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Original Research Article

Histopathological Spectrum of Appendicular Lesions with Emphasis on Incidence of Appendiceal Neoplasms in A Tertiary Care Hospital- Retrospective Descriptive Study

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Abstract:

Background: Appendicitis remains the most common cause of emergency abdominal surgery. While the majority of appendectomy specimens show inflammatory pathology, a subset reveals unexpected findings, including granulomatous, parasitic, or neoplastic lesions. Although appendiceal neoplasms are rare, their detection is clinically important as they may alter management and prognosis.

Methods: This retrospective descriptive study analyzed 446 appendectomy specimens received in the Department of Pathology of a tertiary care hospital between January 2022 and January 2025. Demographic details were collected, and all specimens underwent gross and microscopic evaluation. Histopathological diagnoses were classified, and data were analyzed using SPSS v22.

Results: The study included 245 males (54.9%) and 201 females (45.1%), with a male-to-female ratio of 1.22:1. Patient age ranged from 6 to 79 years, with peak incidence in the second (25.3%) and third decades (26.3%). Acute appendicitis was the most frequent finding (168 cases, 37.67%), followed by chronic/recurrent appendicitis (135 cases, 30.27%) and acute appendicitis with peri-appendicitis (56 cases, 12.56%). Other patterns included suppurative appendicitis (5.83%), gangrenous appendicitis (0.67%), perforated appendicitis (2.47%), fibrous obliteration (4.48%), eosinophilic appendicitis (2.69%), and rare conditions such as tuberculous appendicitis (0.45%) Enterobius vermicularis infestation (0.67%), Meckle's diverticulitis (0.45%) and chronic appendicitis with inflammatory bowel disease (0.22%). Neoplastic lesions were detected in 7 cases (1.57%), comprising neuroendocrine tumors (3 cases, 0.67%), low-grade appendiceal mucinous neoplasms (3 cases, 0.67%), and mucinous cystadenoma (1 case, 0.22%).

Conclusion: Inflammatory lesions accounted for the majority of appendectomy specimens, with acute appendicitis being the most common diagnosis. Neoplasms, though infrequent, were clinically significant incidental findings, highlighting the necessity of routine histopathological examination of all appendectomy specimens.

Introduction

Acute appendicitis is an inflammatory condition that typically originates in the mucosa of the vermiform appendix and progressively involves the entire appendiceal wall up to the serosa [1,2]. Owing to its slender, worm-like projection from the cecum, it is also referred to as the vermiform appendix [3]. Globally, acute appendicitis represents the most frequent surgical emergency of the abdomen, with appendectomy being one of the most commonly performed surgical procedures, particularly in individuals during their second and third decades of life [4].

The reported incidence of appendiceal neoplasms in appendectomy specimens has historically been low, estimated at approximately 0.12 cases per 1,000,000 individuals annually. More recent population-based database studies, however, suggest that the incidence may be considerably higher, reaching up to 0.97 per 100,000 population [5,6]. In developing regions such as urban India, the burden of acute appendicitis is rising, a phenomenon attributed to increasing westernization of diet and lifestyle [7]. Current estimates indicate an annual incidence of

around 233 cases per 100,000 population, with a lifetime risk ranging between 6.7% and 8.6% [8,9].

Although appendiceal neoplasms account for fewer than 2% of appendectomy specimens, their recognition is clinically relevant, as the absolute number of detected cases has risen in parallel with increasing appendectomy rates and improved histopathological scrutiny [10]. The pathogenesis of acute appendicitis is multifactorial, most commonly related to luminal obstruction by fecaliths, lymphoid hyperplasia, or inspissated fecal material, and occasionally secondary to infections or, more rarely, neoplastic lesions of the appendix or cecum [11].

Malignant appendiceal tumors are rare and often present with nonspecific clinical features, which contributes to the scarcity of robust epidemiological data. While reports indicate an increase in incidence between 1990 and 2019, it is uncertain whether this upward trend has persisted in recent years or whether it is uniform across different geographic regions [12].

Against this background, the present study was undertaken to evaluate the histopathological spectrum of appendiceal lesions in a tertiary care center in South India, with a particular emphasis on determining the incidence of malignant appendiceal tumors.

Methodology

Retrospective Descriptive study done on 446 appendicectomy specimen received in department of histopathology from January 2022 to January 2025. Patient data was accessed to extract demographic data and histopathological findings following appendectomy. The data was analysed using SPSSv22

Data collection: Clinical details such as age, sex, presenting complaints, and pertinent medical history were retrieved from the requisition forms. All appendectomy specimens were subjected to detailed gross examination, followed by routine tissue processing and hematoxylin and eosin (H&E) staining. Final histopathological interpretation was made on microscopic evaluation, and the lesions were categorized according to established diagnostic criteria described in standard pathology reference literature..

Objectives:

1) To analyze the Histopathological spectrum of Appendicectomy Lesions in all age groups
2) To assess the incidence of Appendiceal malignancies in all age groups

Inclusion criteria:

1) All the appendicectomy specimens received in department of pathology clinically diagnosed as acute appendicitis from January 2022 to January 2025

Exclusion criteria:

1) Patients in whom appendix is removed as part of other surgical procedures are excluded from the study

Results

A total of 446 appendectomy specimens were received in the Department of Pathology over a study period spanning three years, from January 2022 to January 2025. Of these, 245 patients were male (54.93%) and 201 were female (45.1%), resulting in a male-to-female ratio of 1.22:1. The age range of patients extended from 6 to 79 years, with a higher overall frequency of appendectomies observed in the male population.

The clinical spectrum of appendiceal pathology was dominated by acute appendicitis, which accounted for 168 cases (37.67%), followed by chronic/ recurrent appendicitis in 135 cases (30.27%). Additionally, 56 cases (12.56%) were diagnosed as acute appendicitis with peri-appendicitis, and 26 cases (5.83%) as acute suppurative appendicitis. Less common presentations included gangrenous appendicitis in 3 cases (0.67%), perforated appendicitis in 11 cases (2.47%), fibrous obliteration of the appendix in 20 cases (4.48%), and eosinophilic appendicitis in 12 cases (2.69%). Parasitic and granulomatous conditions were rare, with 3 cases (0.67%) of Enterobius vermicularis and 2 cases (0.45%) of tuberculous appendicitis. Other uncommon findings included chronic appendicitis associated with Meckel's diverticulum in 2 cases (0.45%) and 1 case (0.22%) of Chronic appendicitis with inflammatory bowel disease.

Out of the total cohort, seven patients (1.56%) were diagnosed with appendiceal neoplasms. The most common tumor types were neuroendocrine tumors seen in 3 cases (0.67%) and low-grade appendiceal mucinous neoplasms (LAMN) seen in 3 cases (0.67%) and 1 case (0.22%) of mucinous cystadenoma was identified.

Table 1: Distribution according to Sex

Sex	Number of cases
Male	245
Female	201

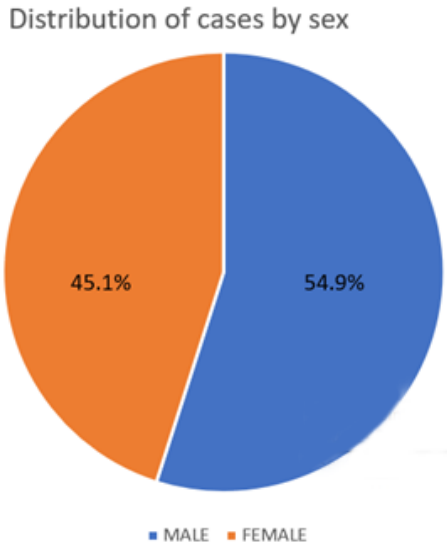

Figure 1: Distribution of cases by sex

Figure 1: Distribution of appendectomy cases by sex. Out of the total cases, 245 (54.9%) were males and 201 (45.1%) were females, showing a slight male predominance.

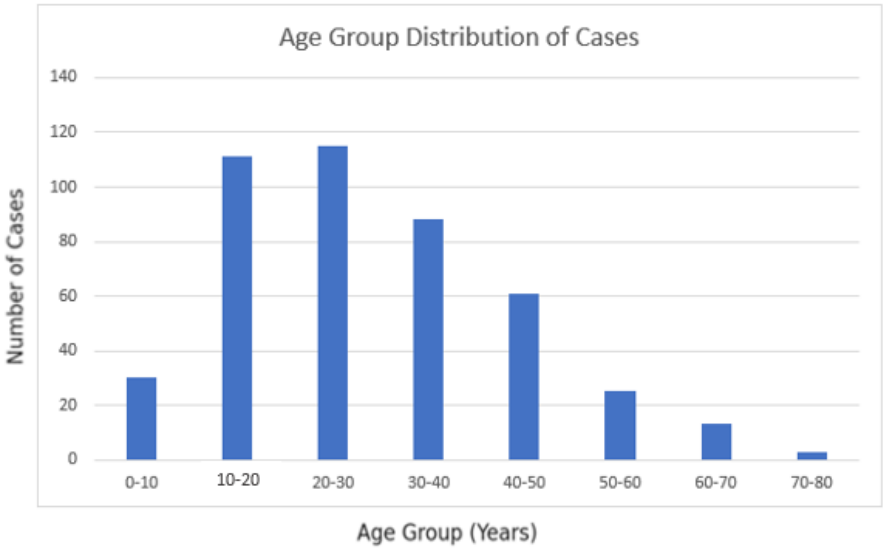

Figure 2: Age group distribution of cases

Figure 2: Age group distribution of appendectomy cases. The majority of patients were in the second (10–20 years, n = 111) and third decades (20–30 years, n = 115), followed by the fourth decade (30–40 years, n = 89). Fewer cases were observed in older age groups, with only 2 cases (0.5%) in the seventh decade (70–80 years).

Table 2: Distribution according to Age

Age group	Number of cases
0-10	30
10-20	111
20-30	115
30-40	88
40-50	61
50-60	25
60-70	13
70-80	03

Table 3: Histopathological findings for 446 appendicectomy specimen

Histopathological Diagnosis	Cases	%
Acute appendicitis	168	37.67%
Acute appendicitis with peri appendicitis	56	12.56%
Acute suppurative appendicitis	26	5.83%
Acute gangrenous appendicitis	3	0.67%
Perforated appendicitis	11	2.47%
Eosinophilic appendicitis	12	2.69%
Enterobius vermicularis	3	0.67%
Tuberculous appendix	2	0.45%
Chronic/recurrent appendicitis	135	30.27%
Fibrous obliteration of appendix	20	4.48%
Chronic appendicitis with Meckle's diverticulitis	2	0.45%
Chronic appendicitis with inflammatory bowel disease	1	0.22 %
Low grade appendiceal mucinous neoplasm	3	0.67%
Well differentiated neuroendocrine tumour	3	0.67%
Mucinous cystadenoma	1	0.22%
Total	446	100%

Table 4: Distribution of appendicectomy specimen

Specimen	Cases	%
Non neoplastic lesions	439	98.44%
Neoplastic lesions	07	1.57%

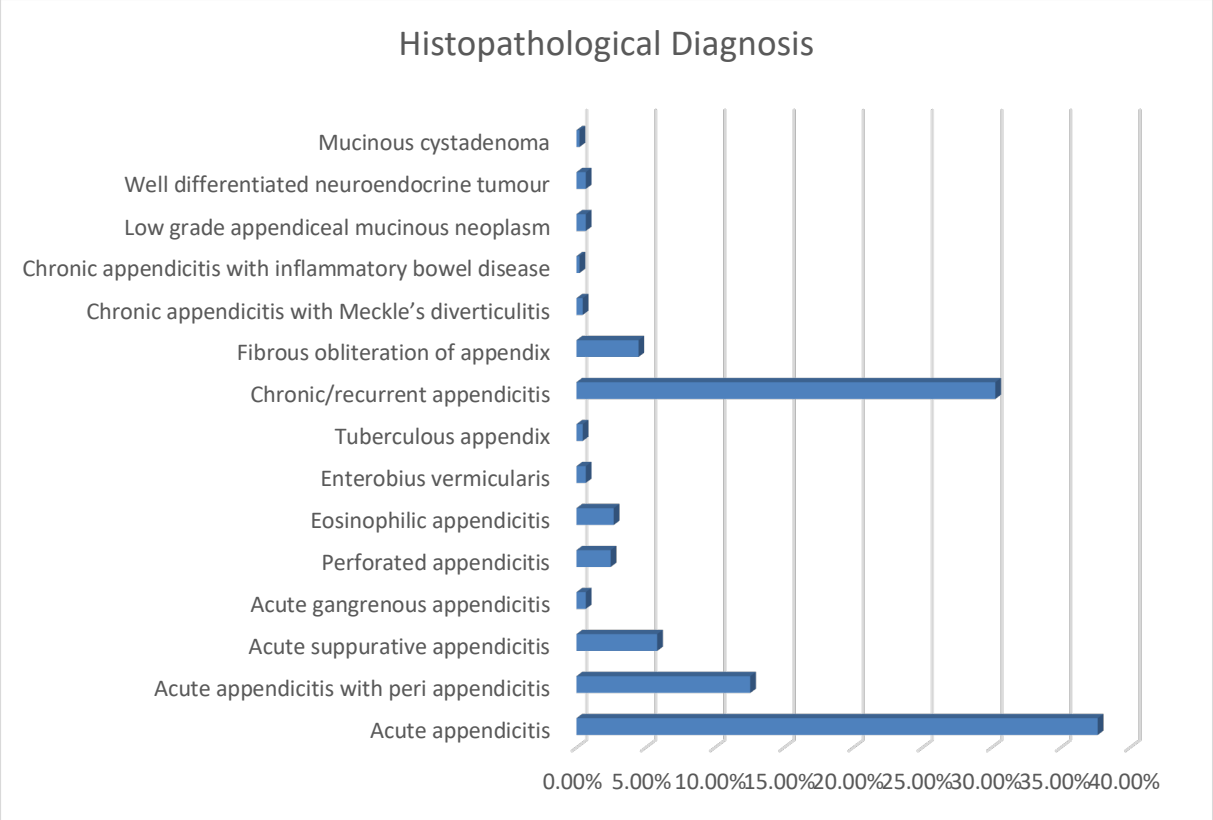

Figure 3: Histopathological Diagnosis

Figure 3: Distribution of histopathological diagnoses in appendectomy specimens (n = 438). Acute appendicitis was the most common diagnosis (164 cases, 37.4%), followed by chronic/recurrent appendicitis (135 cases, 30.8%) and acute appendicitis with peri-appendicitis (56 cases, 12.8%). Other less common findings included acute suppurative appendicitis (26 cases, 5.9%), fibrous obliteration (20 cases, 4.6%), eosinophilic appendicitis (12 cases, 2.7%), perforated appendicitis (11 cases, 2.5%), and rare lesions such as tuberculous appendix, Enterobius vermicularis, and appendiceal neoplasms.

Discussion

Appendicectomy is the most frequently performed abdominal surgery, with acute appendicitis being the most common emergency surgical procedure worldwide [13]. Appendiceal malignancies, although rare, are most often detected incidentally either intraoperatively or during the histopathological examination of appendectomy specimens [14,15]. Timely recognition of such lesions is essential, as it significantly reduces morbidity and mortality.

The primary rationale for subjecting all appendectomy specimens to histopathological evaluation is twofold: first, to establish the underlying pathology responsible for the appendicitis, and second, to detect unexpected incidental findings that may necessitate further clinical management [16,17]. Despite this, in many centres it is still observed that appendectomy specimens are not routinely submitted for histopathological examination [18,19]. This practice stems from the assumption that the probability of aberrant findings is low [20]. However, several recent studies have demonstrated that incidental findings are more common than previously anticipated. Conditions such as Enterobius vermicularis, other parasitic infestations, and appendiceal neoplasms are frequently diagnosed only through histopathological analysis, and occasionally during intraoperative inspection [21].

The clinical implications of missed diagnoses are profound. Identification of appendiceal neoplasms, regardless of the modality, alters treatment strategies and directly impacts patient prognosis. Alarmingly, more than one-third of appendiceal neoplasms have already metastasized at the time of diagnosis, underscoring the importance of early detection [22, 23, 24].

The World Health Organization (WHO) broadly classifies appendiceal neoplasms into epithelial and non-epithelial categories. Epithelial tumors encompass serrated lesions/polyps, mucinous neoplasms, and adenocarcinomas, which may be further subclassified into colonic-type, mucinous, and goblet cell variants. In contrast, the non-

epithelial category is predominantly represented by neuroendocrine neoplasms.[25].

Most appendiceal neoplasms are discovered incidentally in appendectomy specimens from patients presenting with acute appendicitis [26]. Neuroendocrine tumors constitute approximately 65% of these lesions, while adenocarcinomas account for nearly 20% [27, 28]. The majority of these tumors are located at the tip of the appendix, with 60–80% measuring less than 1 cm in size. Despite their small size, they carry significant clinical importance [4].

In the present study, out of 446 appendicectomy specimens, 245 were from males and 201 from females, yielding a male-to-female ratio of 1.22:1. This distribution is consistent with the findings of Tiwari et al. [29] and Bag et al. [30]. The peak incidence of appendicitis was observed in the third decade of life (115 cases), followed by the second decade (111 cases). Similar age-related trends have been reported by Saini M. et al. [31] and Sujatha R. et al. [32].

Acute appendicitis emerged as the most common diagnosis, with chronic/recurrent appendicitis being the second most frequent. These findings are comparable to those reported by Das S. et al. [33] and Shah B. et al. [34]. Acute appendicitis with periappendicitis was the third most common finding in our study, with 56 cases, which differs from the observations of Choudhary JK et al. [35], who reported 37 cases out of 60 appendicectomies.

Acute suppurative appendicitis was noted in 26 cases in the present study, contrasting with the findings of Shrestha R. et al. [36], who recorded 189 cases out of 930 specimens. Gangrenous appendicitis was identified in 3 cases, which is in agreement with the study by Ullah A et al. [37], who reported a single case out of 100 appendicectomies. Perforated appendicitis was observed in 11 cases in our series, which is consistent with the findings of Ullah A et al. [37] and Tripathy et al. [38], who reported 4 and 9 cases, respectively, in their cohorts of 100 and 541 appendicectomies.

Fibrous obliteration of the appendix was noted in 20 cases, a finding that aligns closely with the study of Momin YA et al. [39], who reported 23 cases among 1092 appendicectomies. Tubercular appendicitis was observed in 2 cases, consistent with the findings of Tripathy et al. [38], who also reported 2 cases out of 541 appendicectomies. Additionally, 1 case of Meckel's diverticulitis was identified in our series, which is comparable to the single case reported by Shrestha R. et al. [36] out of 930 specimens.

We also documented 12 cases of eosinophilic appendicitis. Histologically, eosinophilic appendicitis is characterized by the absence of neutrophilic infiltration, with prominent eosinophilic infiltration of the muscle layer and interstitial oedema separating muscle fibres. Our findings are consistent with those of Shinde et al. [40] and Kasture MH et al. [41], who reported 5 cases among 268 and 4 cases among 178 appendicectomy specimens, respectively.

Additionally, we detected three cases of Enterobius vermicularis infestation in the appendix. All patients presented with symptoms mimicking acute appendicitis, and the parasitic involvement was discovered incidentally on histopathological examination. Comparable findings have been described in the literature, with one study done by Pogorelić Z et al. [42] documenting 61 cases of Enterobius vermicularis among 6,359 appendectomy specimens.

Neoplastic lesions, though rare, remain clinically significant. In our study, the incidence of neoplastic lesions was 1.57%. This is in agreement with previous reports by R. Sujatha et al. [32], Tiwari et al. [29], Lesi O et al. [4] and Rencuzogullari et al. [5] where 1.8 %, 1.87 %, 1.9 % and 2.38 % incidence is reported respectively.

In our study neuroendocrine tumors and low-grade mucinous neoplasms showed highest incidence with 3 cases each followed by one case of mucinous cystadenoma. These findings are in concordance with other studies conducted by Lesi O et al. [4], Rencuzogullari et al. [5] and Sujatha et al. [32] which also showed predominance of neuroendocrine tumours. Table 5 presents a comparative analysis of appendiceal neoplasms between the present study and previously published series.

The distinct contribution of this study is its emphasis on the essential role of routine histopathological assessment of appendectomy specimens. In addition to determining the etiology of appendicitis, such analysis can uncover incidental yet clinically relevant findings that might otherwise go unnoticed. Early detection of appendiceal neoplasms is particularly important, as it directly impacts therapeutic decision-making and has the potential to enhance patient prognosis. Furthermore, our findings draw attention to an important gap in current practice, especially in smaller healthcare settings, where routine histopathological analysis is not always undertaken. Ensuring that every specimen undergoes evaluation could help avoid missed diagnoses and ensure timely, appropriate management.

Table 5: Presents a comparative analysis of appendiceal neoplasms between the present study and previously published series

Study	Total Specimens	Neoplasms Detected (n)	Incidence (%)	Tumor distribution
Current Study	446	7	1.57%	Neuroendocrine Tumor (NET)- 3 LAMN – 3 Mucinous cystadenoma - 1
R. Sujatha et al. [32] (2017)	230	4	1.8%	Neuroendocrine Tumor (NET)-3 Mucinous cystadenoma -1
Tiwari et al. [29] (2025)	350	7	1.87%	Neuroendocrine Tumor (NET) - 3 Adenocarcinoma NOS - 2 LAMN – 1
Rencuzogullari et al. [5] (2023)	1423	34	2.38%	Neuroendocrine Tumor (NET)-11 Mucinous cystadenoma-9 Adenocarcinoma-9 LAMN-5
Lesi O et al. [4] (2021)	529	10	1.90%	Neuroendocrine Tumor (NET)-6 Adenocarcinoma -4

Table 5: Presents a comparative analysis of appendiceal neoplasms between the present study and previously published series. The incidence in our study (1.57%) closely parallels reports by Sujatha et al. (1.8%) and Tiwari et al. (1.87%), while larger cohorts such as Rencuzogullari et al. (2.38%) and Lesi O et al. (1.9%) demonstrate slightly higher rates. Despite minor variations, all studies consistently highlight neuroendocrine tumors as the predominant neoplasm, followed by mucinous lesions and adenocarcinomas.

Conclusion:

In the present study, incidental findings such as *Enterobius vermicularis* infestation, granulomatous inflammation, and appendiceal malignancies were identified, most of which could only be confirmed through histopathological evaluation. A higher occurrence of appendiceal neoplasms was noted, aligning with global epidemiological patterns. This trend may reflect the rising number of appendectomies performed in recent years, although additional studies are required to elucidate the underlying factors. Although rare, these malignancies carry significant clinical implications if not promptly diagnosed and treated. Histopathological examination continues to serve as the gold standard for establishing a definitive diagnosis and guiding appropriate management. These observations highlight the necessity of subjecting all appendectomy specimens to routine histopathological evaluation to ensure diagnostic accuracy, facilitate timely intervention, and ultimately improve patient outcomes.

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