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Original Research Article

Evaluating the Cost-Effectiveness of Non-Operative Management and laparoscopic appendectomy (LA) in Acute Uncomplicated Appendicitis

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Abstract:

Background: Acute uncomplicated appendicitis remains one of the most common surgical emergencies. Traditionally, (LA) has been the standard treatment, offering definitive cure. However, recent evidence suggests that non-operative management (NOM) with antibiotics may be a cost-effective alternative in selected patients. Balancing clinical outcomes with economic considerations is crucial in optimizing treatment strategies.

Aim: To compare the cost-effectiveness of non-operative management versus (LA) in patients with acute uncomplicated appendicitis.

Methods: A prospective comparative study was conducted over 12 months at Darbhanga Medical College & Hospital, Laheriasarai, involving 100 patients diagnosed with acute uncomplicated appendicitis. Patients were randomized into two groups: Group A (NOM with antibiotics, n = 50) and Group B (laparoscopic appendectomy, n = 50). Data regarding demographic profile, hospital stay, complications, recurrence, readmission, return to normal activity, and total treatment cost were collected. Statistical analysis was performed using SPSS version 23.0, with $p < 0.05$ considered significant.

Results: Both groups were comparable in baseline characteristics. The mean hospital stay was significantly shorter in Group B (2.8 ± 1.1 days) compared to Group A (4.6 ± 1.7 days, $p < 0.001$). Recurrence was observed in 20% of Group A, while none was reported in Group B ($p = 0.002$). Readmission was higher in Group A (16%) versus Group B (4%, $p = 0.04$). However, total treatment cost was significantly lower in Group A (₹18,500 ± 4,200) compared to Group B (₹32,700 ± 5,100, $p < 0.001$).

Conclusion: (LA) offers superior clinical outcomes, including shorter hospital stays, faster recovery, and no recurrence, though at a higher financial burden. Non-operative management is more cost-effective in the short term but carries a risk of recurrence and readmission that may increase long-term costs.

Recommendations: (LA) should remain the standard of care for most patients with acute uncomplicated appendicitis. Non-operative management may be considered in carefully selected patients, such as those unfit for surgery or in resource-limited settings, with proper counseling regarding recurrence risks. Further multicenter studies with longer follow-up are recommended to establish long-term cost-effectiveness.

Keywords: Acute Appendicitis, Non-Operative Management, Laparoscopic Appendectomy, Cost-Effectiveness, Antibiotic Therapy.

Introduction

Acute uncomplicated appendicitis is a prevalent surgical emergency worldwide, traditionally managed with appendectomy—either via open or laparoscopic approaches. However, accumulating evidence suggests that (NOM) using antibiotics may offer a viable alternative in selected cases. Emerging research emphasizes both clinical and economic implications of these differing management strategies.

The landmark APPAC (Appendicitis Acute) randomized controlled trial evaluated long-term cost outcomes of antibiotics versus appendectomy for uncomplicated appendicitis. Over a five-year follow-up, antibiotic therapy yielded significantly

lower overall costs compared to appendectomy (€4,171 vs €5,716; $p < 0.001$), with most patients (61%) avoiding surgery altogether [1].

Complementing this, broader economic models—such as those derived from Colombia—have revealed that (LA) (LA) can offer higher net monetary benefit (NMB) than non-operative treatment, particularly within certain willingness-to-pay thresholds. These models attributed the advantage to LA's shorter recovery, lower postoperative complications, and reduced hospital stay [2, 3].

In pediatric populations, NOM has shown promising outcomes as well. A JAMA Surgery study reported that in children with uncomplicated appendicitis, NOM incurred lower healthcare costs over one-year, fewer disability days, and similar health-related quality of life compared to surgery [4]. Supporting this, analysis published in the Journal of the American College of Surgeons demonstrated that antibiotics-only management in pediatric patients was both more effective (QALY 0.895 vs 0.884) and less costly ($8,044 vs $9,791) than (LA) over a one-year period [5].

Despite these cost benefits, non-operative treatment carries a higher risk of recurrence. Analysis from Verywell Health summarized that approximately 39% of patients treated with antibiotics may experience recurrence within five years, indicating that long-term resolution remains a concern [6].

These findings highlight a nuanced balance between short-term cost savings and long-term outcomes. While NOM may minimize upfront expenses and reduce disability, recurrence risk and eventual procedures may counterbalance its economic and clinical advantages. Conversely, laparoscopic appendectomy—though costlier initially—may offer more definitive management with fewer long-term complications.

Methodology

Study Design: This was a prospective comparative study.

Study Setting: The study was carried out in the Department of General Surgery at Darbhanga Medical College & Hospital, Laheriasarai, a tertiary care teaching hospital. The institution receives a high volume of emergency surgical cases, providing an adequate patient pool for the study.

Study Duration: The study was conducted over a period of 12 months.

Participants: A total of 100 patients diagnosed with acute uncomplicated appendicitis were enrolled. Patients were divided equally into two groups of 50 each: non-operative management group and (LA) group.

Inclusion Criteria

- Patients aged between 18 and 60 years.
- Clinical diagnosis of acute uncomplicated appendicitis confirmed by ultrasonography or CT scan.
- Patients willing to participate and provide informed consent.

Exclusion Criteria

- Patients with complicated appendicitis (perforation, abscess, or peritonitis).
- Patients with recurrent appendicitis.
- Pregnant women.
- Patients with severe comorbid conditions contraindicating surgery or antibiotic therapy.
- Patients unwilling to consent.

Bias Control: Selection bias was minimized by using random allocation of patients into treatment groups. Observer bias was reduced by ensuring that cost data and outcome assessments were analyzed by an independent investigator not directly involved in the treatment process.

Data Collection: A predesigned structured proforma was used to collect data. Baseline information such as demographic details, clinical presentation, investigations, hospital stay duration, treatment cost, and postoperative complications were recorded. Follow-up data were collected at 1 month and 3 months to assess recurrence, complications, and overall cost burden.

Procedure: Patients in the non-operative group were treated with intravenous antibiotics, analgesics, and supportive care according to institutional protocols. Patients in the surgical group underwent (LA) performed under general anesthesia using a standard three-port technique. Postoperative care included antibiotics, analgesics, and early mobilization. Both groups were monitored for duration of hospital stay, complications, recurrence, and total expenditure.

Statistical Analysis: Data were entered into Microsoft Excel and analyzed using SPSS version 23.0. Continuous variables were expressed as mean ± standard deviation and compared using the Student's t-test. Categorical variables were expressed as percentages and analyzed using the chi-square test or Fisher's exact test as appropriate. A p-value of <0.05 was considered statistically significant.

Results

1. Study Population Characteristics

Out of the 100 patients included in the study, 50 underwent NOM (Group A) and 50 underwent

(LA) (Group B). The mean age of participants was 31.6 ± 9.4 years, with 58 males (58%) and 42 females (42%). Both groups were comparable in terms of baseline demographic and clinical characteristics, with no statistically significant difference ($p > 0.05$).

Table 1: Baseline Characteristics of the Study Population

Variable	Group A (Non-operative) (n=50)	Group B (Laparoscopic) (n=50)	p-value
Mean Age (years)	32.4 ± 9.6	30.8 ± 9.3	0.42
Gender (Male/Female)	28/22	30/20	0.68
Mean BMI (kg/m²)	23.8 ± 2.6	24.1 ± 2.4	0.57
Mean WBC count (×10⁹/L)	12.4 ± 3.1	12.7 ± 2.9	0.63
Duration of symptoms (hrs)	24.2 ± 8.5	25.4 ± 7.9	0.49

Both groups were well-matched in terms of age, sex distribution, BMI, WBC count, and symptom duration, ensuring comparability before intervention.

2. **Clinical Outcomes**

The mean hospital stay was significantly shorter in the laparoscopic group (2.8 ± 1.1 days) compared to the non-operative group (4.6 ± 1.7 days, $p < 0.001$). However, the recurrence rate was higher in the non-operative group (20%) as compared to none in the surgical group ($p = 0.002$).

Table 2: Comparison of Clinical Outcomes

Outcome	Group A (Non-operative) (n=50)	Group B (Laparoscopic) (n=50)	p-value
Mean Hospital Stay (days)	4.6 ± 1.7	2.8 ± 1.1	<0.001*
Recurrence at 3 months	10 (20%)	0 (0%)	0.002*
Complications (minor)	6 (12%)	8 (16%)	0.57
Readmission Rate	8 (16%)	2 (4%)	0.04*
Return to Normal Activity (days)	6.8 ± 2.1	5.2 ± 1.4	0.001*

*Statistically significant

(LA) resulted in significantly fewer readmissions, shorter hospital stays, and faster return to daily activities, while non-operative management was correlated with higher recurrence rates.

3. **Cost Analysis**

The mean total cost of treatment (including hospitalization, medication, and follow-up) was lower in the non-operative group (₹18,500 ± 4,200) compared to the laparoscopic group (₹32,700 ± 5,100), and this difference was statistically significant ($p < 0.001$).

Table 3: Cost Comparison between Groups

Cost Parameter	Group A (Non-operative) (n=50)	Group B (Laparoscopic) (n=50)	p-value
Hospitalization Cost (₹)	10,200 ± 2,100	15,800 ± 2,700	<0.001*
Procedure/Operation Cost (₹)	0	10,500 ± 1,600	<0.001*
Medication Cost (₹)	5,300 ± 1,200	3,200 ± 900	<0.001*
Follow-up/Readmission (₹)	3,000 ± 1,800	3,200 ± 1,500	0.64
Total Cost (₹)	**18,500 ± 4,200**	**32,700 ± 5,100**	<0.001*

Non-operative management was significantly more cost-effective in terms of overall expenditure. However, the higher recurrence rate increased indirect costs due to readmissions.

4. **Summary of Findings**

- Both groups were comparable in baseline characteristics.
- (LA) patients had shorter hospital stay, no recurrence, and faster return to activity.
- Non-operative management was cheaper but carried a 20% recurrence risk.
- The cost-effectiveness advantage of non-operative treatment was partially offset by higher recurrence and readmission rates.

Discussion

In this study, 100 patients with acute uncomplicated appendicitis were divided into two groups, with 50 managed conservatively using antibiotics (Group A) and 50 undergoing (LA) (Group B). Both groups were comparable in terms of baseline demographics such as age, sex distribution, BMI, WBC count, and duration of symptoms, indicating that the study population was

well-matched and reducing the risk of confounding bias.

Clinical outcomes showed distinct differences between the two approaches. The mean hospital stay was significantly shorter in the (LA) group (2.8 days) compared to the non-operative group (4.6 days). Similarly, patients who underwent surgery were able to return to their normal activities earlier than those treated conservatively. Importantly, no recurrences were reported in the surgical group, whereas the non-operative group experienced a recurrence rate of 20%. This suggests that while non-operative management may be effective initially, it carries a substantial risk of recurrence that could impact long-term outcomes and patient satisfaction.

Complication rates were similar between both groups, with minor postoperative infections or drug-related side effects reported, but the difference was not statistically significant. However, the readmission rate was higher in the non-operative group (16%) compared to the laparoscopic group (4%), which further reflects the clinical burden correlated with recurrence and treatment failure in conservative management.

Cost analysis revealed that non-operative management was significantly more cost-effective, with a mean total cost of ₹18,500 compared to ₹32,700 for laparoscopic appendectomy. This difference was largely attributable to the absence of operative charges in the non-operative group and lower immediate hospitalization expenses. However, the need for follow-up visits and readmissions in the non-operative group slightly diminished this cost advantage. From a purely financial perspective, conservative treatment was cheaper, but the higher recurrence rate may increase indirect costs over time.

Recent studies since 2018 have increasingly compared the cost-effectiveness of non-operative management with antibiotics versus (LA) in acute uncomplicated appendicitis. Evidence suggests that antibiotic treatment can be more cost-effective in the short term due to lower initial hospital and surgical costs, though this benefit is often offset by higher recurrence and readmission rates over time. Barceló et al. reported that non-operative management yielded reduced immediate costs in adults, but recurrences significantly diminished its economic advantage in longer follow-up periods [7]. Similarly, Hansson et al. emphasized that while antibiotics may lower short-term healthcare expenditures, the societal cost increases due to recurrences and subsequent interventions [8].

Other studies have shown that laparoscopic appendectomy, despite higher upfront surgical and hospitalization costs, becomes more cost-effective in the long run. Schmidt et al. demonstrated that appendectomy reduces lifetime healthcare costs by preventing recurrences and additional hospital admissions, making it more economically favorable in populations with higher recurrence risks [9]. Huffman et al. further supported this finding, showing that appendectomy maintained superiority in cost-effectiveness analysis unless the risk of recurrence following antibiotics was exceptionally low [10].

Additionally, cost-effectiveness varies depending on healthcare systems. Studies from European countries, such as Barceló et al., tend to favor antibiotic therapy due to lower healthcare costs for recurrence and follow-up care, while U.S.-based analyses often favor surgery because higher readmission and re-treatment costs outweigh the initial benefits of antibiotics [7,10]. Overall, the patient's risk profile, healthcare system structure, and likelihood of recurrence are key determinants in deciding the most cost-effective treatment strategy.

Conclusion

This study demonstrates that that (LA) offers superior clinical outcomes, with shorter hospital stays, no recurrence, and quicker return to activity, albeit at a higher cost, whereas NOM is cost-effective in the short term but correlated with higher recurrence and readmission rates. Thus, the choice between the two strategies should be individualized, balancing immediate financial considerations against long-term clinical outcomes.

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