may look like a viral infection, and difficulties in describing pain often contribue to diagnostic delay and a higher likehood of perforation (9,10). In pregnancy, physiological and anatomical displacement of abdominal organs reduces the accuracy of physical examination and can mask typical signs, complicating decision-making (11). Older adults frequently present with poorly deined abdominal discomfort, minimal tendernes, and a blunted inflammatory response due to comoridities and age-related immune dysfunction, resulting in higher rates of complications and mortality (2,12).

These age-specific variations underscore the importance of a tailored clinical assessment. The aim of this review is to summarise the clinical presentation of acute appendicits across these specific patient populations and outline features that may improve early recognition and clinical decision-making.

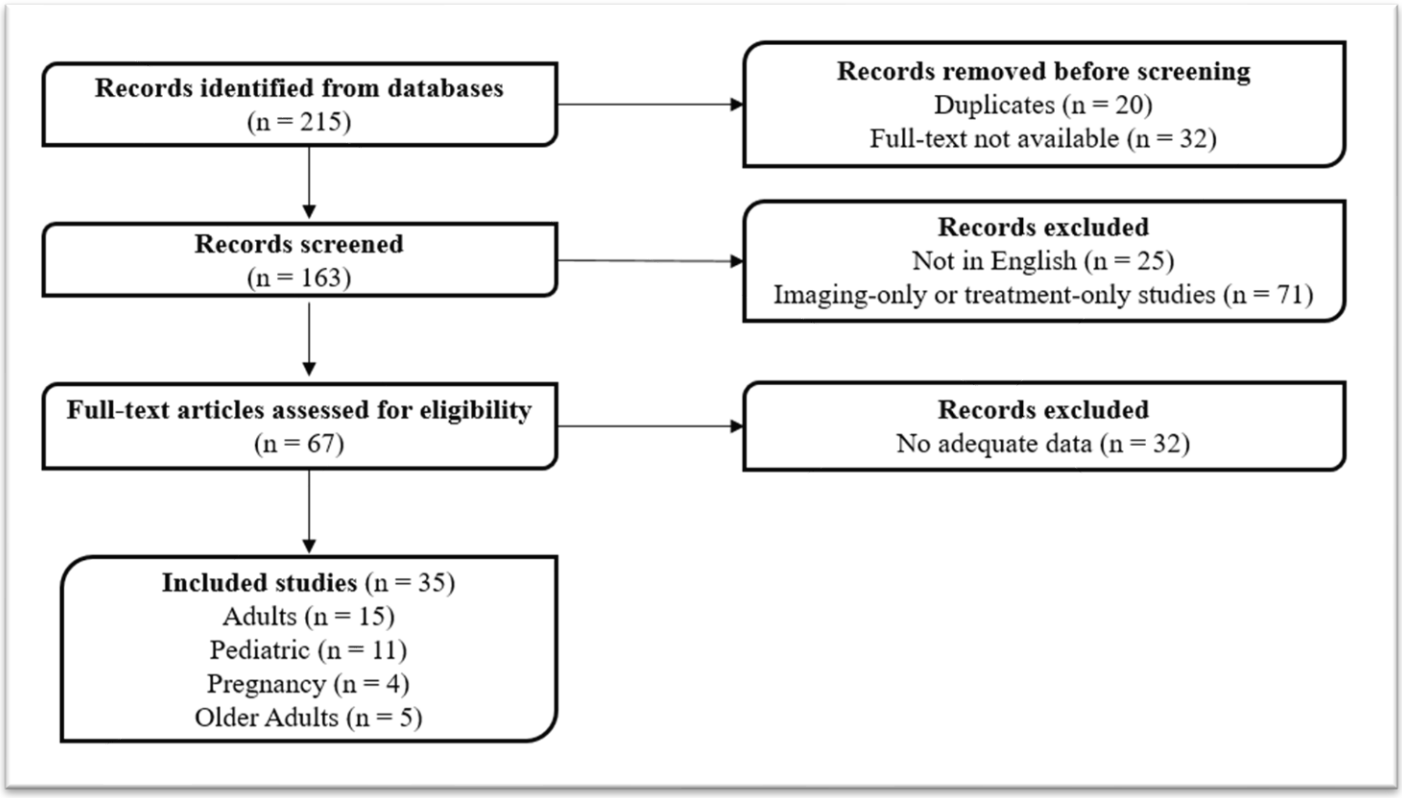

Figure 1. Flowchart of the study selection process

Material and Methods

This rewiev is based on a structured literature search performed in PubMed, Scopus, and Web of Science, with the keywords acute appendicitis, clinical presentation, symptoms, adult, adulthood, pediatric, neonates, childhood, children, adolescente, pregnancy, older adults and elderly. UpToDate was additionally consulted to ensure inclusion of recent clinical insights and guideline-based information. Priority was given to studies published in the last 10-15 years. Articles not available in English, those focused solely on imaging or treatment, studies without full-text access, and those lacking sufficient information on presenting symptoms were excluded. Of the 215 studies retrieved, 35 remained after applying the exclusion criteria. The scheme of the selection process is shown in Figure 1.

Table 1. Clinical presentation of acute appendicits in adults, pregnant woman, and older adults

Symptoms / clinical feature	Adults*	Pregnant women	Older adults‡
Right iliac fossa pain	> 90 %	75 % / RUQ 20 %	60.6 %
Pain migration (periumbilical → RLQ)	50-60 %	29–53 %	30.3–45.1 %
Nausea	80-90 %	85 %	45.5–68.3 %
Vomiting	75 %	70 %	
Anorexia	90 %	65 %	57.6–67 %
Fever	30 %	20 %	20 %
Peritoneal signs (distension, guarding)	13 %	50 %	35 %
Perforation	20 %	55 %	70 %
Reference	(21-31)	(13–16)	(8,17–20)

*Adults: ≥18 years; ‡Older adults: threshold vary across studies (commonly ≥65 years)
Abbreviations: RLQ = right lower quadrant; RUQ = right upper quadrant; Note: reference numbers in parentheses refer to all data within the each column.

Table 2. Clinical presentation of acute appendicits in chidren

Symptoms / clinical feature	Neonates (0-30 days)	Young children (<5 years)	School-age (5-12 years)	Adolescent
Abdominal distension	50-75 %	35 %		similar to those in adults
Diffuse abdominal tenderness	9-38 %	56 %		
Abdominal wall celulitis	4-24 %			
Abdominal mass	3-12 %			
Right iliac fossa pain		38 %	82 %	
Nausea			79 %	
Vomiting	up to 40 % (may be bilious)	88-83 %	66 %	
Anorexia	up to 40 %	42-74 %	75 %	
Fever	28 %	62-90 %	47 %	
Peritoneal signs (guarding)		62-72 %		
Diarrhea	haematochezia in 10 %	32-46 %	16 %	
Sepsis	38 %			
Respiratory distress	15 %			
Difficulty walking			82 %	
Pain with hopping, or coughing			79 %	
Perforation	50-85 %	51-100 %	11-32 %	
Reference	(32–36)	(37–40)	(41,42)	

Abbreviations: RLQ = right lower quadrant.
Note: reference numbers in parentheses refer to all data within the each column.

Clinical Presentation of Acute Appendicitis

Clinical presentation of acute appendicitis varies considerably across different patients groups. These variations are summarised in Table 1 and Table 2.

Adults

In adults (≥ 18 years), the presentation is typically the most classic and recognisable. Right lower quadrant pain is usually well localised. Although the migration of pain from the periumbilical region to the right lower quadrant occurs in only 50-60 % of patients, it is observed more often in adults than in other groups (21,24). Nauesa and vomiting, when present, usually occur after the onset of pain (25). Fever-related symptoms tend to apear later in the course of the disease. Low-grade fever is common, while temperature above 38°C should raise suspicion of perforation, particularly when accompained by abnormal vital signs or clinical signs of systemic illnes (43). Because symptoms in adults are generally more characteristic and easier to interpret, diagnosis is often made earlier and complication rates are lower.

However, the clinical picture can still vary considerably depending on the position of the appendiceal tip (44). Although the appendix is consistently attached to the cecal base, its tip may extend in several directions – most commonly retrocecal (60 %) but also subcecal, preileal, postileal or pelvic (23). A retrocecal appendix, may cause back or flank pain, or even right upper quadrant discomfort due to psoas irritation. This also explains why patients may experience relief when lying on their right side with the hip slightly flexed, as this position reduces psoas tension. In contrast, a pelvic appendix can manifest with urinary frequency, pelvic pressure, or tenesmus (45).

In addition to anatomical variations, several physical examination signs have been described to aid clinical assessment (Table 3). Most of these signs were developed before modern imaging became widely available, and studies demonstrate substantial variability in sensitivitiy and specificity. As such, they should be interpreted with caution, as no single sign, nor any combination, realiably confirms appendcitis, and their absence does not exclude the diagnosis. When present in children aged 3-12 years, however, these signs demonstrate high specificity for appendicitis, ranging from 86 to 98 % depending on age (42,46).

Table 3. Physical examination signs associated with acute appendicitis

Sign	Description	Related anatomy/ appendix position	Sensitivity (%)	Specificitiy (%)	Reference
McBurney's	Maximal tenderness located 1/3 of the distance from the umbilicus to the anterior superior iliac spine	Typical anteromedial appendix position	50-94	75-86	(31,47,48)
Blumberg (rebound tenderness)	Pain upon sudden release of deep palpitation of the RLQ	Peritoneal irritation	81	49	(29,39)
Rovsing's	Palpitation of the LLQ produces pain in the RLQ	Peritoneal irritation	22-68	58-96	(29,31,49)
Obturator	Pain in the RLQ during flexion and internal rotatoin of the right hip	Pelvic appendix, irritatin of the internal obturator muscle	8	94	(27)
Psoas	RLQ pain during passive etension of the right hip	Retrocecal appendix, irritation of the psoas major muscle	13-42	79-97	(26,27,49)

Abbreviations: LLQ = left lower quadrant; RLQ = right lower quadrant

Population-Specific Clinical Presentation of Acute Appendicitis

Children

Appendicitis accounts for 1-8 % of pediatric cases presenting with acute abdominal pain with incidence increasing steadily from early chilhood into adolescence (50). This age-related rise is partialy explaned by developmental factors that influence disease behaviour. In infancy, the appendix has a funnel-shaped lumen that makes obstruction less likely whereas prominent lymphoid tissue in later childhood enlarges and peaks during adolescence, predisposing to luminal obstruction and contributing to the higher incidence in older children (42). Although the appendix in children is most often located in a retrocecal position, its anatomical location is more variable than in adults (45). Congenital abdormalities of intestinal rotation or positioning, such as malrotation or situs inversus totalis, and postoperative changes after repair of congenital diaphragmatic hernia, gastroschisis, or omphalocele may displace the appendix to the upper abdomen or even ot the left side, further complicating assessment (51,52).

As summarized in Table 2, classic symptoms are less common in children than adults. In neonates, appendicitis is exeptionally rare, and when it does occur, the clinical presentation is highly atypical. Abdominal distension is one of the most prominent feature, while localisation of pain is generally absent. Haematochezia may reflect appendeceal necrotizing enterocolitis, and some infants may present with sepsis or respiratory distress (32,36). Because appendicitis is uncommon in this age group, its diagnosis should prompt careful evaluation for alternative or underlying conditions, including Hirschsprung disease.

In young children (<5 years), appendicitis may present with abdominal pain, vomiting, diarrhea, or even right hip discomfort. Localised right iliac fossa pain is still uncomon, and diffuse abdominal tenderness is more typical. Many affected children lie still with hips flexed and remain comfortable if not disturbed, while peritoneal iritation reduces normal movement of the abdominal wall during breathing (42). Diarrhea further complicates differentiation from gastroenteritis. In appendicitis, stools tends to be low-volume, frequent, and mucinoid due to rectal irritation, while gastroenteritis typically causes larger, foul-smelling stools (37,40). Although appendicitis is rare in this age group, when it does occur it is often already advanced, with peroforation reported in over half to nearly all cases (38,39). This is largely attribbuted to nonspecific early symptoms and an immature omentum that allows rapid progression to generalised peritonitis. Younger children often struggle to describe the character or location of their pain, resulting in a vague and sometimes misleading clinical picture. Clinical examination may be further complicated by anxiety, tearfulness, or limited cooperation.

School-aged children (5-12 years) more often show a typical presentation of appendicitis. Localised right lower quadrant pain becomes more reliable, and symptoms such as anorexia, vomiting, and fever follow a more expected pattern. Diarrhea is less common, making differentiation from gastroenteritis easier than in younger children. Functional signs, such as difficulty walking or pain provoked by coughing or hopping, are more evident and clinically helpful indicators of peritoneal irritation (42,46). Because communication is clearer and symptoms are more recognisable, diagnosis tends to occur earlier and disease is less advanced at presentation compared with younger children.

Adolescents typically display a presentation that is very similar to adults, with periumbilical pain that migrates to the right lower quadrant, anorexia and vimiting. In perimenarchial girls, menstrual and sexual history is important to help distinguish gynecological causes of abdominal pain. Common conditions that can mimic appendictis in this age roup include mittelschmerz, ovarian cysts or torsion, ectopic pregnancy, and pelvic inflammatory disease.

Pregnancy

Acute apendicitis is relatively uncommon in pregnancy, occuring in one out of 800-1500, and

is most often diagnosed during the second trimester (53,54).

Clinical evaluation is frequently challenging because many pregnancy-related simptoms, such as abdominal pain, nausea and vomiting, closely resamble those o appendicitis. In most pregnant patients, right lower quadrant pain remains the predominant complaint. Although, earlier studies suggested that the appendix progressively shifts upward with advancing gestation, potentially reaching the right hypochondrium by the end of the third trimester, more recent evidence indicates that this displacement is minimal or absent (11,55,56).

Classic physical findings tend to be less evident, especially in later pregnancy. Abdominal tenderness may be less pronounced because the growing uterus elevates the abdominal wall away from the inflamed appendix, reducing peritoneal irritation (57). Consequently, rebound tenderness and guarding are frequently disminished, and the omentum is less effective at localizing inflammation.

Pregnant patients may also report heartburn, bloating, bowel irregularities, flatulance, or nonspecific abdominal discomfort (13). Additionaly, urinary symptoms may occur when the appendix is positioned near the bladder. Dysuria is reported in approximately 8 % of cases, while hematuria or pyuria appear in < 20 % (15,58).

Taken together, these factors contribue to delayed diagnosis, which is clinically important, as pregnant patients tend to present with more advanced disease than non-pregnant adults. Once perforation occurs, maternal morbiditiy increase substantially and fetal outcomes worsen considerably, with the risk of fetal loss reaching around 36 % (7,16).

Older Adults

With increasing life expectancy and a growing proportion of older adults in the general population, the number of appendicits cases diagnosed in this age group is also rising (59). In literature, this population is variably described as „older adults" or „eldery", although the age thresholds differ across studies. While ≥ 65 years is traditionally used as the chronological cutoff, recent evidence suggests that this definition may not accurately reflect the functional status of today's aging population. Research incorporating measures of physical activity, functional independence, and markers of vascular aging indicates that a treshold of ≥ 75 years may be more appropriate (60). Because the studies on appendicitis apply a wide range of age cutoffs, from 60 to 80 years, the term „older adults" will be used throught this rewiev, in accordance with the definitions adopted in the included studies (8,59–63).

Earlier studies reported that more than half o folder adults presenting to the emergency department with abdominal pain required hospitalisation, and 30-40 % ultimately underwent surgery for the underlying pathology (61). Although appenditicits is not condisedered a typical abdominal emergency in older patients, it should not be regarded as rare (62,63). Among older adults presenting with acute abdominal pain, 15-27 % are diagnosed with appendicitis (62,64), making it one of the most common urgent surgical conditions in this population, with its occurrence continuing to rise (8).

Despiteits its clinical importance, older adults remain understudied and are frequently misdiagnosed. They experience a more severe disease course and a significantly higher rate of complications and diagnostic errors in this population likely carry more serious consequences. Complicated appendicits occurs in more than half of cases, and perforation may already be present in up to 70 % at the time of diagnosis (20,65).

Some authors suggest that appendicitis appears „atypical" in older adults because these patients frequently present later in the disease course (8). While delayed presentation certainly contribues to a different clinical picture, early symptoms may also be genuinely muted due to age-related physiological and immunological changes, meaning that the presentation can deviate from the classical pattern even before complications develope. Reduced inflammatory reactivitiy, altered sensory perception, and coeistence of chronic conditions such as diabetes mellitus or cardiovascular disease, together with cognitive imparement, may mask

early symptoms and further delay recognition of abdominal pathology (21,66).

While abdominal pain is almost universally reported in the general adult population, its prevalece decreasses markedly in older adults (Table 1). This partly reflects age-related attenation of pain percepcion – studies show reduced spinal afferent nerve signaling in older individuals with abdominal pain, and experimental data suggest decreased transmission of inflammatory signals (12). As a result, instead of reporting a clearly localized pain patter, older adults often describe vague abdominal discomfort or present with non-specific features such as constipation, urinary simptoms, lethargy, or even confusion and delirium.

In addition to muted early symptoms, older adults tend to exibit more pronounced signs of acute abdominal disease and peritonitis, likely reflcting the high rate of perforations at presentation (8). Fever is also commonly absent, owing to a blunted temeprature response driven by impared theromoregulation, a lower baseline body temperature, and reduced sensitivity to inflammatory mediators (19).

Limitations

Research focusing specifically on clinical presentation in acute appendicitis remains limited. Existing studies predominantly focus on imaging strategies, laboratory biomarkers, risk-score models and treatmen outcomes, while symptom patterns themselves remain comparatively unerstudied. In addition, the available evidence is heterogeneus, with considerable variation in study design, definitions of patient subgrups, and diagnostic criteria. This gap reduces the strenght and generalisability of conclusions that can be drawn from the current literature.

Conclusion

The clinical presentation of acute appendicitis varies substantially across different patient populations, reflecting age-related anatomical, physiological, and immunological differences. Given the serious complications and increased healthcare burden associated with misdiagnosis, there is a clear need for a more systematic and integrated diagnostic approach, as well as enhanced clinitian awareness of the varying clinical presentation across patient subpopulations.

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Akutni apendicitis: od pedijatrije do gerijatrije

Sažetak

Akutna upala crvuljka (apendicitis) jedna je od najčešćih hitnih kirurških stanja, no klinička slika može značajno varirati među različitim skupinama bolesnika. Ovaj pregledni rad prikazuje kliničku sliku akutne upale crvuljka u djece, odraslih, trudnica i starijih osoba. Iako su klasični simptomi poput boli u trbuhu koja se premješta u donji desni kvadrant, gubitak apetita te mučnina i povraćanje dobro prepoznati u općoj odrasloj populaciji, u djece, trudnica i starijih bolesnika oni su često odsutni ili izmijenjeni. U djece klinička slika može biti nespecifična i nalikovati virusnoj infekciji, a teškoće u lokaliziranju i opisivanju boli često dovode do odgode dijagnoze i povećanog rizika od perforacije. U trudnoći fiziološke i anatomske promjene, uključujući pomak trbušnih organa, smanjuju pouzdanost fizikalnog pregleda. Stariji bolesnici često imaju nejasne simptome i smanjeni upalni odgovor zbog komorbiditeta i slabljenja imunološke funkcije, što rezultira većim rizikom komplikacija. Svijest o razlikama u kliničkoj slici unutar ovih populacija, može poboljšati dijagnostičku točnost i pravovremeno prepoznavanje bolesti.

Ključne riječI: apendicitis, dijagnoza, dijete, trudnoća, starije osobe