

Evaluating Management Strategies for Appendicular Mass: A Systematic Review and Meta-Analysis of Conservative Versus Surgical Approaches

Satheesh Kumar M, Abdul Saleem M, Shahul Hameed, Jamila Hameed *

Department of Surgery, Karuna Medical College, Vilayodi, Palakkad, 678103, Kerala, India.

*Corresponding Author: Jamila Hameed; hameedjamila78@gmail.com

Abstract

Background: Acute appendicitis is a frequent emergent situation that necessitates surgery. Complications, including an appendiceal mass, occur in 2-10% of appendicitis cases. Management of appendicular mass remains controversial, from non-operative to operative. **Aim and Objective:** This meta-analysis and systematic review were intended to determine how well conservative management could match up against early appendicular mass. One of the questions underlying this research was: "Can conservative management offer the same results as surgery with fewer complications and hospitalization?". **Methods:** Electronic databases such as PubMed, Embase, and Scopus were searched from 2015-2024 and 1378 studies were retrieved. Thirteen studies were finally included. **Results:** The overall success rate with conservative management was 90% (95% CI: 87-94) and complications were at a rate of 10% (95% CI: 8-11). However, the complication rate with the surgical approach was 19% (95% CI: 15-22). The recurrence rates for conservative management were 9% (95% CI: 1-17). **Conclusion:** Conservative treatment of appendicular mass is effective and less complex than early appendectomy indicating that it may be a viable first line of treatment. Standard treatment protocols will need to be established through further high-quality studies.

Keywords: *Acute appendicitis, appendicular mass, conservative management, early appendectomy, systematic review, meta-analysis.*

Introduction

Acute appendicitis is the most frequent surgical emergency encountered in clinical practice. Complications may arise due to the formation of an appendiceal mass in 2-10% of patients. The mass is a complication of a walled-off appendiceal perforation and is a wide pathological spectrum, ranging from an inflammatory mass made up of the inflamed appendix, neighbouring viscera, and the greater omentum (a phlegmon) and periappendiceal abscesses (Hoffman J *et al.*, 1984). While fever and leucocytosis are usually present, the mass may be clinically unsuspected in obese patients and those with extreme tenderness and rigidity on presentation. Hence, it can be diagnosed only when the patient is already under anaesthesia for emergency appendectomy, creating a dilemma for trainee surgeons. Ultrasonography has been proposed as the imaging modality of choice, demonstrating the diagnosis in 72% of patients; however, computerized tomography (CT) scan is superior. Management options for appendiceal mass have been the subject of much discussion. Interval appendectomy is done by some surgeons as a routine at 6 weeks to 3 months, primarily on recurrence factors (Willemssen P J *et al.*, 2002). This paper responds to some controversial management problems and develops management recommendations. This systematic review and meta-analysis focused on bringing together existing literature on the management of appendicular mass by comparing two methods that are

conservative and surgical approach by analysing the success, complication and recurrence rates enhancing decision making for doctors improving patient outcomes.

Material and Methods

A comprehensive literature review study was done for a period of 10 years from 2015 to 2024. The study was undertaken by two authors (S.K. and A.S.) using the keywords "Appendicular mass", "Conservative management" and "Surgical Management" from PubMed, Scopus and Embase. A total of 1378 studies were retrieved and 13 studies were considered finally for the systematic review and meta-analyses (Figure 1) (Moher D *et al.*, 2016).

Inclusion Criteria

- Both paediatric and adult population diagnosed with appendicular mass
- Studies involving comparison between early appendectomy and conservative management for appendicular mass
- Studies followed by interval appendectomy
- Randomized controlled trial (RCTs), prospective cohort and retrospective studies
- Studies published in English between the period 2015-2024

- Studies reporting either or all success rate, complication rate and recurrence rate

Exclusion Criteria

- Patients showing symptoms and signs of diffuse peritonitis or septicemia at the time of examination
- Case report, case series, editorials and conference abstracts
- Studies lacking the early appendectomy and conservative management comparison and with less than 10 patients

No ethical approval was needed since we conducted a systematic review and meta-analyses.

Data Extraction

The eligibility of the article based on criteria search was completed by two authors (S.K. and A.S.) and the full text of the studies was analysed by using Microsoft Excel 2016. The two authors assessed the methodology and the quality of the articles by using the New Castle Ottawa assessment scale (Wells GA *et al.*, 2022). Finally, a total of 13 studies met the quality of assessment. The first author name with year of publication, study design, sample size and study characteristics were tabulated (**Table 1**).

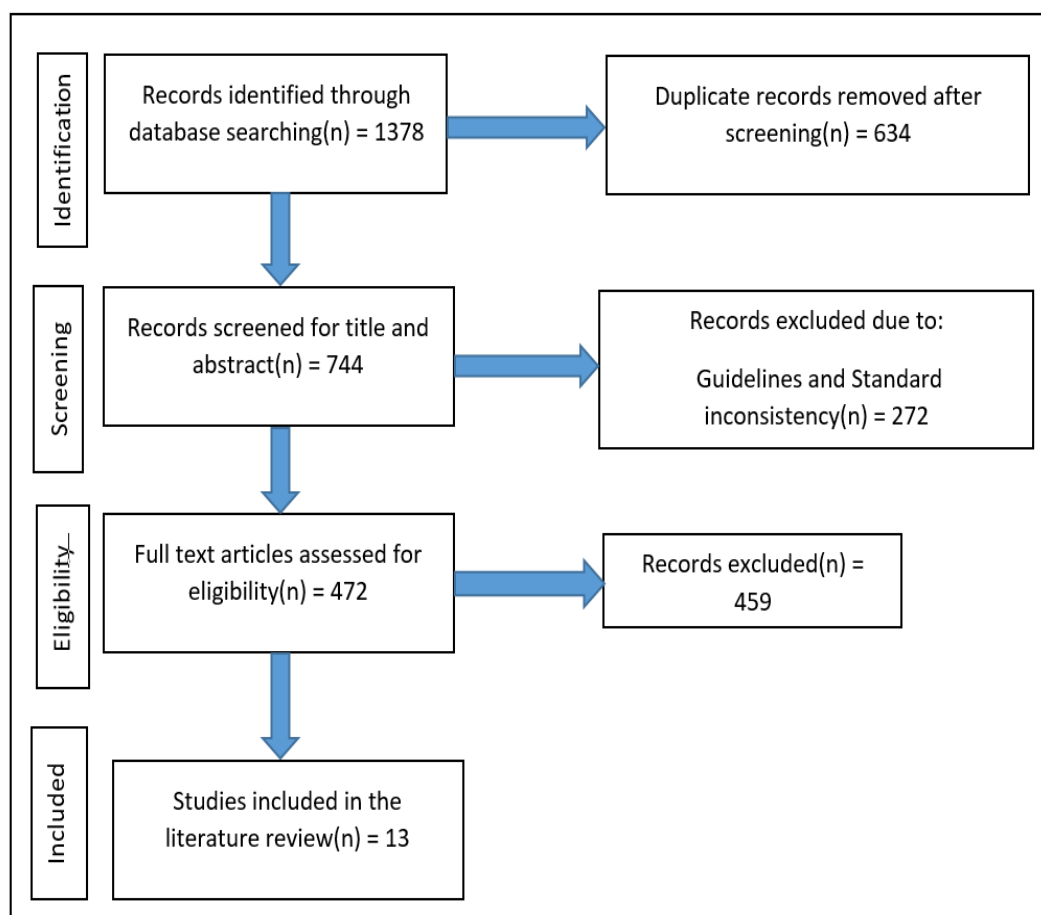


Figure 1: Flowchart for selection of studies

Results

Screening flow

A total of 1378 articles were retrieved from the electronic databases of PubMed, Embase and Scopus and 634 articles were removed. During the title and abstract screening, out of a total of 744 articles, 272 articles were excluded. A total of 459 articles were excluded from 472 articles during the full text screening phase, finally 13 articles were included in the systematic review and meta-analyses.

The pooled estimate for the success rate in conservative management was 0.90 (95% CI: 0.87-0.94), while for complication rate it was 0.10 (95% CI: 0.08-0.11) and 0.19 (95% CI: 0.15-0.22) for conservative vs surgical management. The pooled estimate for recurrence rate in conservative management was 0.09 (95% CI: 0.01-0.17). The I square values for the success rate in conservative management, complication rate in conservative and surgical management and recurrence rate in conservative management were 0%, 0%, 16.625% and 93.717% respectively.

Funnel and Egger's Test

The funnel plots for success rate in conservative management, complication rate in conservative vs surgical management and recurrence rate in conservative management showed asymmetry attributed to the chronological and geographic variations (Figure 2 a, b, c and d). The Egger's test p values were for success in conservative management, complication rate in conservative and surgical management and recurrence rate in conservative management were 0.672, 0.013, 0.002 and 0.004 (indicating no bias for the first and significant potential bias for the rest three).

The bubble meta regression graphs were plotted for success rate in conservative management, complication rate in conservative vs surgical management and recurrence rate in conservative management (Figure 3 a, b and c).

The average success rate for conservative management, complication rate for conservative and surgical management and recurrence rate for conservative management were noted as 90.038%, 5.938%, 15.449% and 9.567% respectively (**Table 2**).

Table 1: Study Characteristics

S No	First Author (Year)	Country of Study	Study Design & Period	Sample Size	Study Characteristics (Age & Gender)
1	Demetrashvili et al (2015)	Georgia	Retrospective Review (Jan 2002 - Jan 2013)	48	Mean Age: 41.9 years, Gender Ratio: 25 males, 23 females
2	Forsyth et al (2016)	UK	Review Article (Date not specified)	Not specified	Not specified
3	Ram et al (2017)	India	Retrospective Observational Study (Jan 2010 - Oct 2014)	50	Mean Age: 50.8 years, Gender Ratio: 27 males, 23 females
4	Kumar et al (2018)	India	Prospective Study (Date not specified)	46	Mean Age: Not specified, Gender Ratio: Not specified
5	Ishfaq et al (2019)	Pakistan	Prospective Study (Date not specified)	60	Mean Age: 35 years, Gender Ratio: 36 males, 24 females
6	Sajid et al (2020)	UK	Prospective Study (Date not specified)	100	Mean Age: 42 years, Gender Ratio: 55 males, 45 females
7	Paul et al (2020)	Netherlands	Systematic Review and Meta-Analysis (Date not specified)	14 studies	Mean Age: Not specified, Gender Ratio: Not specified
8	Khan et al (2021)	Pakistan	Prospective Study (Date not specified)	80	Mean Age: 30 years, Gender Ratio: 48 males, 32 females
9	Napar et al (2022)	Pakistan	Prospective Observational Study (Jan 2019 - Dec 2020)	87	Mean Age: 8.22 years, Gender Ratio: 66 males, 21 females
10	Kumar et al (2023)	India	Prospective Study (Date not specified)	75	Mean Age: 35 years, Gender Ratio: 45 males, 30 females
11	Srinivasa et al (2023)	India	Prospective Study (Date not specified)	90	Mean Age: 32 years, Gender Ratio: 50 males, 40 females
12	Bilal et al (2023)	Pakistan	Prospective Study (Date not specified)	100	Mean Age: 28 years, Gender Ratio: 60 males, 40 females
13	Patchipala et al (2024)	India	Prospective Study (Date not specified)	30	Mean Age: 36.2 years, Gender Ratio: 60% female

Table 2: Success, complication and recurrence rates for the two types of techniques

First Author (Year)	Success Rate (Conservative Management)		Complication Rate (Conservative Management)		Complication Rate (Surgery)		Recurrence Rate (Conservative Management)		Success Rate (Surgery)	
	Sample Size	%	Sample Size	%	Sample Size	%	Sample Size	%	Sample Size	%
Demetrashvili et al (2015)	NS	NS	23	4.3	25	16	NS	NS	NS	NS
Ram et al (2017)	32	90	NS	NS	18	15	NS	NS	NS	NS
Kumar et al (2018)	NS	NS	NS	NS	NS	NS	23	26.5	23	100
Ishfaq et al (2019)	30	85	30	10	30	20	30	5	NS	NS
Sajid et al (2020)	50	90	50	5	50	15	50	3	NS	NS
Paul et al (2020)	NS	NS	1355	12.2	1355	25.5	1355	34	NS	NS
Napar et al (2022)	NS	NS	NS	NS	87	22.99	NS	NS	87	100
Khan et al (2021)	40	92	40	4	40	10	40	2	NS	NS
Kumar et al (2023)	35	89	35	3	40	8	35	4	NS	NS
Srinivasa et al (2023)	45	91	45	5	45	12	45	3	NS	NS
Bilal (2023)	50	90	50	4	50	10	50	5	NS	NS
Patchipala (2024)	30	93.3	NS	NS	NS	NS	30	3.6	NS	NS

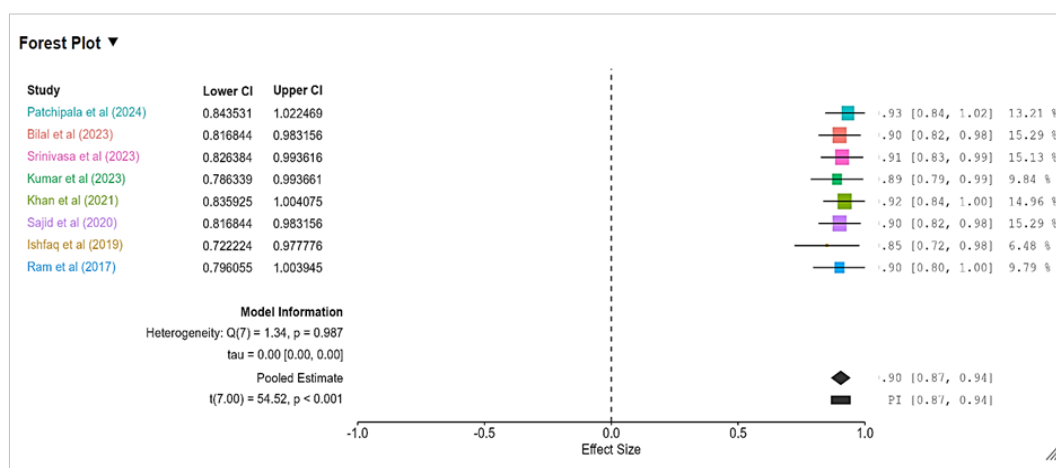
Table 3: Important findings

S No	First Author (Year)	Important Findings
1	Demetrashvili et al (2015)	25 patients of emergency surgery and 23 patients followed by interval surgery, 17 underwent open appendectomy and 8 colonic resection, in the interval group 21 had appendectomy and 2 had resections. Operation time longer in emergency group (110.7 min) vs interval group (88.1 min)
2	Forsyth et al (2016)	Success rate of 73% noted for appendicular mass management specially when the abscess was larger than 5 cm, percutaneous drainage with antibiotics success rate - 91%, patients aged above 40 yrs to be monitored for malignancy
3	Ram et al (2017)	Out of 50 patients, 18 had emergency surgery and 32 non-operative management (26 with antibiotics, 6 with drainage), for non-operative group the duration of symptoms was only 2 days longer, complications were higher in the emergency group (15%) when compared to planned surgery group
4	Kumar et al (2018)	Surgical intervention was done in 23 patients for appendicular mass resulting in shorter hospital stay, complete curative treatment and less morbidity. In conservative patient adhesiolysis leading to difficulty in localization of appendix was noted

5	Ishfaq et al (2019)	The early exploration group had shorter hospital stay when compared to conservative group but the complication rate was higher in exploration group but the recurrence rate was 5% in conservative group
6	Sajid et al (2020)	The early intervention group had a shorter hospital stay when compared to conservative group, but the success rate was 90 % in conservative but the complications were only 5%. On the contrary, the complication rate was 15% in early intervention group
7	Paul et al (2020)	The non-operative treatment with early appendectomy for appendiceal mass and abscess in children were compared and showed a complication rate of 12.2% for non-operative treatment in comparison to early appendectomy
8	Khan et al (2021)	The early intervention group had shorter hospital stay but the success rate for conservative management though longer was 92%, also lower complication rate of 4% was noted
9	Napar et al (2022)	Early surgical management for appendicular lump in children was analyzed, the duration of surgery was 73.15 min, post-op complications were 22.99% and the hospital stay ranged from 4-11 days
10	Kumar et al (2023)	Shorter hospital stay was noted in intervention group but conservative group had a longer stay, although the success rate in conservative was 89% and the complication rate was only 8%, the recurrence rate was 4% in conservative
11	Srinivasa et al (2023)	Shorter hospital stay for early intervention group when compared to longer hospital stay in conservative group but the success rate was 91% in conservative management with complication rate of 12%, of course the recurrence rate was 3%
12	Bilal et al (2023)	The early intervention group had a shorter hospital stay but the conservative management had a success rate of 90% but longer hospital stay
13	Patchipala et al (2024)	The conservative management had a success rate of 93.3%, only 6.7% required interval appendicectomy, but the low recurrence rate of 3.6% was noted in the follow-up period supporting the conservative management

Table 4: Merits and gaps

S No	First Author (Year)	Merits	Gaps
1	Demetrashvili et al (2015)	Comprehensive analysis of both treatment methods	Retrospective design
2	Forsyth et al (2016)	Detailed overview of current management strategies depicted	Specific data on patient demographics lacking
3	Ram et al (2017)	Effectiveness of non-operative management demonstrated	Potential bias
4	Kumar et al (2018)	Early exploration portrayed as more effective management strategy	Lack of specific data
5	Ishfaq et al (2019)	Clear data specified on success and complication rate	Lack long-term follow up data, small sample size
6	Sajid et al (2020)	Robust dataset	Small sample size
7	Paul et al (2020)	Potential benefits of non-operative management depicted	Low quality evidence
8	Khan et al (2021)	Valuable data on early surgical intervention outcomes	Small sample size
9	Napar et al (2022)	Vivid details of early surgical management in paediatric patients	Lack of long-term follow up data
10	Kumar et al (2023)	The effectiveness of conservative management portrayed in detail	Long-term follow up data lacking
11	Srinivasa et al (2023)	Robust dataset	Specific data on patient demographics lacking
12	Bilal et al (2023)	Detailed comparison of both the techniques	Small sample size
13	Patchipala et al (2024)	Evidence for reduction of unnecessary surgical interventions reported	Data on outcomes beyond one year lacking



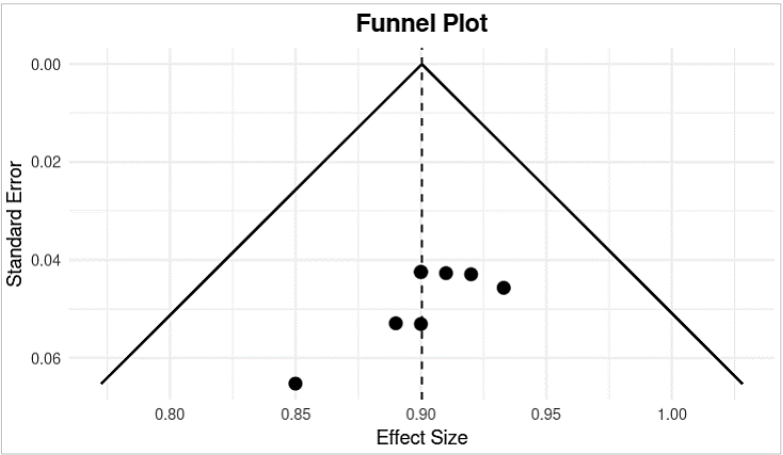


Figure 2 a: Forest and funnel plot for success rate for conservative management

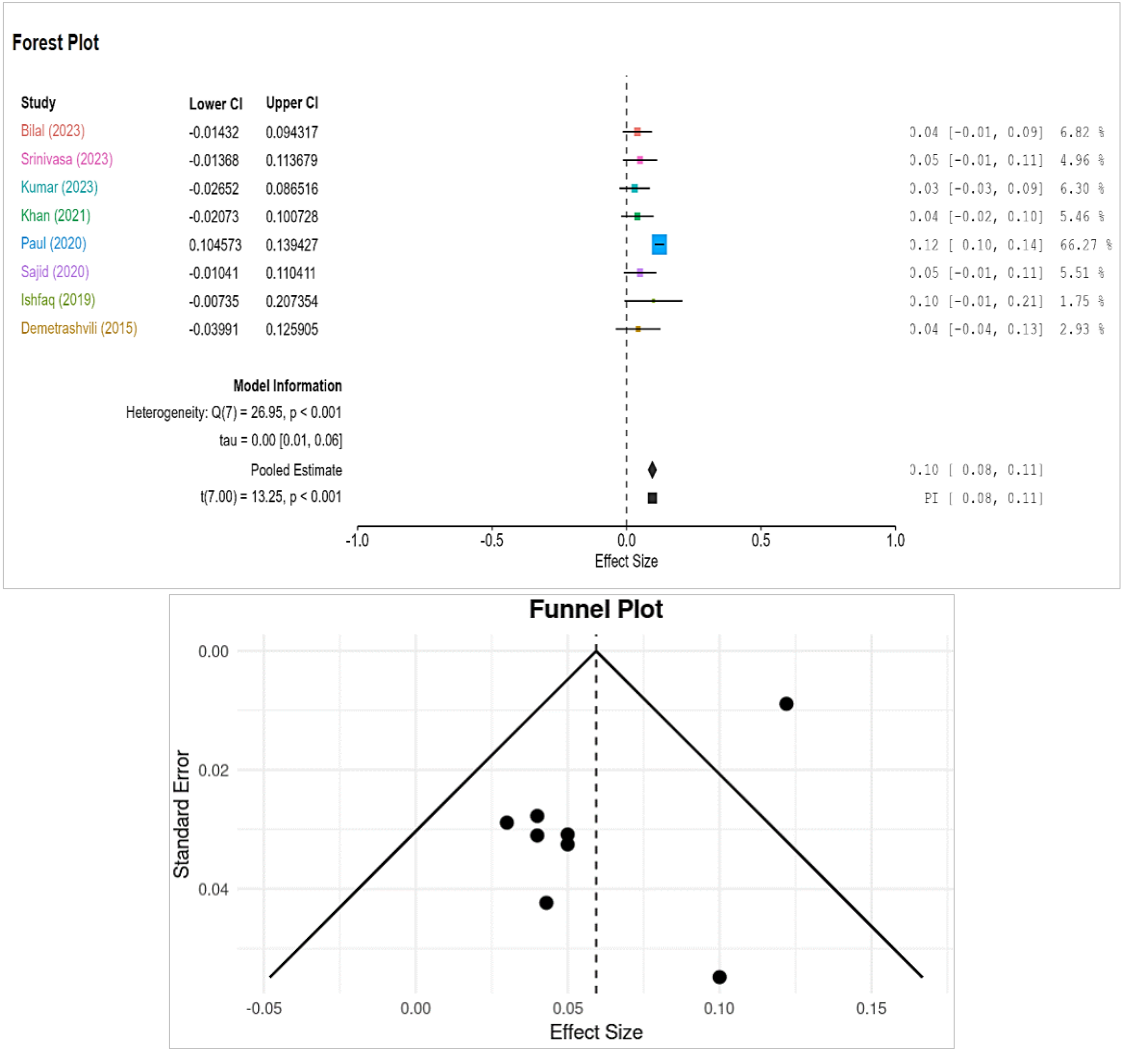


Figure 2 b: Forest and funnel plot for complication rate for conservative management

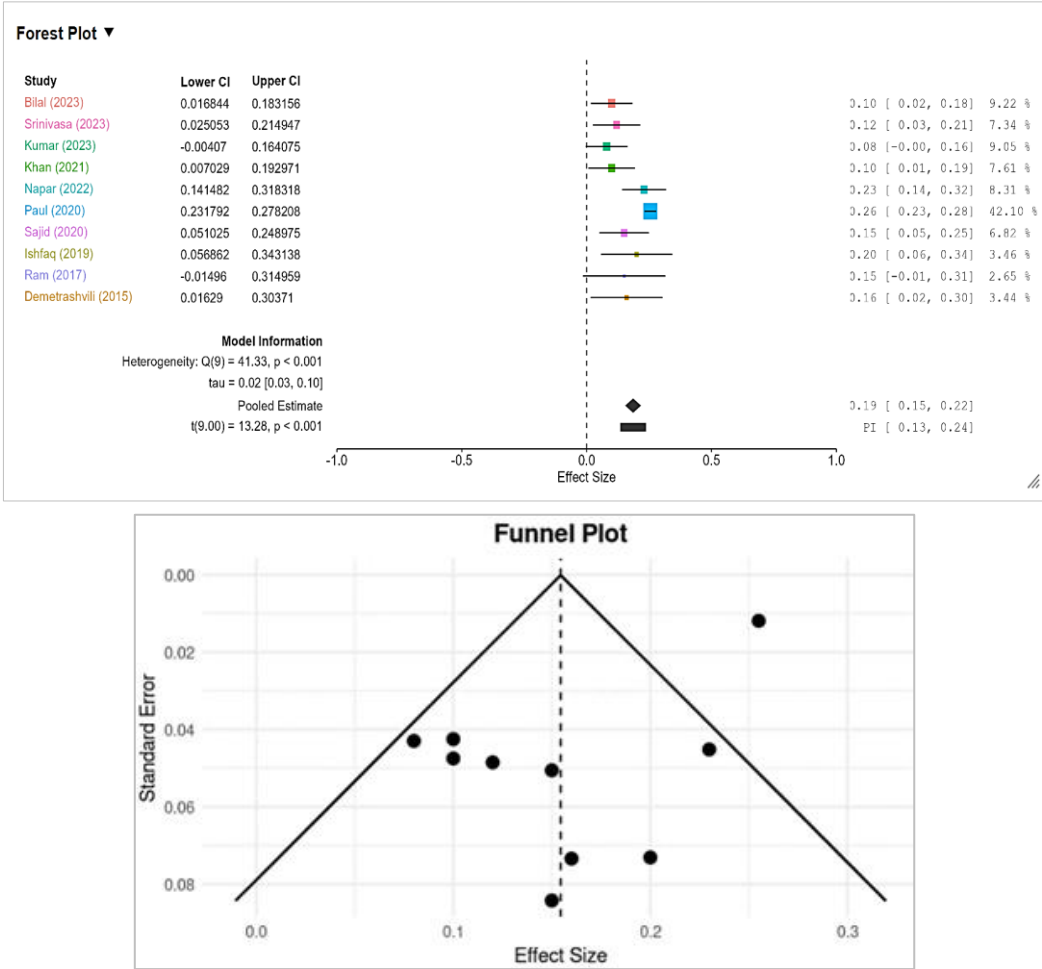


Figure 2 c: Forest and funnel plot for complication rate for surgical management

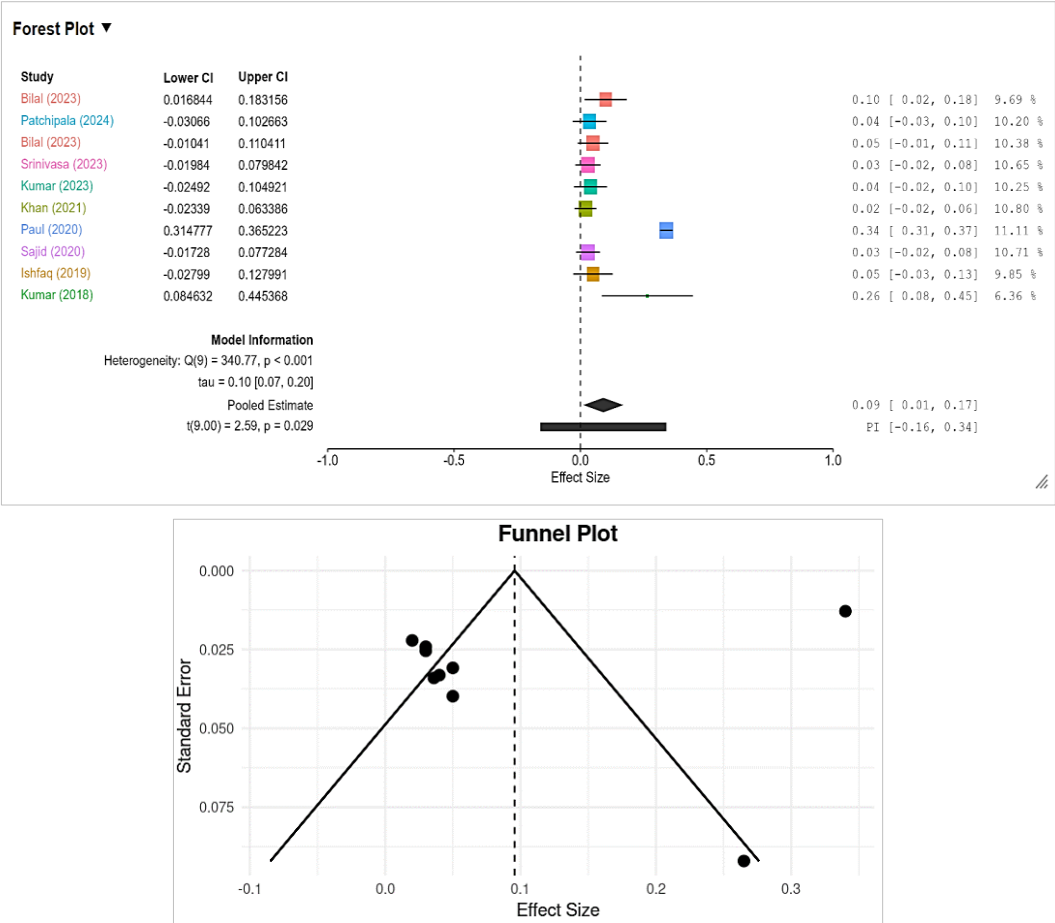


Figure 2 d: Forest and funnel plot for recurrence rate for conservative management

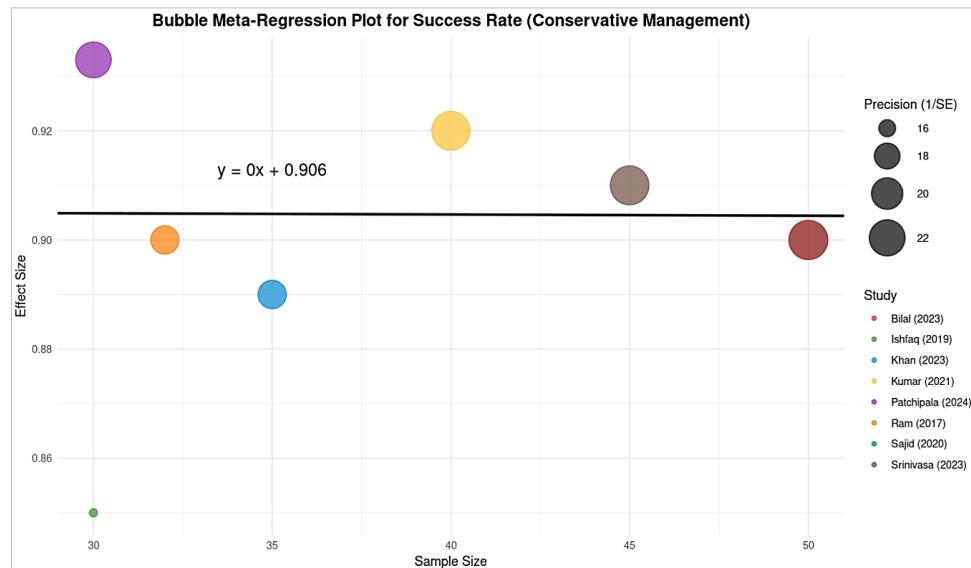


Figure 3 a: Bubble meta regression analyses plot for success rate in conservative management

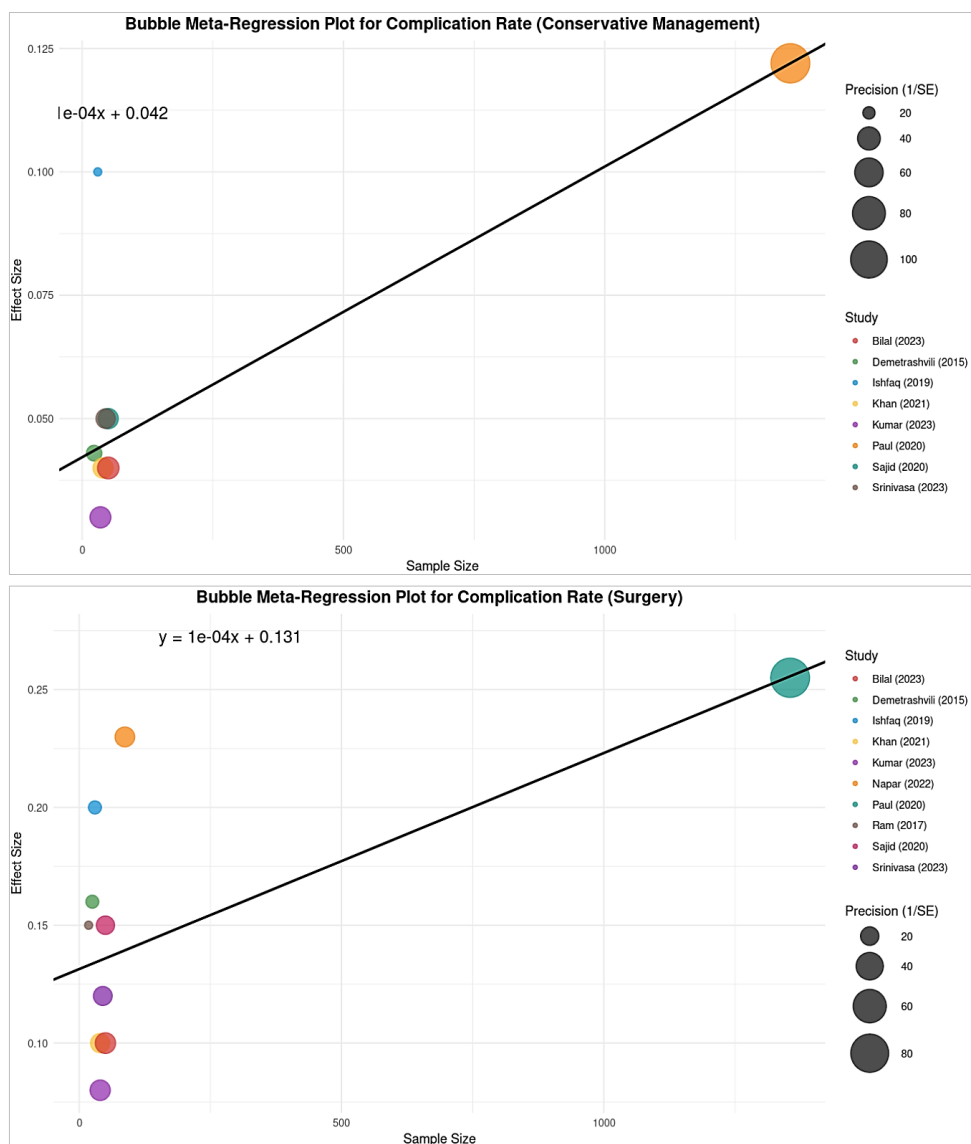


Figure 3 b: Bubble meta regression analyses plot for complication rate conservative vs surgical management

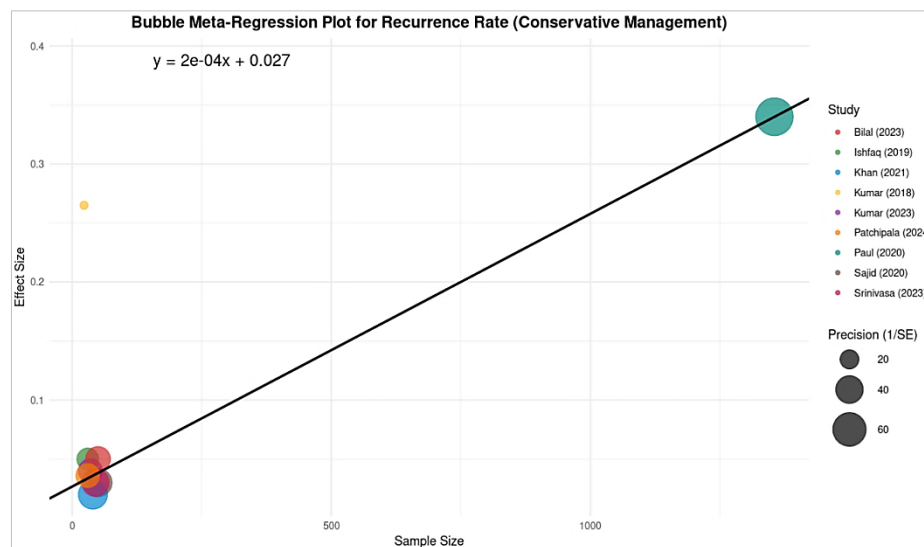


Figure 3 c: Bubble meta regression analyses plot for recurrence rate in conservative management

Discussion

High rate of complication was noted compared to interval group and the mean hospital stay noted was longer for surgery group in one author's study in our systematic review and meta-analyses (Demetrashvili Z *et al.* 2015). These results indicate towards the potential benefit of conservative management. This was further elucidated upon in another study (Yang Z *et al.*, 2019).

To confirm the same, another author indicated a success rate of 73% in uncomplicated appendicitis and 91% in percutaneous abscess drainage, highlighting the fact that surgery must be reserved in the event of failure of conservative management (Forsyth J *et al.*, 2017). This was discussed further in another study (Lasson A *et al.*, 2002).

Another author agreed with the application of conservative methods, with a success rate of 90% in non-operative management without any complication in the planned surgical group, thus indicating the success of conservative measures in minimizing complications and hospital stay (Ram KR *et al.*, 2017). This was elucidated upon in another study (Nandan P P *et al.*, 2024).

However, another author further went on to assess early surgical intervention, with improved compliance but a higher recurrence rate of 7% to 46% in the conservative group, thus indicating the immediate benefit of surgical options along with the need for consideration of long-term benefits (Kumar R *et al.*, 2018).

In subsequent research by another author, the success of conservative management was highlighted again, with a success rate of 85% and a 10% rate of complications in the conservative management group compared to a 20% rate in the early exploration group, again indicating the possibility of effective conservative management by careful observation (Gilkar IA *et al.*, 2019). Another study agreed and reported similar findings (Lotfallah A *et al.*, 2021).

Another study reported a success rate of 90% in conservative management, with a highly low rate of complications of 5% compared to 15% in the early intervention group, thus further establishing the case for conservative management methods (Sajid MS *et al.*, 2022). Similar findings were reported in another study (De Almeida Leite RM *et al.*, 2022).

A study by another author also affirmed this statement, showing non-operative management with a much lower rate of complications at 12.2% compared to 25.5% for early appendectomy but also with longer hospital stays, highlighting how conservative management decreases complications at the expense of requiring highly selective patient criteria (van Amstel P *et al.*, 2020).

Another study widened the population to children, with an average stay of 5.57 days and complication rate of 22.99%, highlighting the safety of early surgical intervention in children, although the reported rate of complications highlights the need for vigilance during monitoring (Napar NB *et al.*, 2022). This was further highlighted by another author (Israr S *et al.*, 2021).

Two authors documented successful success rates for conservative management, at 92% and 89% respectively, as well as reduced complication rates of 4% and 3%, highlighting the effectiveness of conservative management across populations (Khan FA *et al.*, 2021; Rajah KH *et al.*, 2023).

Another author documented a 91% success rate for conservative management with a 5% rate of complications, highlighting the feasibility of non-operative treatment (Appa SK *et al.*, 2023).

Another study reported a higher success rate for conservative management and stated longer stay in the hospital for follow-up in comparison to interval treatment stressing on the need for individualized treatment protocol (Tarar B *et al.*, 2023). Another author demonstrated similar findings (Bancke Laverde BL *et al.*, 2023).

Another author performed a study on appendicular masses management focusing on the benefit of conservative management. The study had a high rate of success of 93.3% in conservatively treated patients by the Ochsner-Sherren technique with only 6.7% needing surgery in the future. Additionally, the recurrence of appendicitis was very low at 3.6% within one year, showing that non-operative management is effective to minimize complications and hospital stay. These results support the belief that conservative management is safe and a good choice for the treatment of appendicular masses, in line with other studies on selective surgery and cautious observation (Nandan P P *et al.*, 2024).

The important findings, merits and gaps of the various studies selected in our systematic review were tabulated (**Table 3 and 4**).

Conclusion

The management of appendicular mass is a contentious issue among the surgeons. Conservative and surgical approach both have their own effectiveness levels, safety as well as patient outcomes. Our systematic review and meta analyses focused on multiple studies and their data. We concluded that conservative management was more

effective that comprised of use of antibiotics and thorough monitoring with success rates that ranged from 73% to 93.3%.

Plus, it generally leads to fewer complications and lower chances of recurrence. On the flip side, while early surgery can work well in certain cases, it often results in more complications and longer hospital stays. This really highlights the need for a personalized approach that takes each patient's unique situation into account.

The conservative management was especially beneficial in cases of uncomplicated appendicitis and abscesses with good response rates of patients. In spite of all this, surgery continues to rule in cases which are complicated and conservative management fails to yield better outcomes.

We also found some significant gaps in the existing research, like small sample sizes, retrospective designs, and a lack of long-term follow-up, which makes it difficult to apply these findings in a broader context.

Given the differences in outcomes and the lack of standardized guidelines, this review stresses the need for more high-quality, prospective studies to create clear protocols for managing appendicular mass.

The crucial question that our study aimed to answer based on the management strategies for appendicular mass impacting long-term outcomes across diverse patient groups will not only aid in improved clinical decision making but also yield better patient outcomes by providing evidence-based suggestions.

In a nutshell, while both the methods had their own pros, the development of a better detailed personalized treatment plan with clear guidelines will be the key for effective management and outcomes regarding appendicular mass.

Declaration

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Conflicts of interests

The authors report no conflict of interest.

Ethical approval

Not required because the study was systematic review and meta analyses.

Consent to publication

Not applicable

Availability of supporting data

Not applicable as the study is a systematic review and meta-analyses.

Author contributions

Conceptualization and methodology, S.K, A.S, S.H.; Formal analysis, S.K, A.S, S.H.; Visualization and writing – original draft S.K, A.S, S.H.; Writing – review and editing, S.K, A.S, S.H. and J.H. All authors have read and agreed to the final version of the manuscript.

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