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ACUTE APPENDICITIS MANAGEMENT: HISTORICAL INSIGHTS, MODERN APPROACHES, AND FUTURE PERSPECTIVES

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ABSTRACT

Objectives: This narrative review aims to summarize the historical evolution, current manage-ment strategies, and emerging future directions in the treatment of acute appendicitis, emphasiz-ing the transition from historically fatal disease to modern, evidence-based care.
Methods: A thorough review of the literature was conducted, summarizing historical medical texts, surgical publications, and recent clinical guidelines. Emphasis was placed on the evolu-tion of surgical techniques, antibiotic therapy, and non-operative management strategies, as well as recent innovations in minimally invasive and personalized care.
Key Findings: Acute appendicitis represents a heterogeneous disease spectrum requiring indi-vidualized management. While open appendectomy historically served as the gold standard, laparoscopic appendectomy is now the first-line operative approach in most cases. Non-operative management with antibiotics is a viable option in carefully selected patients with un-complicated disease, although recurrence and treatment failure remain concerns. Management of complicated appendicitis continues to rely on timely source control, with selective use of con-servative and interventional strategies. Emerging trends include ambulatory surgery, personal-ized treatment algorithms, and experimental endoscopic approaches.
Conclusions: Advances in surgical technique, antimicrobial therapy, and perioperative care have dramatically reduced appendicitis-related morbidity and mortality. Contemporary man-agement emphasizes patient selection, minimally invasive surgery, and value-based care. Future progress will depend on high-quality evidence supporting personalized and resource-efficient treatment pathways.

KEYWORDS

Acute Appendicitis, Appendectomy, Laparoscopic Surgery, Non-Operative Management

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1. Introduction

Acute appendicitis is one of the most frequent causes of acute abdominal pain and a leading indication for emergency surgery worldwide. It affects approximately 8% of the population over a lifetime, with the highest incidence occurring between the ages of 10 and 30 (Switzer et al., 2012). In 2021, the global age-standarized incidence rate of acute appendicitis was estimated at 214 per 100 000 persons per year, corresponding to about 17 million new cases per year (Han et al., 2024). Despite its common presentation, acute appendicitis represents a heterogeneous clinical spectrum ranging from mild, self-limiting inflammation to severe perforation associated with peritonitis and sepsis (Selvaggi et al., 2025). The condition can result from luminal obstruction of the appendix - for instance - due to a fecalith (appendicolith), although recent data show that fecaliths are found in only about 20–25% of adult appendicitis specimens, suggesting that alternative pathogenic mechanisms must play a role (Tran et al., 2021). These mechanisms are thought to include primary mucosal inflammation, dysbiosis-driven bacterial overgrowth, and immune-mediated processes (Tran et al., 2021).

Clinically, acute appendicitis typically begins with vague, poorly localized periumbilical or epigastric abdominal pain, reflecting visceral peritoneal irritation (Rosenthal & Sarosi, 2024). Patients may experience pain that awakens them from sleep or intensifies when walking or coughing (Rosenthal & Sarosi, 2024).Within hours, the pain migrates to the right lower quadrant as the parietal peritoneum becomes inflamed. This pain is typically accompanied by anorexia, nausea with or without vomiting, diarrhea, and urinary frequency or urgency. Low-grade fever and malaise may also occur as systemic inflammation progresses (Rosenthal & Sarosi, 2024). However, up to one third of patients may present atypically, with absent pain migration, minimal fever, or predominant back, pelvic, or flank pain. Atypical presentation may occur especially in the elderly, pregnant patients, and those with retrocecal or pelvic appendices (Moris et al., 2021).

On physical examination, patients with acute appendicitis typically exhibit localized tenderness in the right lower quadrant, most commonly at McBurney's point, reflecting irritation of the parietal peritoneum as inflammation progresses (Moris et al., 2021). Rebound tenderness and voluntary or involuntary guarding may be present and indicate peritoneal involvement (Rosenthal & Sarosi, 2024). Rovsing's sign may also occur and consists of pain in the right lower quadrant elicited by palpation of the left lower quadrant. The psoas sign, characterized by increased pain during passive hip extension or active hip flexion, suggesting irritation of a retrocecal appendix. The obturator sign appears when internal rotation of the flexed hip produces pain due to contact with an inflamed pelvic appendix (Rosenthal & Sarosi, 2024).

In untreated or delayed cases of acute appendicitis, the disease may progress from simple inflammation to perforation, generalized peritonitis, sepsis, and ultimately death (Moris et al., 2021). Historically - before the advent of effective surgical techniques and antibiotics - mortality rates were high: early literature documented overall mortality as high as 26%, with operative mortality reaching up to 40% in some series (Selvaggi et al., 2025). Modern studies report that due to prompt diagnosis, proper treatment, and improved perioperative care mortality rates are drastically reduced, typically under 1% (Moeng et al., 2025).

The purpose of this review is to provide a comprehensive overview of the evolution of acute appendicitis management, tracing the transition from early, often fatal cases to modern, evidence-based strategies and future perspectives.

2. Methodology

This article is a narrative review of the literature addressing the historical development, current management strategies, and future perspectives in acute appendicitis. A targeted search of PubMed, MEDLINE, and Scopus was performed, supplemented by manual review of reference lists from key publications. Peer-reviewed articles in English, including clinical trials, reviews, guidelines, and historically significant surgical reports, were included. The literature was analyzed and synthesized thematically to integrate historical context with contemporary evidence and latest treatment paradigms.

3. Historical Insights

3.1. Historical Approaches to Acute Appendicitis Treatment

The earliest descriptions of abdominal disease possibly related to acute appendicitis can be traced back to antiquity, although the vermiform appendix itself was not yet anatomically recognized. Evidence from ancient Egypt - including references in canopic jars to intestinal conditions described as the "worm of the bowel" - has been interpreted by modern historians as potential early observations of appendiceal pathology (Selvaggi et al., 2025). During the Middle Ages, physicians in both the Islamic and European medical traditions described acute abdominal pain syndromes, though these were interpreted within the prevailing humoral framework as disorders of the intestines rather than inflammation of a distinct organ. Avicenna, for example, offered detailed accounts of sudden abdominal pain, attributing it to imbalances of humors, obstruction, or intestinal swelling, reflecting the conceptual limits of medieval pathology (Mazengenya & Bhikha, 2018). The dominance of Galenic doctrine, which emphasized functional disturbances of the humors over structural pathology, further impaired the recognition of discrete anatomical sources of disease, including the appendix (Balalykin, 2019). Moreover, strict restrictions on human dissection in medieval Europe prevented anatomical clarification, allowing right lower-quadrant inflammatory conditions to remain broadly categorized as intestinal diseases until the anatomical advancements of the Renaissance (Riva & Ceresoli, 2022).

3.2. Early Concepts of Appendicitis in the 18th–19th Century

Understanding of appendicitis evolved gradually during the 18th and 19th centuries. Early anatomists such as Berengario da Carpi and later Vesalius described the vermiform appendix but did not associate it with inflammatory disease (Herrod et al., 2023). Throughout the 1700s, physicians frequently misattributed right lower-quadrant pain to conditions of the caecum, termed "typhlitis" or "perityphlitis," as the pathological role of the appendix had not yet been recognized. A turning point came in 1886, when Reginald Fitz published a seminal paper identifying the appendix as the primary source of purulent inflammation in the right iliac fossa and advocating for early surgical intervention; this work formed the cornerstone of modern appendicitis management (Williams, 1983a).

3.3. Introduction of Appendectomy

The first documented appendectomy was performed by Claudius Amyand in 1735 during the surgical repair of an inguinal hernia that unexpectedly contained a perforated appendix, marking the earliest known instance of operative removal of the organ (Herrod et al., 2023). Despite this historically significant case, appendectomy did not gain recognition as a formal therapeutic procedure for more than a century. Throughout the early 19th century, cases of suspected appendiceal inflammation were still commonly treated conservatively or misattributed to caecal disease, and surgeons intervened only when abscesses formed, typically performing drainage rather than excision of the appendix (Williams, 1983).

A significant conceptual shift occurred after Fitz's landmark 1886 paper, which clearly identified the appendix as the primary cause of right iliac fossa inflammation and suggested early surgical removal to prevent perforation - laying the groundwork for routine appendectomy (Williams, 1983b). Shortly thereafter, surgeons such as Thomas G. Morton and Robert T. Morris began performing intentional appendectomies in acute cases, demonstrating improved outcomes compared with conservative management.

The adoption of appendectomy accelerated rapidly following Charles McBurney's 1889 description of the point of maximal tenderness and his development of the muscle-splitting right iliac fossa incision. McBurney's technique minimized postoperative complications, enhanced exposure of the appendix, and solidified the procedure as both safe and effective. By the early 20th century, appendectomy had become widely accepted as the standard, lifesaving intervention for acute appendicitis, replacing drainage and non-operative management as the primary therapeutic approach (Switzer et al., 2012).

3.4. Development of Open Appendectomy as the Gold Standard

During the early 20th century, open appendectomy emerged as the widely accepted standard treatment for patients with acute appendicitis. This transition was driven by major advances in surgical antisepsis, anesthesia, and perioperative care, which significantly reduced operative mortality and improved safety (Humes & Simpson, 2006; Williams, 1983a). By the 1930s, appendectomy had become one of the most frequently undertaken emergency abdominal procedures worldwide, reflecting its reputation as a reliable and lifesaving intervention (Williams, 1983a).

Technical refinements also solidified open appendectomy as the preferred approach. Improved right lower-quadrant incisions - such as the McBurney and later the Rocky-Davis incision - enhanced surgical exposure and decreased wound complications (Williams, 1983). Secure ligation techniques for the appendiceal stump, including purse-string sutures and later more standardized stump closure methods, significantly reduced postoperative stump leakage and intra-abdominal abscess formation (Andersson, 2007). Selective use of peritoneal drainage in cases of perforation or local abscess further contributed to improved outcomes in complicated appendicitis (Berry & Malt, 1984).

Open appendectomy clarity, reproducibility, and favorable safety profile entrenched it as the gold standard treatment for decades (Switzer et al., 2012).

3.5. Pre-Antibiotic Era vs. Post-Antibiotic Era

The introduction of antibiotics in the 1940s revolutionized outcomes for patients with appendicitis and marked one of the most transformative shifts in the history of abdominal surgery.

The advent of sulfonamides and, shortly thereafter, penicillin fundamentally altered the management of appendicitis. Antibiotics significantly reduced the incidence of postoperative infectious complications and allowed surgeons to perform earlier and more extensive operations in cases of complicated appendicitis (Berry & Malt, 1984; Humes & Simpson, 2006). Importantly, the combination of timely surgery and effective antimicrobial therapy shifted appendicitis from a condition with historically high fatality into one with predictable and favourable results (Berry & Malt, 1984). This dramatic decline underscores the combination of advances in surgical technique, supportive care, and antimicrobial therapy (Selvaggi et al., 2025).

4. Current approaches of acute appendicitis management

4.1. Laparoscopic Appendectomy (First-Line Operative Approach)

Laparoscopic appendectomy is widely regarded as the first-line operative approach for acute appendicitis (Di Saverio et al., 2020; Weledji et al., 2023). It is indicated in the majority of acute appendicitis cases, including uncomplicated disease and selected cases of complicated appendicitis in clinically stable patients (Di Saverio et al., 2020; Kumar et al., 2024). Relative contraindications include conditions limiting tolerance of pneumoperitoneum, such as severe cardiopulmonary disease, as well as lack of appropriate laparoscopic facilities or an experienced surgical team (Di Saverio et al., 2020). The main advantages of laparoscopic appendectomy include reduced postoperative pain, shorter hospital stay, and faster recovery when compared with open appendectomy (Katkhouda et al., 2005; Weledji et al., 2023).

Additionally, the minimally invasive approach is associated with a lower risk of surgical site infection and improved cosmetic outcomes (Nikolov et al., 2024).

Laparoscopic access is also associated with a lower incidence of incisional hernia compared with open techniques (Weledji et al., 2023). Furthermore, enhanced visualization of the abdominal cavity allows identification of alternative diagnoses and assessment of intra-abdominal pathology, which may influence intraoperative decision-making (Kumar et al., 2024). However, laparoscopic appendectomy requires higher technical expertise, specialized equipment, and greater organizational resources, which may limit its availability in some settings (Di Saverio et al., 2020). Procedural costs may be higher in certain healthcare systems, particularly when operative volume is low or resources are constrained (Poprom et al., 2025). Furthermore, outcomes are more operator-dependent, and some studies suggest a potential increased risk of postoperative intra-abdominal abscess formation in severe complicated appendicitis (Ali Khan et al., 2024; Di Saverio et al., 2020).

4.2. Open Appendectomy (Alternative Operative Approach)

Open appendectomy remains an important alternative operative approach in the management of acute appendicitis, particularly in settings where laparoscopic surgery is unavailable or contraindicated (Ali Khan et al., 2024; Di Saverio et al., 2020). It is also indicated when conversion from laparoscopy is required due to extensive inflammation, distorted anatomy, or technical difficulty (Kumar et al., 2024). There are no absolute method-specific contraindications to open appendectomy beyond general surgical and anesthetic risk considerations (Weledji et al., 2023)). The advantages of open appendectomy include its wide availability and lower equipment requirements, making it feasible in resource-limited environments (Weledji et al., 2023). In cases of advanced inflammatory changes, open surgery may provide predictable exposure and facilitate safe and rapid source control in experienced hands (Di Saverio et al., 2020). Short operative times can be achieved by surgeons proficient in open techniques, which may be advantageous in emergency settings (Weledji et al., 2023). However, open appendectomy is associated with increased postoperative pain compared with laparoscopic approaches (Nikolov et al., 2024). Hospital length of stay and time to functional recovery are typically longer following open surgery (Weledji et al., 2023). The risk of wound infection and incisional hernia is higher, and cosmetic outcomes are generally inferior compared with minimally invasive techniques (Nikolov et al., 2024).

4.3. Non-Operative Management with Antibiotics (Selected Uncomplicated Appendicitis)

Non-operative management with antibiotics has gained increasing acceptance as an alternative strategy for selected patients with imaging-confirmed uncomplicated acute appendicitis (De Almeida Leite et al., 2022). This approach is indicated in clinically stable patients without signs of generalized peritonitis and in settings where close clinical monitoring and prompt access to surgery are available (Kumar et al., 2024). Contraindications include perforation, abscess formation, generalized peritonitis, sepsis, or clinical deterioration, as these conditions require definitive surgical source control (Di Saverio et al., 2020). The presence of an appendicolith is often considered a relative contraindication due to its association with increased rates of treatment failure and recurrence (De Almeida Leite et al., 2022). Advantages of non-operative management include avoidance of anaesthesia and surgery, as well as elimination of procedure-related complications (De Almeida Leite et al., 2022; St Peter et al., 2025). Selected patients may experience faster short-term recovery and earlier return to normal activities compared with immediate surgery (De Almeida Leite et al., 2022; St Peter et al., 2025). Initial healthcare costs may be lower, although long-term cost-effectiveness depends on recurrence and rehospitalization rates (Sindhu et al., 2025). Importantly, non-operative management carries a clinically relevant risk of treatment failure during the index admission (St

Peter et al., 2025). Recurrence rates during follow-up remain significant, frequently necessitating delayed appendectomy or repeat hospitalization (De Almeida Leite et al., 2022). Furthermore, misclassification of complicated appendicitis as uncomplicated may delay definitive treatment and increase morbidity, underscoring the importance of careful patient selection (Di Saverio et al., 2020).

4.4. Management of Complicated Appendicitis

As mentioned, complicated appendicitis represents a heterogeneous clinical entity that includes perforation, abscess formation, phlegmon, and generalized peritonitis, requiring individualized management strategies (Di Saverio et al., 2020). Contemporary practice typically follows two main pathways: an operative pathway focused on urgent source control and a conservative or interventional pathway in selected stable patients (Kumar et al., 2024).

4.4.1 Operative Pathway (Urgent Source Control)

The operative pathway is indicated in patients with perforated appendicitis associated with generalized peritonitis, sepsis, or clinical deterioration (De Almeida Leite et al., 2022; Di Saverio et al., 2020). Failure of conservative management also constitutes a clear indication for operative intervention (Kumar et al., 2024). There are no absolute contraindications to urgent source control in these scenarios, although preoperative stabilization should be undertaken whenever feasible (Di Saverio et al., 2020). The primary advantage of operative management is immediate and definitive control of the infectious source, reducing the risk of ongoing septic progression (Di Saverio et al., 2020). Definitive appendectomy during the index admission eliminates the risk of recurrence related to the affected appendix (Weledji et al., 2023). Nevertheless, operative management of complicated appendicitis is associated with higher postoperative complication rates, prolonged antibiotic therapy, and longer hospital stays compared with uncomplicated cases (Di Saverio et al., 2020).

4.4.2 Conservative / Interventional Pathway (Antibiotics ± Image-Guided Drainage)

The conservative or interventional pathway is considered in clinically stable patients with localized appendiceal abscess or inflammatory (Di Saverio et al., 2020). This strategy is indicated when imaging confirms a drainable abscess and when broad-spectrum antibiotics and interventional radiology resources are available (Mansilla et al., 2024). Contraindications include generalized peritonitis, hemodynamic instability, uncontrolled sepsis, or lack of clinical improvement during observation (Di Saverio et al., 2020). An important advantage of this approach is avoidance of technically challenging surgery during the acute inflammatory phase, which may reduce iatrogenic injury (Mansilla et al., 2024). Percutaneous drainage can complement antibiotic therapy and improve outcomes in selected patients with appendiceal abscess (Mansilla et al., 2024). However, conservative management carries a risk of recurrence and frequently necessitates delayed or interval appendectomy (Table 1.) (Di Saverio et al., 2020).

Close follow-up and structured monitoring are essential to ensure timely escalation of treatment if clinical deterioration occurs (Kumar et al., 2024).

Table 1. Contemporary Approaches to Acute Appendicitis Management: Indications, Advantages, and Limitations

Management strategy	Main indications	Key advantages	Main limitations
Laparoscopic appendectomy	Majority of acute appendicitis cases; uncomplicated appendicitis; selected complicated cases in stable patients	Reduced postoperative pain; shorter hospital stay; faster recovery; lower surgical site infection rate; improved visualization; better cosmetic outcomes	Higher technical and organizational requirements; increased costs in some settings; operator-dependent outcomes; possible higher risk of intra-abdominal abscess in severe complicated cases
Open appendectomy	Lack of laparoscopic availability; conversion from laparoscopy; advanced inflammatory changes	Wide availability; lower equipment requirements; predictable technique in advanced inflammation; short operative time in experienced hands	Increased postoperative pain; longer hospitalization and recovery; higher wound infection rate; increased risk of incisional hernia; inferior cosmetic result
Non-operative management with antibiotics	Imaging-confirmed uncomplicated appendicitis; clinically stable patients; availability of close monitoring	Avoidance of surgery and anesthesia; no procedure-related complications; faster short-term recovery; potentially lower initial costs	Risk of treatment failure during index admission; significant recurrence risk; possible rehospitalization; risk of delayed surgery if misclassified
Operative pathway for complicated appendicitis	Perforation with generalized peritonitis; sepsis; clinical deterioration; failure of conservative treatment	Immediate source control; reduced risk of septic progression; definitive treatment	Higher postoperative complication rates; longer antibiotic therapy; prolonged hospitalization
Conservative/interventional pathway for complicated appendicitis	Appendiceal abscess or inflammatory mass in stable patients; availability of antibiotics and image-guided drainage	Avoidance of technically difficult surgery in acute phase; reduced risk of iatrogenic injury	Risk of recurrence; need for delayed appendectomy; requirement for close follow-up

5. Future Perspectives

5.1. Ambulatory Appendectomy and Accelerated Recovery Pathways

Ambulatory appendectomy represents a paradigm shift toward value-based surgical care, emphasizing early discharge, reduced hospital utilization, and maintenance of patient safety through standardized perioperative pathways (Kumar et al., 2024). Same-day discharge following laparoscopic appendectomy for uncomplicated acute appendicitis is already practiced in selected high-volume centers, particularly where enhanced recovery after surgery (ERAS) principles have been implemented (Halter et al., 2016; Kumar et al., 2024). This model relies on strict patient selection criteria, typically including hemodynamic stability, absence of significant comorbidities, uncomplicated disease, and adequate social support after discharge (Cidoncha-Secilla et al., 2024). The primary advantages of ambulatory appendectomy include a significant reduction in hospital length of stay, lower direct and indirect healthcare costs, and high levels of patient satisfaction when discharge criteria are rigorously applied (Cruz-Centeno et al., 2023). However, successful implementation of ambulatory appendectomy requires well-defined perioperative protocols, including standardized anaesthesia regimens, multimodal analgesia, early oral intake, and clear discharge criteria (Halter et al., 2016; Kumar et al., 2024). Equally important is the availability of reliable post-discharge follow-up mechanisms, such as structured telephone calls or telemedicine visits, to promptly identify complications and reduce unplanned readmissions (Cidoncha-Secilla et al., 2024; Cruz-Centeno et al., 2023). Concerns regarding postoperative complications occurring outside the hospital setting, variability in organizational readiness, and medicolegal responsibility continue to limit widespread adoption of ambulatory appendectomy pathways (Grigorian et al., 2021). Future expansion of ambulatory appendectomy is likely to depend on further prospective studies, broader dissemination of ERAS-based protocols, and integration of digital health tools to support safe outpatient recovery (Cruz-Centeno et al., 2023).

5.2. Endoscopic and Transluminal Appendiceal Interventions

Endoscopic and transluminal appendiceal interventions represent an emerging and experimental treatment frontier aimed at avoiding surgical appendectomy (Dhindsa et al., 2022). These technics aim to treat acute appendicitis by accessing the appendiceal lumen endoscopically - most commonly via colonoscopy - to achieve decompression, drainage, irrigation, and, in some approaches, stent placement without surgical appendectomy (Pata et al., 2023). Novel techniques such as endoscopic retrograde appendicitis therapy (ERAT) and hybrid transluminal approaches have been described in recent feasibility studies and narrative reviews (Dhindsa et al., 2022; Pata et al., 2023). The theoretical advantages of these techniques include minimal invasiveness, preservation of abdominal wall integrity, and potential avoidance of general anaesthesia (Pata et al., 2023). However, the current evidence base remains limited to small case series and observational studies, with a complete absence of randomized controlled trials demonstrating non-inferiority or superiority compared with laparoscopic appendectomy (Dhindsa et al., 2022; Kumar et al., 2024). Concerns persist regarding incomplete source control, missed perforation, and lack of standardized procedural protocols (Kumar et al., 2024). Furthermore, these interventions require advanced endoscopic expertise, dedicated equipment, and close multidisciplinary collaboration, which significantly limits scalability outside tertiary referral centres (Pata et al., 2023). As a result, endoscopic appendiceal interventions remain confined to highly specialized centers and are not recommended for routine clinical use (Kumar et al., 2024).

5.3. Robotic Appendectomy and Advanced Minimally Invasive Surgery

Robotic-assisted appendectomy represents an extension of minimally invasive surgery, that leverages enhanced three-dimensional visualization, wristed instruments, and improved surgeon ergonomics compared with conventional laparoscopy (Kumar et al., 2024). This approach is currently performed in selected institutions, primarily within established robotic surgery programs rather than as a standard treatment modality for acute appendicitis (Becker et al., 2023; Kumar et al., 2024). Potential advantages of robotic appendectomy include improved ergonomics for the operating surgeon, enhanced dexterity in confined spaces, and facilitation of complex dissection in patients with obesity, dense inflammatory changes, or challenging anatomy (Becker et al., 2023; Kumar et al., 2024). Robotic platforms may also provide technical advantages in complicated appendicitis, particularly when precise dissection near critical structures is required (Becker et al., 2023). Furthermore, proponents suggest that robotic systems may contribute to procedural standardization and improved training environments for minimally invasive surgery (Kumar et al., 2024). Despite these theoretical benefits, current comparative studies consistently demonstrate that clinical outcomes of robotic appendectomy—including complication rates, length of stay, and postoperative recovery—are largely comparable to those achieved with conventional laparoscopic appendectomy (Becker et al., 2023). Robotic appendectomy is associated with longer operative times, particularly during the docking phase, which may be clinically relevant in emergency surgical settings, and substantially higher procedural costs without clear patient-centered benefit (Kumar et al., 2024). From a health systems perspective, the absence of demonstrated patient-centered benefit over laparoscopy, combined with higher costs and longer operating room utilization, undermines the rationale for widespread adoption of robotic appendectomy in routine appendicitis care (Kumar et al., 2024). Future expansion of robotic appendectomy may depend on reductions in platform costs, improved emergency workflow integration, and evidence demonstrating clear advantages in selected high-risk or complex patient subgroups (Becker et al., 2023; Kumar et al., 2024). Until such evidence emerges, robotic appendectomy is likely to remain a niche application within broader robotic surgery programs rather than a routine component of appendicitis management (Morais et al., 2025).

5.4. Short-Course and Outpatient Antibiotic Protocols

Future treatment paradigms increasingly focus on reducing antibiotic exposure through shorter treatment courses and outpatient-based regimens when clinically appropriate (Kumar et al., 2024; Salö et al., 2025). Short-course antibiotic therapy is already incorporated into contemporary management of both uncomplicated and complicated appendicitis as part of antimicrobial stewardship initiatives (Salö et al., 2025). The main advantages of this strategy include reduced antibiotic-related adverse events, decreased selective pressure for antimicrobial resistance, and lower healthcare costs (Salö et al., 2025). Outpatient antibiotic protocols may further reduce hospital length of stay and improve patient convenience without compromising safety in carefully selected cases (Collaborative et al., 2022). (Kumar et al., 2024). However, outpatient management requires robust follow-up systems and rapid access to emergency surgical care in case of clinical deterioration (Salminen et al., 2018). These infrastructural and organizational requirements explain why outpatient antibiotic

treatment is not yet widely implemented across diverse healthcare systems (Collaborative et al., 2022). From a public health perspective, minimizing unnecessary antibiotic exposure is increasingly important given the global rise in antimicrobial resistance, which represents a major threat to the effectiveness of both medical and surgical treatments (Ajulo & Awosile, 2024). Prolonged or empiric broad-spectrum antibiotic use in appendicitis has been identified as a potential contributor to resistance development, particularly in healthcare systems with high antibiotic consumption rates (Salö et al., 2025).

5.5. Personalized Approach in Acute Appendicitis Treatment

Personalization of treatment in acute appendicitis should begin with structured stratification of patients into clinically relevant therapeutic groups, as outcomes vary more across patient subpopulations than by diagnosis alone (Di Saverio et al., 2020). Patients aged 65 years and older represent a distinct population in whom non-operative management is associated with fewer short-term complications but increased long-term mortality, indicating that treatment decisions should be guided by age-specific risk–benefit considerations rather than direct generalization from younger cohorts (Bhangu et al., 2015). Across age groups, frailty and physiological reserve are stronger predictors of adverse outcomes than chronological age, supporting their use as core stratification variables in personalized care pathways (Reinisch et al., 2022). Pediatric randomized trials demonstrate that children constitute a separate personalization domain, in which antibiotics-first treatment may be feasible in selected cases but remains inferior to appendectomy as initial therapy (St Peter et al., 2025). Beyond population-based grouping, additional determinants refine personalization, including the presence of an appendicolith, which substantially increases the risk of failure with antibiotics-first management and shifts the therapeutic balance toward surgery (Collaborative et al., 2022), as well as baseline inflammatory burden measured by CRP or leukocyte count, which helps identify patients more likely to respond to conservative treatment (Sallinen et al., 2016). Treatment response is also influenced by symptom duration prior to presentation, reflecting time-dependent disease progression (Galletti et al., 2019), and by host factors such as immunosuppression, which are associated with higher infectious risk and less predictable outcomes under non-operative management (Talan et al., 2017). Finally, access to follow-up care and patient preferences independently affect the safety and acceptability of available strategies, underscoring that effective personalization requires integration of clinical, biological, and contextual factors rather than reliance on disease classification alone (Schumm & Livingston, 2021; Vons et al., 2011).

6. Conclusions

Acute appendicitis has undergone a profound conceptual and therapeutic evolution, transforming from a poorly understood and frequently fatal abdominal condition into a disease managed through highly standardized, evidence-based strategies. Historical advances in anatomical understanding, surgical technique, anesthesia, antisepsis, and antibiotic therapy collectively established appendectomy as a safe and effective intervention, dramatically reducing morbidity and mortality. In contemporary practice, laparoscopic appendectomy has emerged as the preferred operative approach for most patients, offering superior postoperative recovery, reduced complication rates, and improved patient-centered outcomes compared with traditional open surgery, while open appendectomy remains a valuable and reliable alternative in selected clinical and resource-limited settings.

At the same time, growing evidence supports non-operative management with antibiotics as a feasible option for carefully selected patients with uncomplicated appendicitis, underscoring a broader shift toward individualized, risk-adapted care. Management of complicated appendicitis continues to require tailored strategies that balance timely surgical source control against conservative or interventional approaches in clinically stable patients. Future perspectives - including ambulatory appendectomy, short-course and outpatient antibiotic regimens, and emerging minimally invasive and endoscopic techniques - reflect an ongoing emphasis on value-based care, reduced treatment burden, and optimal resource utilization.

Ultimately, the effective management of acute appendicitis depends on integrating clinical presentation, disease severity, patient-specific factors, and healthcare system capabilities. Continued refinement of personalized treatment algorithms, supported by high-quality prospective research, will be essential to further improve outcomes and guide the next phase in the evolution of appendicitis care.

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