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Incidence of malignancy in appendectomy specimens: a three-year retrospective analysis

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ABSTRACT

Aims: Appendectomy is one of the most commonly performed surgical procedures for acute abdominal pain. Although inflammatory changes are the predominant pathological findings, unexpected neoplastic lesions may also be identified in a small proportion of appendectomy specimens.

Methods: This study included all patients who underwent appendectomy at our institution between August 2022 and August 2025. All appendix specimens removed, regardless of the surgical indication, were evaluated. Pathology reports were retrieved from the electronic archive and analyzed on a patient-specific basis.

Results: A total of 1168 appendectomy cases were included. Patient ages ranged from 7 to 84 years, with a median age of 33 years (IQR: 24-42) and a mean age of 34.6±12.5 years. Of the patients, 690 (59.1%) were male and 477 (40.8%) were female; sex information was unavailable for one patient. Malignancy was detected in three cases. According to morphology codes, malignancy subtypes were recorded as NET G1 (8240/3) and unspecified malignant neoplasm (8000/3). In addition, four cases were diagnosed as low-grade appendiceal mucinous neoplasm (LAMN). The ages of patients with LAMN ranged from 35 to 65 years, with an equal sex distribution.

Conclusion: This study demonstrates that the incidence of malignancy in appendectomy specimens is low; however, distinct histopathological entities with potential implications for clinical management may be encountered. In addition to malignant subtypes such as neuroendocrine tumors and adenocarcinoma, LAMN should be carefully reported as a separate diagnostic category. Given the potential association of LAMN with complications such as pseudomyxoma peritonei, these lesions carry particular clinical relevance. The findings underscore the importance of thorough histopathological evaluation of all appendectomy specimens and suggest that reporting contemporary incidence data from our country may contribute to the standardization of pathological reporting and postoperative follow-up strategies.

Keywords: Appendectomy, neoplasms, neuroendocrine tumors, adenocarcinoma

INTRODUCTION

Appendectomy is one of the most frequently performed emergency surgical procedures worldwide, and although the majority of specimens reveal inflammatory pathology, a small proportion contain incidental neoplastic lesions.[1] Recent systematic reviews have reported that the incidence of neoplasia in appendectomy specimens ranges approximately between 0.7% and 2%, with neuroendocrine tumors (NETs) being consistently identified as the most common histological subtype.[2,3]

Epidemiological analyses from population-based registries have demonstrated that primary appendiceal neoplasms remain rare; however, a significant increase in incidence has been observed over the last two decades, likely reflecting improved pathological recognition and increased surgical volume.[4,5]

Among non-invasive mucinous lesions, low-grade appendiceal mucinous neoplasm (LAMN) constitutes a distinct pathological category due to its potential progression to pseudomyxoma peritonei (PMP) when associated with perforation or extra-luminal mucin. Current World Health Organization (WHO) and expert consensus guidelines emphasize the importance of reporting LAMN separately from malignant tumors because of its unique biological behavior.[6]

Given these epidemiological patterns and evolving pathological classifications, understanding the incidence and distribution of appendiceal neoplasms-even in routine appendectomy series-remains clinically relevant. The present study evaluates all appendectomy specimens processed at our institution over a three-year period, with the objective of determining the incidence of malignancy (behavior code/3) and describing the frequency of LAMN as a separate diagnostic subgroup.

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METHODS

Approval for the study was obtained from the Scientific Researches Ethics Committee of Sincan Training and Research Hospital (Date: 27.10.2025, Decision No: SEAH-BAEK-2025-105). All procedures were carried out in accordance with the ethical rules and the principles of the Declaration of Helsinki.

This study was conducted using a single-center, retrospective, observational design. All patients who underwent appendectomy at our institution between August 2022 and August 2025 were consecutively included. All appendix specimens removed, regardless of the indication for surgery (acute appendicitis, incidental appendectomy, etc.), were included in the study. Pathology reports were retrieved from the electronic archive and combined to ensure each patient was unique. Incidental appendectomies could not be reliably differentiated within the pathology-based dataset, because the study was designed using pathology archive records rather than operative notes. For this reason, all appendectomy specimens reported by pathology (whether primary or incidental) were included in the analysis, consistent with previous pathology-driven incidence studies.

All specimens underwent routine histopathological evaluation (H&E), and lesions were classified according to ICDO morphology and behavior codes. Malignancy was defined as tumors reported with behavior code /3 (e.g., adenocarcinomas, NETs). LAMN cases were accepted as borderline behavior mucinous neoplasms with the ICDO code 8480/1 and were reported as a separate subgroup without being included in the malignancy incidence. The current pathology classification was referenced for the diagnosis and reporting principles of LAMN.[6]

The primary endpoint was to determine the incidence of malignancy in appendectomy specimens, expressed as a percentage with 95% confidence intervals. Secondary analyses included the frequency of LAMN, distribution of malignant subtypes, and distribution by age, sex, and year. For continuous variables, the mean±SD or median [IQR] was calculated; for categorical variables, the number and percentage were calculated. Percentages were calculated using the 95% confidence interval (CI) Wilson method. All statistical analyses were performed using IBM SPSS Statistics (IBM Corp., Armonk, NY); a two-tailed $p<0.05$ was considered statistically significant.

RESULTS

The study included a total of 1,168 appendectomy cases performed between August 2022 and August 2025. The patients' ages ranged from 7 to 84 years. The median age was 33 years (IQR: 24-42), and the mean age was 34.6±12.5 years. There were 690 male patients (59.1%), 477 female patients (40.8%), and 1 patient whose gender was unknown. Sex information for the single patient with missing data was unavailable due to incomplete demographic records in the electronic pathology archive. The demographic data of the patients are summarized in Table 1.

A total of 3 malignancy cases were detected (rate: 0.26%; 95% CI: 0.09%-0.75%). Malignancy subtypes, according to morphology codes, were recorded as NET G1 (8240/3) and unspecified malignant neoplasm (8000/3). The subtype distribution of cases with detected malignancy is summarized in Table 2.

Table 1. Basic characteristics of patients and incidence of malignancy/LAMN

Variable	Value
Total number of cases	1168
Age (median [IQR])	33 [24-42]
Age (mean±SD)	34.6±12.5
Gender (male)	690 (59.1%)
Gender (female)	477 (40.8%)
Malignancy, n (%)	3 (0.26%)
Malignancy 95% confidence interval	0.09%-0.75%
LAMN, n (%)	4 (0.34%)
LAMN 95% confidence interval	0.13%-0.88%

* Note: Gender information was not available for one patient; percentages were calculated based on the total number of cases. LAMN: Low-grade appendiceal mucinous neoplasm, IQR: Interquartile range, SD: Standard deviation

Table 2. Subtype distribution of cases with detected malignancy

Morphology code	Definition	Number of cases
8000/3	Malignant neoplasm	2
8240/3	Carcinoid tumor	1

Additionally, 4 cases were reported as LAMN (rate: 0.34%; 95% CI: 0.13%-0.88%). The ages of LAMN cases ranged from 35 to 65 years, with two male and two female patients.

DISCUSSION

In this single-center retrospective study, malignant appendiceal tumors were rarely identified in routine appendectomy specimens; however, the histological spectrum observed underscores the clinical relevance of incidental neoplastic findings. When interpreted in the context of the existing literature, the low incidence observed in our series is not unexpected and falls within the wide range of rates reported for appendiceal neoplasms detected after appendectomy. Previous appendectomy-based studies have reported that appendiceal neoplasms are detected in approximately 0.7%-2.5% of specimens, with variability largely attributed to differences in study design, patient selection, and pathological classification systems.[2,3] Accordingly, the lower incidence observed in our series may be related to the single-center retrospective design, the limited absolute number of malignant cases, and the use of a pathology-based dataset that did not allow stratification by appendicitis severity or operative indication.

With respect to histological subtypes, NETs are consistently reported as the most frequent neoplastic lesions encountered in appendectomy specimens across different series. Large appendectomy series and population-based analyses have shown that NETs account for a substantial proportion of appendiceal neoplasms, frequently representing the most common histological subtype identified after appendectomy.[2,4] In our series, only a very limited number of NETs were identified, a finding that should be interpreted cautiously given the overall low number of malignant cases and the single-center retrospective nature of the study. Despite their

generally indolent behavior, the identification of appendiceal NETs remains clinically important, as current ENETS guidelines emphasize tumor size, mesoappendiceal invasion, and margin status as key determinants of postoperative management and the need for additional surgery.[7]

LAMN represents a distinct pathological entity that differs from invasive appendiceal adenocarcinoma in terms of biological behavior and clinical management and therefore warrants separate consideration in appendectomy series. Although LAMN lacks conventional histological invasion, it may be associated with the development of PMP in the presence of perforation or extra-luminal mucin, which underlies current recommendations to classify and report LAMN separately from invasive appendiceal adenocarcinoma.[6] In our series, the identification of LAMN highlights the importance of careful histopathological evaluation of appendectomy specimens, as these lesions may otherwise remain unrecognized despite their potential implications for postoperative follow-up. To reduce ambiguity in appendiceal mucinous lesions, the PSOGI consensus provides standardized terminology and diagnostic definitions for routine reporting, including clear separation of non-infiltrative mucinous neoplasms from invasive adenocarcinoma.[6]

The reported incidence of unexpected appendiceal neoplasms in appendectomy specimens varies across studies, reflecting differences in case-mix (adult vs pediatric population), clinical presentation, and surgical strategy (e.g., immediate vs interval appendectomy).[2,3] Large retrospective datasets further suggest that the probability of detecting an underlying neoplasm increases with advancing age and is higher in complicated appendicitis phenotypes (e.g., perforation or periappendicular abscess), where malignant histologies (such as adenocarcinoma or pseudomyxoma) are disproportionately represented.[8] In line with this, adult cohorts managed with an interval approach after complicated appendicitis have shown substantially higher neoplasm rates compared with immediate appendectomy groups.[9] In the present series, the small number of malignant cases (n=3) precluded a meaningful assessment of age-related risk; however, LAMN cases occurred in adult patients (35-65 years), which is compatible with the predominantly adult distribution reported in contemporary appendectomy series that include mucinous neoplasms among the most frequent appendiceal tumor types.[2,3] Taken together, these data support interpreting malignancy rates in appendectomy-based studies within an appropriate clinical and demographic context-particularly in adults and in complicated appendicitis-rather than assuming uniform risk across all age groups.[8,9]

Limitations

The relatively low malignancy rate observed in the present study may be explained by several factors. First, the cohort consisted predominantly of younger patients, with a median age of 33 years, a demographic characteristic that has been associated with lower appendiceal neoplasm detection rates in prior studies. Second, the study reflects routine emergency appendectomy practice rather than a selected population undergoing interval appendectomy after complicated disease, a context in which higher neoplasm rates have been reported. Finally, the retrospective, single-center design and the limited absolute number of malignant cases inherently constrain the detection of less common appendiceal tumors. These considerations should be taken into account when comparing malignancy rates across appendectomy series with differing patient profiles and clinical settings.

CONCLUSION

In this large single-center retrospective series, the incidence of malignant appendiceal neoplasms detected after appendectomy was low. While malignancy remains an uncommon finding in routine appendectomy specimens, the presence of clinically relevant neoplastic entities such as LAMN highlights the need for careful pathological evaluation. The findings emphasize that malignancy rates should be interpreted in light of patient age, clinical presentation, and study context. Further multicenter studies with larger cohorts may help to better define risk profiles and inform tailored diagnostic and follow-up strategies in patients undergoing appendectomy.

ETHICAL DECLARATIONS

Ethics Committee Approval

Approval for the study was obtained from the Scientific Researches Ethics Committee of Sincan Training and Research Hospital (Date: 27.10.2025, Decision No: SEAH-BAEK-2025-105).

Informed Consent

As this was a retrospective study, formal written informed consent was not required and was therefore not obtained.

Peer Review Process

This manuscript was subject to external peer review.

Conflict of Interest

The authors declare no conflicts of interest related to this study.

Financial Disclosure

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Author Contributions

Concept: T.E.S., G.K.; Design: T.E.S., H.H.A.; Control: T.E.S., G.K.; Data collection and/or processing: T.E.S.; Analysis and/or interpretation: T.E.S., G.K.; Literature review: T.E.S., H.H.A.; Article writing: T.E.S., G.K.; Critical review: All authors.

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