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Review Article

Time to appendectomy for acute appendicitis: A systematic review

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ABSTRACT

Objective: The goal of this systematic review by the American Pediatric Surgical Association Outcomes and Evidence-Based Practice Committee was to develop recommendations regarding time to appendectomy for acute appendicitis in children within the context of preventing adverse events, reducing cost, and optimizing patient/parent satisfaction.

Methods: The committee selected three questions that were addressed by searching MEDLINE, Embase, and the Cochrane Library databases for English language articles published between January 1, 1970 and November 3, 2016. Consensus recommendations for each question were made based on the best available evidence for both children and adults.

Results: Based on level 3–4 evidence, appendectomy performed within 24 h of admission in patients with acute appendicitis does not appear to be associated with increased perforation rates or other adverse events. Based on level 4 evidence, time from admission to appendectomy within 24 h does not increase hospital cost or length of stay (LOS). Data are currently limited to determine an association between the timing of appendectomy and parent/patient satisfaction.

Conclusions: There is a paucity of high-quality evidence in the literature regarding timing of appendectomy for patients with acute appendicitis and its association with adverse events or resource utilization. Based on available evidence, appendectomy performed within the first 24 h from presentation is not associated with an increased risk of perforation or adverse outcomes.

Type of study: Systematic Review of Level 1–4 studies

Appendicitis is the most common indication for abdominal surgery in children and accounts for a significant proportion of procedure-related costs within the scope of pediatric surgical practice [1,2]. Despite the high prevalence and significant resource utilization associated with appendicitis in children, there is a lack of consensus surrounding the optimal timing of appendectomy with regard to perforation risk and postoperative complication rates [3–10]. Many providers consider acute appendicitis an urgent surgical diagnosis requiring emergent intervention while others may choose to manage a child presenting overnight with antibiotics followed by appendectomy the next morning. Data surrounding whether this variation in operative timing increases the risk of perforation vary significantly and may contribute to the wide practice variation observed in the management of pediatric appendicitis.

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Prior studies have demonstrated an association between complicated appendicitis and increased resource utilization (e.g. increased length of stay, postoperative complications, and hospital cost) [6,8,11]. Therefore, there is incentive to characterize better the relationship between time to appendectomy from initial diagnosis and risk of perforation with the ultimate goal of improving patient outcomes, reducing unnecessary cost, and optimizing patient satisfaction. In this review, our aim was to evaluate the literature systematically as it pertains to patients undergoing an appendectomy who were admitted with the intent to proceed to operative intervention. Ultimately, we sought to identify the best available evidence and propose objective recommendations based on the strength of the available data regarding optimal timing of appendectomy.

1. Materials and methods

1.1. Research questions

The American Pediatric Surgical Association Outcomes and Evidence Based Practice Committee, based on a consensus of opinion, developed three questions for review. Both pediatric and adult studies were included owing to the limited number of articles addressing only pediatric patients with appendicitis:

1. Is there an association between timing of appendectomy, relative to hospital admission, and overall adverse event rate?
2. Is there an association between timing of appendectomy, relative to hospital admission, and hospital costs or other resource utilization?
3. Is there an association between timing of appendectomy, relative to hospital admission, on parent/patient satisfaction?

1.2. Search methods and data sources

A literature search was conducted with the aid of a health sciences librarian to identify publications in the English language from January 1, 1970 to November 3, 2016 using OVID MEDLINE, Ovid Embase, and the Cochrane Library databases. Given the paucity of data in the pediatric literature, it was the consensus of the committee members that the literature search could include studies in the adult population. The selected questions were researched with Medical Subject Headings (MeSH) search terms including: “appendicitis”, “appendectomy”, “emergencies”, “emergency service”, “hospital”, “emergency treatment”, “time to treatment”, “night care”, “timing”, “complications”, “adverse event”, “treatment outcome”, “patient admission”, “hospitalization”, “health resources”, “length of stay”, “costs and cost analysis” and “patient satisfaction”. Subject heading searches were exploded to include all narrower terms in the MeSH or EMTREE (subject headings unique to Embase) hierarchy. The search terms were combined by “or” if they represented similar concepts, and by “and” if they represented different concepts. The citations of relevant articles generated from the database search were reviewed but no new articles were identified using this “snowball” methodology. Articles addressing nonsurgical management of acute appendicitis or interval management of complicated appendicitis were excluded.

1.3. Study selection and data extraction

Three of the principal authors (M.T.A., M.B. and R.W.) independently reviewed selected papers to determine eligibility for inclusion. Articles were included or excluded based on their relevance to the three selected research questions. Articles in English language that were published during the defined study period were included. Articles that addressed interval appendectomy, appendectomy performed concurrently with other procedures (e.g. Ladd's), and those addressing the nonoperative management of appendicitis were excluded from the review. Case reports and editorial review articles that were not systematic reviews or meta-analyses were also excluded. Systematic reviews and meta-analyses were only included in the final review if their primary sources were not otherwise included in the final selected papers. Although a systematic review would ideally include only level 1 and level 2 studies, there is a lack of high-level evidence in the current literature regarding the timing of appendectomy to inform practice guidelines. We therefore included level 3 and level 4 studies in our final list of selected papers. The level of evidence was assigned based on the Oxford Centre for Evidence Based Medicine criteria (Table 1) [12].

The final selected papers were reviewed by three authors (M.T.A., D.B.C. and R.W.) and data were compiled for each, including sample size, age (when available), definition of study cohort with regard to timing of appendectomy, postoperative outcomes (e.g. wound complications, length of stay, perforation rates, revisit rates), hospital costs, and patient/parent satisfaction associated with timing of appendectomy. Data collection was performed using a standardized data template.

The Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines were applied when performing this review (Fig. 1) [13]. In total, 3188 abstracts were reviewed of which 83 papers were selected for full review. Ultimately, thirty-four were selected for discussion in the systematic review after excluding poor quality retrospective studies ($n = 49$). In this case, poor quality was defined by extremely small sample size and studies confined to single center experiences. However, the majority of the final selected articles also represented single institution experiences.

2. Results

2.1. Is there an association between timing of appendectomy, relative to hospital admission, and overall adverse event rate?

Of the 83 papers that were reviewed, 65 articles examined the effect that time to appendectomy relative to hospital admission had on adverse event rates, including (but not limited to) rate of perforation and surgical site infection. The majority (49) of these studies were retrospective series with varying inclusion criteria and statistical methods and will not be further discussed but are available in the Table 4. The remaining 34 articles are discussed in detail in the subsequent sections of this review. No randomized trial has addressed the issue of the appropriate timing for appendectomy.

2.1.1. Rate of perforation

Eight prospective, observational trials characterized the association between timing of appendectomy for acute appendicitis relative to hospital admission and findings of perforation (Table 2). The majority of these studies did not find an increase in perforation rates with a longer time to appendectomy. In a small series by Maroju et al., 111 adult patients with appendicitis were grouped into early appendicitis (56%) and advanced appendicitis (44%), where early was defined by an inflamed appendix and advanced was gangrenous or perforated

Table 1
Oxford Centre for Evidence-Based Medicine 2011 Levels of Evidence

Grading classification scheme based on Oxford Centre for Evidence-based Medicine (OCEBM) levels of evidence	
Levels of Evidence	**Grades of Recommendation**
I Randomized trial (N-of-1) or systematic review of randomized trials	A: Consistent Level 1 studies
II Observational study or randomized trial	B:- Consistent Level 2 or 3 studies or extrapolation from Level 1 studies
III Nonrandomized controlled cohort/follow-up studies	C: Level 4 studies or extrapolations from Level 2 or 3 studies
IV Case series, historically controlled studies, or case–control studies	D: Level 5 evidence or inconsistent or inconclusive studies
V Mechanism-based reasoning (expert opinion)	

[a]Adapted from OCEBM Levels of Evidence. http://www.cebm.net