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An Update to the Negative Appendectomy Rate: Review Article

Kumar H.R. (MBBS, MS).[1,2]

[1]Associate Professor of Surgery, Department of Surgery, Taylor's University school of medicine and health science,47500 Subang Jaya, Selangor, Malaysia.

[2]Associate Professor, Taylor's University School of Medicine and Science, clinical campus,4700 Sg Buloh, Selangor, Malaysia.

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Corresponding Author:
Kumar Hari Rajah

ABSTRACT

The negative appendectomy rate is the rate of a normal appendix that is diagnosed histologically. It is an indicator of the diagnosis and treatment of acute appendicitis to prevent complications like perforation or abscess formation. In this review, we will look at the predictive factors for negative appendectomy, the role of pre-operative imaging in reducing the negative appendectomy rate, and the role of laparoscopic appendectomy in reducing this rate.

INTRODUCTION

Acute appendicitis is one of the most common causes of acute abdominal pain that presents to the emergency department. It is the most common surgical cause for acute abdominal pain, and it is seen in 5.7 to 50 patients per 100,000 population with a peak at the 10- to 30-year age group. It is seen more commonly in male rather than female patients(1)The diagnosis of acute appendicitis is made using clinical examination and blood investigations, such as a full blood count, to look for leukocytosis. Imaging modalities like ultrasound and computerized tomography are used for cases where there is difficulty in establishing the diagnosis(2).

A negative appendectomy is defined as a normal histological absence of inflammation of the appendectomy specimen from a patient who has undergone an appendectomy. The negative appendectomy rate is the rate of patients who were diagnosed with acute appendicitis pre-operatively and had undergone an appendectomy, and the histological examination of the appendix was normal. It ranges from 20% to 25%, and it is used as an indicator to avoid complications like perforation(3).The use of imaging modalities like ultrasound or computerized tomography can increase the diagnostic accuracy for detecting acute appendicitis and reduce the negative appendectomy rate(4).The negative appendectomy rate often involves histopathological evaluation of the appendix specimen, and this can involve interobserver variability and the definition of negative appendectomy that is used(5).

This review article was done to look at the factors that affect negative appendectomy, and the role of imaging modalities like ultrasound and computerized tomography in reducing the negative appendectomy rate. The role of laparoscopic appendectomy in the negative appendectomy rate is also evaluated. 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 1990 to 2024. The following keywords were used: "negative appendectomy", "white appendix", "acute appendicitis"," ultrasound"," computerized tomography", "appendectomy", and "laparoscopic appendectomy". All articles were in the English language, and adults and children were included in the study. Case write-ups and commentaries were excluded from this review. Adult and pediatric patients with acute appendicitis were included in this review.

DISCUSSION

Variability in the definition of negative appendectomy

Negative appendectomy is often used as a quality metric to increase the likelihood of acute appendicitis and reduce unnecessary appendectomies. The definition of negative appendectomies is the absence of acute neutrophilic infiltration or any other pathology in the appendix specimen, however, the histological criteria that are used are often not stated(6).Pathological abnormalities other than transmural inflammation of the appendix, like those seen in acute gastroenteritis and inflammatory bowel disease, are often not included in the definition of negative appendectomy(7).A stricter definition of negative appendectomy refers to an appendectomy specimen with no findings of pathological inflammation, which features infiltration of the mucosa and wall by inflammatory cells like leukocytes. Lymphocytes and plasma cells(8).

Predictive factors for negative appendectomy rate

Some of the predictive factors for negative appendectomy rate include female patients below the age of twenty-one years, a total white cell count of less than 10,000, urinary symptoms like frequency and urgency, and the absence of rebound tenderness on abdominal examination(9).Inflammatory markers like the total white cell count, neutrophil to lymphocyte ratio, and C-reactive protein are useful to diagnose acute appendicitis, but cannot be used on their own to reduce the negative appendectomy rate(10,11).Pooria et al conducted an observational study on patients with acute appendicitis, and they concluded that the negative appendectomy rate was higher in female patients in the reproductive age group, with ovarian cyst being the most common differential diagnosis for the presentation(12).

The use of the clinical scoring systems and the negative appendectomy rate

Clinical scoring systems like the Alvarado score have been used to aid in the diagnosis of acute appendicitis and reduce the negative appendectomy rate. Tekili et al retrospectively evaluated the role of using the Alvarado score to rule out acute appendicitis, and a score of seven and below was good at ruling out acute appendicitis and hence reducing the negative appendectomy rate(13). Another retrospective analysis by Rodriguez-Garcia et al also retrospectively assessed the role of clinical examination and scoring systems like the Alvarado score, and they concluded that a score of seven or less was associated with a reduced negative appendectomy rate(14). Sammalkorpi H et al introduced the Adult Appendicitis Score as a clinical scoring tool to stratify patients with suspected appendicitis who would require imaging. A total of 908 patients were included in this study, and high-risk patients were stratified at 49%, and low-risk patients were 7%. The negative appendectomy rate had reduced from 18.2% to 8.7%(15).

The role of pre-operative imaging and the negative appendectomy rate

Pre-operative imaging in the form of ultrasound and computerized tomography is effective in reducing the negative appendectomy rate. Chan et al conducted a retrospective study on two hundred and thirty-two patients who had undergone pre-operative imaging for acute appendicitis. The negative appendectomy rate with computerized tomography was 7.25% against 22.09% for those without computerized tomography(16). Ultrasound is often the first imaging modality that is done, especially for pediatric patients, and a retrospective study conducted by Shieh et al found the negative appendectomy rate between 5% and 11%(17). Sharma et al evaluated the usefulness of ultrasound in suspected appendicitis in reducing the negative appendectomy rate. One hundred and eighteen patients were included in this study, and the negative appendectomy rate was 23.72%(18).

Routine computerized tomography was compared to selective imaging by Symonds et al to look at the negative appendectomy rates, and they concluded that there was no significant difference between the negative appendectomy rates of the two groups(19)Teamah et al. evaluated the negative appendectomy rate with preoperative imaging, including computerized tomography and ultrasound. One hundred patients were included in this study, and the sensitivity and specificity of computerized tomography and ultrasound abdomen were 94.1% and 86.7%, respectively.(20).Webb et al looked at those who would benefit from pre-operative computerized tomography, and they concluded that adult patients would benefit, especially female patients, in making a diagnosis of acute appendicitis and hence reducing the negative appendectomy rate(21).

Preoperative imaging, such as computerized tomography has been associated with a reduction of the negative appendectomy rate. Still, the risk of radiation exposure, especially in the pediatric age group and the female adults of childbearing age, has made routine pre-operative computerized tomography difficult. Ultrasound is safe, as there is no risk of radiation exposure, but it is operator-dependent and associated with a sensitivity rate of 60%(22,23).

Laparoscopic appendectomy and the negative appendectomy rate

Guller et al had retrospectively analyzed 7964 patients who had undergone laparoscopic appendectomy for suspected acute appendicitis. Younger patients, female sex, and the absence of localized peritonitis and high American Society of Anesthesia (ASA) score were associated with a higher risk of negative appendectomy. The negative appendectomy rate had reduced from 12.8% to 2.8%(24). Another study by Augustin et al, who compared both laparoscopic and open appendectomy in the management of suspected appendicitis, also concluded that laparoscopic appendectomy was not associated with an increase in the negative appendectomy rate(25).The use of the laparoscopic appendicitis score, which involves scoring the patient on inspection of the appendix for inflammation, and a negative score of 0 will indicate that the appendix is normal and does not need to be removed. Gelpke et al prospectively assessed this scoring system in 322 patients, and there was a slight reduction in the negative appendectomy

rate, and patients with a negative laparoscopic appendicitis score did not develop any symptoms, but the limitations of this study were the small sample size(26).

A systematic review and meta-analysis varying the negative appendectomy rate after laparoscopic appendectomy was conducted by Henriksen et al. A total of 74 studies with 76,688 patients were included in this study, and the negative appendectomy rate varied between 0% to 46%, with an estimated negative appendectomy rate of 13%. This study concluded that the negative appendectomy rate after laparoscopic appendectomy was 13% (27).

CONCLUSION

The negative appendectomy rate is still relevant to assessing the efficacy in the diagnosis of acute appendicitis and its management. The use of imaging modalities like ultrasound and computerized tomography has led to a reduction of the negative appendectomy rate, but not all hospitals can provide these for all their suspected appendicitis patients. Risk-stratifying those patients who will require further investigations to reduce the risk of negative appendectomy. The use of laparoscopic appendectomy has also seen a reduction in the negative appendectomy rate, but the use of conservative treatment of acute appendicitis may require a revaluation of the role of negative appendectomy in the management of acute appendicitis.

Conflict of interest- There is no conflict of interest

REFERENCES

1. Di Saverio S, Podda M, De Simone B, Ceresoli M, Augustin G, Gori A, et al. Diagnosis and treatment of acute appendicitis: 2020 update of the WSES Jerusalem guidelines. World J Emerg Surg. 2020 Apr 15;15(1):27. doi: 10.1186/s13017-020-00306-3. PMID: 32295644; PMCID: PMC7386163.
2. Gorter RR, Eker HH, Gorter-Stam MA, Abis GS, Acharya A, Ankersmit M, et al. Diagnosis and management of acute appendicitis. EAES consensus development conference 2015. Surg Endosc. 2016 Nov;30(11):4668-4690. doi: 10.1007/s00464-016-5245-7. Epub 2016 Sep 22. PMID: 27660247; PMCID: PMC5082605.
3. Chaochankit W, Boocha A, Samphao S. Negative appendectomy rate in patients diagnosed with acute appendicitis. BMC Surg. 2022 Nov 22;22(1):404. doi: 10.1186/s12893-022-01852-0. PMID: 36419019; PMCID: PMC9682723.
4. Şenocak R, Kaymak Ş. Diagnostic accuracy of ultrasonography and scoring systems: The effects on the negative appendectomy rate and gender. Ulus Travma Acil Cerrahi Derg. 2020 Mar;26(2):306-313. English. doi: 10.14744/tjtes.2019.86717. PMID: 32185777.
5. Bhangu A, Søreide K, Di Saverio S, Assarsson JH, Drake FT. Acute appendicitis: modern understanding of pathogenesis, diagnosis, and management. Lancet. 2015 Sep 26;386(10000):1278-1287. doi: 10.1016/S0140-6736(15)00275-5. Erratum in: Lancet. 2017 Oct 14;390(10104):1736. doi: 10.1016/S0140-6736(17)31502-7. PMID: 26460662.
6. Patel H, Kamel M, Cooper E, Bowen C, Jester I. The Variable Definition of "Negative Appendicitis" Remains a Surgical Challenge. Pediatr Dev Pathol. 2024 Nov-Dec;27(6):552-558. doi: 10.1177/10935266241255281. Epub 2024 Jun 6. PMID: 38845117.
7. Maloney C, Edelman MC, Bolognese AC, Lipskar AM, Rich BS. The Impact of Pathological Criteria on Pediatric Negative Appendectomy Rate. J Pediatr Surg. 2019 Sep;54(9):1794-1799. doi: 10.1016/j.jpedsurg.2018.10.106. Epub 2018 Dec 28. PMID: 30685199.
8. Jeon BG. Predictive factors and outcomes of negative appendectomy. Am J Surg. 2017 Apr;213(4):731-738. doi: 10.1016/j.amjsurg.2016.05.020. Epub 2016 Jul 28. PMID: 27769547.
9. Mohebbi HA, Mehrvarz S, Kashani MT, Kabir A, Moharamzad Y. Predicting negative appendectomy by using demographic, clinical, and laboratory parameters: a cross-sectional study. Int J Surg. 2008 Apr;6(2):115-8. doi: 10.1016/j.ijsu.2008.01.002. Epub 2008 Jan 13. PMID: 18289949.
10. Ozan E, Ataç GK, Alişar K, Alhan A. Role of inflammatory markers in decreasing negative appendectomy rate: A study based on computed tomography findings. Ulus Travma Acil Cerrahi Derg. 2017 Nov;23(6):477-482. doi: 10.5505/tjtes.2017.36605. PMID: 29115649.
11. Donald N, Halliday L, Smith G, Dighe S. Risk Factors Associated With Negative Appendicectomy Rates: A Retrospective Cohort Study. Cureus. 2024 Jul 14;16(7):e64509. doi: 10.7759/cureus.64509. PMID: 39139307; PMCID: PMC11320375.
12. Pooria A, Pourya A, Gheini A. Appendicitis: Clinical implications in negative appendectomy. International Journal of Surgery Open. 2021 Feb 1;29:45–9. https://doi.org/10.1016/j.ijso.2021.01.004
13. Tekeli MT, Ilhan E, Ureyen O, Senlikci A, Yeldan E, Ozturk M, Ustuner MA, Gokcelli U, Dadali E, Cengiz F, Yakan S. How much Reliable Is Alvarado Scoring System in Reducing Negative Appendectomy? Indian J Surg. 2017 Apr;79(2):106-110. doi: 10.1007/s12262-015-1433-2. Epub 2016 Jan 11. PMID: 28442835; PMCID: PMC5386934.
14. Rodriguez-Garcia FA, Rodríguez-Sánchez CE, Naranjo-Chávez JC, Torres-Ortiz-Ocampo CJ, Rojas-Larios F, Covarrubias-Ramírez K, Evangelista-Ruiz EM, Torres-Salazar QL. Assessment of negative appendectomy in acute appendicitis

diagnoses. Surg Pract Sci. 2025 Apr 5;21:100281. doi: 10.1016/j.sipas.2025.100281. PMID: 40270918; PMCID: PMC12017968.

15. Sammalkorpi HE, Mentula P, Savolainen H, Leppäniemi A. The Introduction of Adult Appendicitis Score Reduced Negative Appendectomy Rate. Scand J Surg. 2017 Sep;106(3):196-201. doi: 10.1177/1457496916683099. Epub 2017 Mar 1. PMID: 28737110.
16. Chan J, Fan KS, Mak TLA, Loh SY, Ng SWY, Adapala R. Pre-Operative Imaging can Reduce Negative Appendectomy Rate in Acute Appendicitis. Ulster Med J. 2020 Jan;89(1):25-28. Epub 2020 Feb 18. PMID: 32218624; PMCID: PMC7027177.
17. Shieh A, Pham PK, Plouffe NA, Heyming TW. Negative Appendectomies: Evaluating Diagnostic Imaging Techniques at General versus Pediatric Emergency Departments. J Emerg Med. 2023 Mar;64(3):304-310. doi: 10.1016/j.jemermed.2022.12.018. Epub 2023 Mar 1. PMID: 36868944.
18. Sharma R, Kasliwal DK, Sharma RG. Evaluation of negative appendicectomy rate in cases of suspected acute appendicitis and to study the usefulness of ultrasonography in improving the diagnostic accuracy. Indian J Surg. 2007 Oct;69(5):194-7. doi: 10.1007/s12262-007-0020-6. Epub 2008 Jul 30. PMID: 23132981; PMCID: PMC3452587.
19. Symonds T, Buschel H, Avramovic J, Palamuthusingam P. Routine Computed Tomography Versus Selective Imaging: An Audit of Negative Appendicectomy Rates in Two Hospitals. Cureus. 2022 Dec 10;14(12):e32389. doi: 10.7759/cureus.32389. PMID: 36632248; PMCID: PMC9830005.
20. Teamah, Mohamed Sobhy; Mohamed, Abdel Fattah Morsi saeid; and Morsi, Hany Mohammed Ahmed (2023) "Evaluation of Negative Appendectomy Rate with Preoperative Computed Tomography and Ultrasonography," *Al-Azhar International Medical Journal*: Vol. 4: Iss. 3, Article 11. DOI: https://doi.org/10.58675/2682-339X.1701
21. Webb EM, Nguyen A, Wang ZJ, Stengel JW, Westphalen AC, Coakley FV. The negative appendectomy rate: who benefits from preoperative CT? AJR Am J Roentgenol. 2011 Oct;197(4):861-6. doi: 10.2214/AJR.10.5369. PMID: 21940573.
22. Dirie J, Suleman H, Karimjee H. The Effect of Preoperative Imaging on the Negative Appendicectomy Rate. Cureus. 2023 Jul 13;15(7):e41809. doi: 10.7759/cureus.41809. PMID: 37575745; PMCID: PMC10422921.
23. Grossberg SJ, Brener JD, Bizos EL, Candy GP, Bizos DB. The negative appendicectomy rate at Charlotte Maxeke Johannesburg Academic Hospital - a 10-year review. S Afr J Surg. 2022 Mar;60(1):4-9. PMID: 35451262.
24. Güller U, Rosella L, McCall J, Brügger LE, Candinas D. Negative appendicectomy and perforation rates in patients undergoing laparoscopic surgery for suspected appendicitis. Br J Surg. 2011 Apr;98(4):589-95. doi: 10.1002/bjs.7395. Epub 2011 Jan 24. PMID: 21259233.
25. Augustin G, Čižmešija Z, Žedelj J, Petrović I, Ivković V, Antabak A, Mijatović D, Škegro M. LAPAROSCOPIC APPENDECTOMY DOES NOT INCREASE THE RATE OF NEGATIVE APPENDECTOMY along with a lower rate of perforated appendicitis - RESULTS IN 1899 PATIENTS at Zagreb UHC. Acta Clin Croat. 2018 Sep;57(3):503-509. doi: 10.20471/acc.2018.57.03.14. PMID: 31168184; PMCID: PMC6536279.
26. Gelpke K, Hamminga JTH, van Bastelaar JJ, de Vos B, Bodegom ME, Heineman E, Hofker HS, El Moumni M, Haveman JW. Reducing the negative appendectomy rate with the laparoscopic appendicitis score; a multicenter prospective cohort and validation study. Int J Surg. 2020 Jul;79:257-264. doi: 10.1016/j.ijsu.2020.04.041. Epub 2020 May 6. PMID: 32387211.
27. Henriksen SR, Christophersen C, Rosenberg J, Fonnes S. Varying negative appendectomy rates after laparoscopic appendectomy: a systematic review and meta-analysis. Langenbecks Arch Surg. 2023 May 23;408(1):205. doi: 10.1007/s00423-023-02935-z. PMID: 37219616.