

Review Article

Negative Appendectomy Rates -Current Prospective-Review Article

Abstract

The negative appendectomy rate is generally accepted in the diagnosis of acute appendicitis to prevent complications like perforation. This rate varies according to countries in western and eastern regions of the world. Clinical scoring systems, inflammatory markers and imaging have been used to reduce the negative appendectomy rate. The introduction of computerized tomography has improved the diagnostic accuracy of acute appendicitis. As this rate has been progressively decreasing over the past few years, we have conducted this review article to look at the role of scoring systems, inflammatory markers, and imaging in diagnosing acute appendicitis and hence reduce the negative appendectomy rate.

Keywords-Negative appendectomy, White appendix, Clinical scoring system, Appendectomy

Introduction

Acute appendicitis is a common cause of patients presenting to the emergency department for symptoms of right lower abdominal pain and its incidence is 5.7 to 50 patients per 100,000 in developed countries. (1)

The global incidence of acute appendicitis worldwide is 233 patients per 100,000 population with a lifetime risk of 6.7% to 8.6%.(2)

Negative appendectomy is defined as the final pathological report after appendectomy which shows a normal, congested appendix without inflammation. The negative appendectomy rate ranges from 20 -25% but with the use of per-operative imaging the rate has reduced to 10%. The factors that increase the negative appendectomy rate are female patients, patients who are younger than 40 years and patients with a history of diarrhea. Negative that decreases the negative appendectomy rate are presence of leukocytosis and positive appendicitis, on ultrasound and computerized tomography. (3)

Negative appendectomy is often an indicator of the quality of management of acute appendicitis. As the main aim is to prevent complications like perforated appendicitis, there is a trend for diagnosing acute appendicitis early and proceeding with appendectomy and this has resulted in a higher negative appendectomy rate.(4)

We have conducted this review article to look at the current incidences of negative appendectomy, the factors that affect negative appendectomy and reduce it. A literature review was made on PubMed, Cochrane database of clinical reviews and google scholar to look for original articles, clinical trials, observational and cohort studies, clinical reviews, and review articles from 1996 to 2023. The following keywords were used, “negative appendectomy”, “white appendix”, “acute appendicitis”, and “appendectomy”. All articles were in English language and adults and children were included in the study. Case write ups and commentaries were excluded from this review. Pregnant patients who were presented with acute appendicitis were also excluded from this review.

Negative appendectomy definition and rate

There is no widely accepted term for the definition of negative appendectomy, the most common definition includes a proportion of macroscopically and or histologically normal appendix with no pathological infiltration of the mucosa by polymorphonuclear leucocytes or lymphocytes. This definition is used for cases that have undergone appendectomy.(5)

Another definition of negative appendectomy is the presence of a normal looking appendix during laparoscopic appendectomy for patients who present with right lower abdominal pain. This is still the standard practice in some hospitals.(6)

The negative appendectomy rates vary according to the region with a range of 18-25%. In certain regions like in Africa, the negative appendectomy rate can vary from 16% to 35% depending on the region.(7–9)

In Asia the reported negative appendectomy rates also vary according to the region, like in India where the rate 23.7%. where else in Iran the negative appendectomy rate is about 20%. Certain countries like Oman in central Asia have reported a negative appendectomy rate of 12.23%. In the East Asia the negative appendectomy rate is about 18.2% as reported in Hong Kong.(10–13)

The negative appendectomy rates in western countries also vary with the rate being 19% to 33% in the United Kingdom.(14,15)

The Right Iliac Fossa Treatment (RIFT) study noted that the negative appendectomy rate in the United Kingdom was 28.2% in females and 12.1% in males. The rate among both males and females in other European countries like Italy, Portugal and the republic of Ireland were less than 10%.(16)

The Dutch prospective nationwide outcome audit of surgery of suspected acute appendicitis showed that the negative appendectomy rate in the Netherlands was 2.3%.(17)

The conclusion from these studies is that the negative appendectomy rates vary according to various regions of the world. There are multiple factors that affect the negative appendectomy rate.

Clinical scoring systems and negative appendectomy rate

The Alvarado score is one of the most common scoring systems that has been used to reduce the negative appendectomy rate. A score of 7 or more can reduce the negative appendectomy rate and this was retrospectively assessed by tekeli et al.(18)

The Alvarado score was also prospectively evaluated by bouali et al, and they noted that an Alvarado score of 7 or more was associated with a better diagnosis of acute appendicitis and a negative appendectomy rate of 4.8%. A cross sectional study by memon et al also confirmed this but the negative appendectomy rates were reduced in males and not female patients.(19,20)

The Modified Alvarado score and the Raja Isteri Pengiran anak Saleha appendicitis (RIPASA) score were compared in a retrospective study by Shuaib et al. A score of 7 and above for the modified Alvarado score and 7.5 and above for the Raja isteri Pengiran anak Saleha appendicitis score was associated with a reduction in the negative appendectomy rate. A prospective study by devanathan et al also concluded that the use of both the modified Alvarado score and the RIPASA score was associated with a reduction in the negative appendectomy rate.(21,22)

The raja isteri Pengiran anak Saleha appendicitis (RIPASA) score was prospectively evaluated by singh et al and a cut of score of 7.5 and above in patients with symptoms of acute appendicitis were associated with a better diagnosis and a reduced negative appendectomy rate.(23)

The Adult Appendicitis Score (AAS) was prospectively evaluated and a score of 10 and above was associated with a reduction of the negative appendectomy rate to 8.7%.(24)

The Appendicitis Inflammatory Response Score (AIR) was evaluated in a cross-sectional study and a score of 8 and above was associated with a better diagnosis of acute appendicitis and a reduction of the negative appendectomy rate.(25,26)

In the pediatric population sag et al conducted a prospective study on the clinical scoring systems used in reducing the negative appendectomy rates, and the conclusion was that all the scoring systems were effective in reducing this rate. The negative appendectomy rate was 14.8% in this study.(27)

The conclusion from these studies were that clinical scoring systems were effective in the triage of patients who present with suspected acute appendicitis and were effective in reducing the negative appendectomy rate.

Inflammatory markers and negative appendectomy rate

The common inflammatory markers include the total white cell count, C-reactive protein, neutrophil to lymphocyte ratio and platelet to lymphocyte ratio were retrospectively assessed by yazar et al who concluded that when these markers were used with clinical examination, they improved the diagnostic accuracy of acute appendicitis and hence reduced the negative appendectomy rate.(28)

Most inflammatory markers are useful in the diagnosis of acute appendicitis but are not superior to clinical examination and the duration of symptoms are important to establish the diagnosis and reduce the negative appendectomy rate.(29,30)

A systemic review by acharya et al on the biomarkers of acute appendicitis showed that the use of biomarkers in conjunction with clinical examination will enhance the diagnostic accuracy of acute appendicitis and hence reduce negative appendectomy rate.(31)

Most newer biomarkers like the platelet to lymphocyte ratio, the monocyte to lymphocyte ratio is showing promise in diagnosing acute appendicitis but further studies may be needed to see if it can reduce the negative appendectomy rate.(32,33)

The conclusion from all these studies is that biomarkers are useful in aiding the diagnosis of acute appendicitis when it is combined with clinical examination and imaging. When it is used on its own it will not reduce the negative appendectomy rate.

Imaging and negative appendectomy

The use of imaging modalities like ultrasound and computerized tomography have improved the diagnostic accuracy and reduced the negative appendectomy rate.(34) The use of ultrasound to diagnose acute appendicitis is useful as it involves any use of radiation, and it can be done in the emergency department. A retrospective study by lehmann et al showed its sensitivity was 89.6% and its specificity was 93.8%.(35)

A meta-analysis by Jian Fu et al on the diagnostic accuracy of abdominal ultrasound in the diagnosis of acute appendicitis concluded that the sensitivity was 77.2% and specificity was 60%. Ultrasound was cheap, non-invasive and does not involve the use of ionizing radiation and hence it is useful in diagnosing acute appendicitis.(36)

The use of ultrasound in the diagnosis of acute appendicitis in the pediatric population and a retrospective study by lufvenberg et al concluded that the sensitivity was 82% and its specificity was 97% and it should be the imaging of choice in children regardless of gender.(37)

However, in cases of indeterminate examination of patients with suspected appendicitis, following ultrasound, computerized tomography was the investigation of choice to diagnose

acute appendicitis. The use of computerized tomography has seen a reduction in the negative appendectomy rate.(38–40)

Computerized tomography is the best imaging modality to diagnose acute appendicitis and a retrospective cross-sectional study by Mikwar et al showed that the negative appendectomy rate of 2.66% after imaging against a rate of 13.16% of patients who were diagnosed clinically.(41)

A retrospective study by Webb et al investigated the role of preoperative computerized tomography in patients with acute appendicitis and found that the negative appendectomy rate was 4.7% against 12.7% against those who underwent no imaging. This study confirmed that the negative appendectomy rate was the same in both sexes.(42)

A prospective study by Jamal et al also showed that the use of computerized tomography in patients with suspected appendicitis was associated with a negative appendectomy rate of 6.4% against 19% in patients who did not undergo any imaging.(43)

Further multi-center cross-sectional study on the use of computerized tomography in the diagnosis of acute appendicitis, showed that the negative appendectomy rate was 4.1% and this showed the effective diagnostic capability of this imaging modality. (44)

The conclusion from these studies was that ultrasound and computerized tomography were very effective in reducing the negative appendectomy rates in cases of suspected acute appendicitis.

Conclusion

As the negative appendectomy varies between 10% to 25%, and with better use of clinical scoring systems, blood investigations and imaging has led to improved rates. The use of imaging like Computerized tomography has increased the diagnostic accuracy of acute appendicitis but its limiting factor is its cost, use of ionizing radiation and availability of radiologist to report these images. In Asian countries where cost is an issue, the use of clinical scoring systems may be effectively used to triage patients who present with suspected appendicitis and decide which patients will require imaging. This may be the best method to decrease the negative appendectomy rate.

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Table 1

study	country	N=numbers	Negative Appendectomy rate (NAR)	Study type
Grossberg S et al	South Africa	1217	19%	Retrospective study
Malekpour et al	Iran	1454	20.4%	Retrospective study
Sharma et al	India	118	23.72%	Retrospective

				study
Chaochankit et al	Thailand	892	10%	Retrospective study
Nyamuryekurg E et al	Tanzania	91	38.5%	Retrospective study
Bangu et al	United Kingdom	5345	12.2%-28.2%	RIFT study-retrospective
Van rossem et al	Netherlands	1975	3.3%	Prospective-observational audit

The various negative appendectomy rates in various countries

UNDER PEER REVIEW