

Original Research Article

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Incidence of negative appendectomy: retrospective follow-up of histopathology specimens

Deep P. Talreja¹, Rani Bai¹, Sagar Talreja¹, Hamed H. Al-Amri¹, Khalid Al Sawafi¹,
Parwez Waseemul Haque¹, Ayman Albatanony^{1,2*}

¹Department of General Surgery, Ibra Hospital, North Sharqiya, Oman

²Department of General Surgery, Menoufia faculty of medicine, Menoufia, Egypt

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***Correspondence:**

Dr. Ayman Albatanony,

E-mail: aymanalbatanony@hotmail.com

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ABSTRACT

Background: Diagnosing acute appendicitis (AA) remains challenging in spite of multiple modern diagnostic tools, therefore normal appendices may be removed in some patients thought to have AA. Negative appendectomy remains a concern in current surgical practice. The aim of this study was to determine the rate of negative appendectomy in Ibra hospital in North Sharqiya, Oman.

Methods: This is a retrospective analysis of 515 appendectomies carried out at Ibra hospital, North Sharqiya, Oman between January 2019 and December 2021. The final diagnosis was based on histopathology reports which were retrieved.

Results: A total of 515 appendectomies were performed during the study period. The mean age of the patients was 22.76 years (range, 10-70 years). Patients older than 12 years represented 81.4% of the study population. Female patients accounted for 47% of all the patients. The negative appendectomy rate (NAR) was 9.7% (50 patients). Out of these 50 negative appendectomies, 24 patients were adult females, 21 were adult males and 5 patients were children (4 female and 1 male). The female sex accounted for 56% of the negative appendectomies.

Conclusions: female sex is a risk factor for negative appendectomy. Most studies have suggested that CT is efficacious only in decreasing the NAR among women; we found that men benefited from CT as well.

Keywords: Acute appendicitis, Negative appendectomy, Histopathology, Laparoscopic appendectomy, Open appendectomy

INTRODUCTION

Acute appendicitis (AA) is the most common emergency surgical presentation and emergency appendectomy is the most common operation performed worldwide.¹⁻³ Appendectomy is most probably the first abdominal surgery a resident performs during his surgical training. Although in the advancement of modern diagnostic tools, there is still no single investigation that can give a definite diagnosis. Therefore, AA remains a clinical

diagnosis. A negative appendectomy is defined as one which is performed for a clinical diagnosis of AA but in which the appendix is found to be normal on histopathology examination.^{3,4}

The rates of negative appendectomy vary from place to place. The reported NAR varies from 4 to 45%, with the highest incidence in women of the reproductive age group.⁴ AA is rare in infants, and it reaches a peak incidence in teens and early 20s where the incidence is

equal among males and females before puberty, but in young adults, the male: female ratio increases to 3:2.³⁻⁵ The aim of this study was to determine the rate of negative appendectomy in Ibra hospital in North Sharqiya, Oman.

METHODS

This retrospective study was conducted in 2022, in the department of general surgery, Ibra referral hospital, North Sharqiya, Oman on patients operated for AA between January 2019 and December 2021. Negative appendectomies are those surgeries that were performed for a clinical diagnosis of AA but were later found to have evidence of acute inflammation in the histopathology specimens. The inclusion criteria were any patient operated for appendicectomy with the diagnosis of AA, whether open or laparoscopic, and whose appendix was sent for histopathology. The exclusion criteria were appendices removed for other indications: e.g., interval appendicectomy or as part of other operations. Also, we excluded from the study all cases where the histopathology report of the removed appendix was not retrieved. Relevant data (such as patients' age, gender, clinical presentation, laboratory investigations, imaging, operative findings, and histopathology results of submitted appendicectomy specimens) were retrieved from the hospital's

computerized Al-Shifa system, tabulated and studied. Student's t test was used for comparison. Data were presented as mean and range. Ethical approval was obtained for the implementation and publication of this study from the ethical committee and the director of Ibra hospital, North Sharqiya. Patient data were collected without personal identifiers. The adequate level of confidentiality of the research data had been ensured. Statistical analysis was done using the SPSS® software version 20.

RESULTS

The total number of cases 515 cases. Among these patients, 224 (47.47%) males and 273 (53.53%) were females, thus making a female to male ratio of 1.1:1. The peak age incidence was found to be between 21 and 40 years with a mean age incidence of 22.1 years. More than 80% of cases occurred below age of 40 years (Table 1).

Histological report in 459 cases (80.1%) showed features of acute inflammation, which included AA, lymphoid hyperplasia, intraluminal parasites consistent with enterobius vermicularis, suppurative appendicitis, gangrenous appendicitis, perforation and periappendicitis. Negative appendectomies 50 patients (9.7%). One patient histological diagnosis adenocarcinoma, 5 patients diagnosis carcinoid tumor.

Table 1: Age distribution of the studied cases.

Variables	Frequency	Percent (%)	Valid percent (%)	Cumulative percent (%)
Age (Years)	Child ≤12	90	17.5	17.5
	Adult (13-59)	419	81.4	98.8
	Elderly ≥60	6	1.2	100
	Total	515	100	

Table 2: Histopathology of all appendicectomy specimens.

Variables	Frequency	Percent (%)	Valid percent (%)	Cumulative percent (%)
Valid	AA	459	89.1	89.1
	Adenocarcinoma	1	0.2	89.3
	Carcinoid tumor	5	1.0	90.3
	Negative	50	9.7	100
	Total	515	100	

Out of 50 negative appendectomies, 24 patients were adult females, 21 were adult males and 5 patients were children (4 female and 1 Male). The female sex accounted for 56% of the negative appendectomies. Abdominal ultrasound was done to exclude other abdominal pathology, whereas in 374 patients (72.6%) ultrasound was reported as AA. In 132 cases the ultrasound was inconclusive. In the remaining cases, the report varied: e.g., appendicular lump, hemorrhagic ovarian cyst and normal appendix. Selected 28 patients (5.4%) were selected for undergoing CT.

DISCUSSION

A negative appendectomy represents a dilemma. Its rate in the literature varies widely between 6 and 40%.^{1,2} Being too careful and removing the appendix with the slightest suspicion will avoid the possible consequences of appendicitis such as perforation, peritonitis, abscess formation, peritonitis, and sepsis. However, this will expose the patients to unnecessary risks of anesthesia and

surgery, not to mention the financial costs. The suggested acceptable rate of negative appendectomy is 20%.²⁻⁴ The NAR in our study was 9.7%.

Flum and Koepsell reported the findings of a retrospective analysis of 261,134 patients who underwent non- incidental appendectomies with a NAR of 15.3% (reference). The incidence of negative appendectomies has reportedly been on the decline with large database studies as low as 6-8.4% and single-institution studies as low as 1.7-7%.^{7,8,10,17} The documented decline in NAR notably coincided with increased use of imaging especially computed tomography and laparoscopy as diagnostic tools for appendicitis.¹⁸ Low NAR has been attributed to the use of computed tomography by some studies, however, a definitive causal relationship has not been established.³⁻⁵

CT has a sensitivity of 90-100%, specificity of 91-99%, and a positive predictive value of 95-97%. CT has also proven to be superior to USS in the diagnosis of suspected appendicitis and this observation is consistent with the findings of this study which suggests that USS negative and USS inconclusive reports are not reliable.⁴ The contributory role of imaging in the low incidence of NAR has been further supported by the findings of Raja et al in an 18-year review. They observed a significant reduction in NAR from 23% in 1990 to 1.7% in 2007 and this reduction occurred with the significant increase of preoperative CT from 1% to 97.5% in the same period.¹⁰ Our study reinforces the importance of history taking, clinical examination, basic laboratory investigations, and the selective use of imaging in the diagnosis of AA.

A higher negative appendectomy rate in the female sex compared to the male sex has been reported by multiple studies.⁴⁻⁶ Seetahal et al in a 10-year review of a nationally representative sample of 475,651 cases of appendectomy reported that women accounted for 71.6% of the negative appendectomies.⁵⁻⁷ This is consistent with the findings of this study in which females accounted for approximately 60% of the negative appendectomies. Reasons adduced for this observation include the gynecological conditions that could mimic the presentation of AA. Ovarian cysts, leiomyoma, endometriosis, benign ovarian neoplasms, malignant ovarian disease, and pelvic adhesions have been reportedly misdiagnosed as AA in women.^{7,8} Histopathological examination of resected appendix specimens helps to confirm the diagnosis of appendicitis and also unravels other incidental pathologies that may impact the management of patients. In patients with negative appendectomy, patients' symptoms frequently disappear postoperatively. It has been suggested that in these THERE may be an early sub-clinical appendicitis. The consequences of unusual pathological findings in the literature include gastroenterology follow-up, periodic surveillance, antituberculosis medications, helminthic treatment, right colectomy, and palliative care.^{9,10}

The incidence of unusual pathologies in our study is low (1.2%) and this is consistent with the findings in the literature.¹¹⁻¹³ Unusual pathologies in our study include adenocarcinoma and carcinoid tumor which is consistent with findings reported in the literature. Documented unusual pathologies found on histological examination of resected appendix in the literature include endometriosis, primary or secondary adenocarcinoma, neurofibroma, lymphomas, granulomatous conditions suspicious for tuberculosis and Crohn's disease, eosinophilic appendicitis, Vermicular and actinomycosis of the appendix.¹⁴ The observation of 1,825 unusual pathologies in the retrospective review of 24,697 appendectomy specimens is in support of the continued use of routine histopathological examination of a resected appendix.^{15,16} A systematic review of 19 studies on the usefulness of routine histopathological examination of appendectomy specimens also observed that the incidence of unexpected findings in appendectomy specimens is low and intra-operative diagnosis alone appears insufficient for identifying unexpected diseases and it is subject to great variation.^{16,17} One of the limitations of this study was the inter-personal variation between surgeons diagnosing AA. Our study identified the overall negative appendectomy cases done in Ibra referral hospital, but when we subdivided cases according to surgeons, the rate was higher for some surgeons and lower for others. The same applies for radiologists commenting on ultrasonography and computed tomography. Another limitation is the number of studied cases, which is not small, but larger number of cases will improve the results.

CONCLUSION

Appendicitis can be challenging to diagnose. The NA rate in our study was 9.7%, and misdiagnosis was mostly associated with females. A positive CT was the sole independent predictor of the absence of NA. To reduce the NA rate, we suggest the utilization of CT for patients with symptoms of AA. Further prospective studies are needed to validate our findings and demonstrate how many unnecessary appendectomies can be avoided. Routine histopathology examination of the appendix must be undertaken in all cases. Results of all pre-operative investigations are non-specific, and diagnosis is made only after histopathology.

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