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Unexpected Histopathological Diagnoses in Appendectomy Specimens: A Retrospective Analysis of 765 Patients At Tertiary Care Hospital

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Abstract

Objective:

Appendectomy is the most commonly performed abdominal surgery worldwide. In this study, we examined the pathology results of acute appendicitis cases and analyzed unexpected pathology results.

Method:

We retrospectively analyzed the age, gender, and pathologic diagnoses of patients operated for acute appendicitis between 2020 and 2025 in the Department of General Surgery, Pamukkale University Faculty of Medicine.

Results:

A total of 765 patients were included in the study. Of these patients, 495 (64.7%) were male and 270 (35.3%) were female, and the mean age of all patients was 38.8 years. Unexpected pathological results were detected in 23 (3%) of the patients who underwent surgery for acute appendicitis. Of the patients with unexpected pathology results, 15 (65.2%) were female and 8 (34.8%) were male. The mean age of patients with unexpected pathological findings was 48.5 years. There was a statistically significant difference in age between the two groups; the average age of the unexpected pathology group was higher than that of the appendectomy group (p = 0.012). Unexpected pathological results included endometriosis in 4 (0.52%) patients, adenocarcinoma in 2 (0.26%) patients, enterobius vermicularis in 1 (0.13%) patient, granulomatous inflammation in 1 (0.13%) patient, low-grade appendiceal mucinous neoplasia (LAMN) in 12 (1.57%) patients, high-grade appendiceal mucinous neoplasia (HAMN) in 1 (0.13%) patient, mucocele in 1 (0.13%) patient, and malignant epithelial tumor metastasis of the breast in 1 (0.13%) patient.

Conclusion:

The most common cause of acute appendicitis is obstruction of the appendiceal lumen due to lymphoid hyperplasia and fecaloid, but some rare causes of acute appendicitis should be kept in mind. These include parasitic infections, benign and malignant tumors and various incidental pathologies. Patients with an unexpected pathologic diagnosis have the chance to receive the correct treatment according to the results of the pathology reports.

Keywords: Appendicitis, Appendectomy, Unexpected Pathology

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Apendektomi Spesmenlerinde Beklenmedik Histopatolojik Tanılar: Üçüncü Basamak Hastanede 765 Hastanın Retrospektif Analizi

Özet

Amaç:

Apendektomi, dünya çapında en sık uygulanan abdominal cerrahidir. Bu çalışmada, akut apandisit olgularının patoloji sonuçlarını inceledik ve beklenmedik patoloji sonuçlarını analiz ettik.

Yöntem:

Pamukkale Üniversitesi Tıp Fakültesi Genel Cerrahi Anabilim Dalı'nda 2020-2025 yılları arasında akut apandisit nedeniyle opere edilen hastaların yaş, cinsiyet ve patolojik tanıları retrospektif olarak incelendi.

Bulgular:

Çalışmaya toplam 765 hasta dahil edildi. Bu hastaların 495'i (%64,7) erkek, 270'i (%35,3) kadındı ve tüm hastaların yaş ortalaması 38,8 yıldı. Akut apandisit nedeniyle ameliyat edilen hastaların 23'ünde (%3) beklenmedik patolojik sonuç saptandı. Beklenmeyen patolojik sonuçlanan hastaların 15'i (%65,2) kadın, 8'i (%34,8) erkekti. Beklenmeyen patolojik bulgu saptanan hastaların yaş ortalaması 48,5 yıldı. İki grup arasında yaş açısından istatistiksel olarak anlamlı fark vardı; beklenmeyen patoloji grubunun yaş ortalaması, apendektomi grubundan daha yüksekti (p=0,012). Beklenmeyen patolojik bulgular arasında 4 (%0,52) hastada endometriozis, 2 (%0,26) hastada adenokarsinom, 1 (%0,13) hastada enterobius vermicularis, 1 (%0,13) hastada granülomatöz inflamasyon, 12 (%1,57) hastada düşük dereceli apendiks musinöz neoplazisi (LAMN), 1 (%0,13) hastada yüksek dereceli apendiks musinöz neoplazisi (HAMN), 1 (%0,13) hastada mukosel ve 1 (%0,13) hastada memede malign epitel tümör metastazı vardı.

Sonuç:

Akut apandisitin en sık nedeni, lenfoid hiperplazi ve fekaloid nedeniyle apendiks lümeninin tıkanmasıdır. Ancak, akut apandisitin bazı nadir nedenleri de akılda tutulmalıdır. Bunlar arasında paraziter enfeksiyonlar, iyi huylu ve kötü huylu tümörler ve çeşitli tesadüfi patolojiler bulunur. Beklenmeyen patolojik tanı alan hastalar, patoloji raporlarının sonuçlarına göre doğru tedaviyi alma şansına sahiptir.

Anahtar Kelime: Apandisit, Apendektomi, Beklenmedik Patoloji

Introduction

Acute appendicitis (AA) is one of the most common surgical conditions in the world. The risk of developing AA is 8.6% in men and 6.7% in women [1]. Acute appendicitis is defined as the inflammatory process of the vermiform inner lining of the appendix. Mechanical obstruction of the appendix lumen due to faecalith or lymphoid tissue proliferation is the primary cause of acute appendicitis. [1, 2] Luminal obstruction results in the formation of a closed enteric loop. Despite this obstruction, the appendix continues to produce mucus. As intraluminal pressure increases, venous outflow becomes compromised, leading to ischemia and eventual perforation of the appendix. This progression ultimately results in complicated appendicitis.[3] However, in rare circumstances, luminal obstruction caused by various infectious, inflammatory, or neoplastic conditions can precipitate acute appendicitis. These include enterobiasis, ascariasis, tapeworm infection, actinomycosis, schistosomiasis, amoebiasis, as well as carcinoid tumours, adenocarcinoma, endometriosis, granulomatous diseases, gastrointestinal stromal tumours, and mucoceles.[2-4] Histopathological

examination of appendix still remains the gold standard method for confirmation of appendicitis. Pathology results for patients undergoing surgery for acute appendicitis are mostly identified as appendicitis or normal appendix tissue associated with infection. In some cases, however, unexpected pathologies such as malignant or benign tumours, parasitic diseases, or endometrioma may rarely be identified. The aim of our study is to retrospectively review the pathology results of patients who underwent surgery for acute appendicitis at our hospital and to present the rare unexpected pathological results in the context of the literature.

Materials and Methods

Data were retrospectively obtained from 765 patients who underwent emergency surgery for acute appendicitis at the Department of General Surgery, Faculty of Medicine, Pamukkale University, between January 2020 and July 2025. The patients' gender, age and pathology results were analysed. Pathology results including appendicular diverticulum, granulomatous appendicitis, endometrioma, parasitic infection, mucocele, mucinous neoplasia, neuroendocrine tumour, adenocarcinoma and metastatic lesions were considered unexpected pathological findings. Clinical approval was obtained for the study.

Statistical Analysis

Data analysis was performed using the Statistical Package for the Social Sciences (SPSS Inc., Chicago, Illinois, USA) version 15.0 software package. Descriptive statistical analysis was used for age, gender, and evaluation of findings. The chi-square test was used for comparing categorical data. A p-value <0.05 was considered statistically significant.

Results

A total of 765 patients were included in the study. Of these patients, 495 (64.7%) were male and 270 (35.3%) were female, and the mean age of all patients was 38.8 years. Unexpected pathological results were detected in 23 (3%) of the patients who underwent surgery for acute appendicitis. Of the patients with unexpected pathology results, 15 (65.2%) were female and 8 (34.8%) were male. The mean age of patients with unexpected pathological findings was 48.5 years. There was a statistically significant difference in age between the two groups; the average age of the unexpected pathology group was higher than that of the appendectomy group ($p = 0.012$). The mean age of the 17 patients with oncological pathology after appendectomy was $53,7 \pm 16,7$. The average age of oncology patients was again statistically higher than the average age of all patients who underwent appendectomy. The significantly higher mean age in patients with unexpected pathology suggests that non-inflammatory or neoplastic etiologies should be strongly considered in older patients presenting with acute appendicitis.

Upon examining the unexpected pathological results, endometriosis was detected in 4 (0.52%) patients, 2 (0.26%) patients had adenocarcinoma, 1 (0.13%) patient had enterobius vermicularis, 1 (0.13%) patient had granulomatous inflammation, 12 (1.57%) patients had low-grade appendiceal mucinous neoplasia (LAMN), 1 (0.13%) patients had high-grade appendiceal mucinous neoplasia (HAMN), 1 (0.13%) patient had a mucocele (mucinous cystadenoma), and 1 (0.13%) patient had malignant epithelial tumour metastasis of the breast (Table 1).

Table 1. *Unexpected pathologies diagnosed after appendectomy.*

	Unexpected pathological diagnosis(N=23)	**Total (N=765)**
Endometriosis	4 (17.4 %)	4 (0.52 %)
Adenocarcinoma	2 (8.7 %)	2 (0.26 %)
Enterobius vermicularis	1(4.3 %)	1 (0.13 %)
Granulamatous inflammation	1 (4.3 %)	1 (0.13 %)
Low-Grade Appendiceal Mucinous Neoplasia (LAMN)	12 (52.2 %)	12 (1.57 %)
High-Grade Appendiceal Mucinous Neoplasia (HAMN)	1 (4.3 %)	1 (0.13 %)
Mucosel(mucinous cystadenoma)	1 (4.3 %)	1 (0.13 %)
Malignant Epithelial Tumor Metastasis (breast)	1 (4.3 %)	1 (0.13 %

The average age of patients with LAMN, which was the most common diagnosis with 12 cases, was 53.5 ± 19.9. Five of the patients were female and 7 were male. Right hemicolectomy was performed in 2 patients with LAMN due to appendiceal perforation during appendectomy and mucin deposits in other quadrants of the abdomen. Postoperatively cytoreductive surgery and hyperthermic intraperitoneal chemotherapy (HIPEC) were planned for these patients. Right hemicolectomy was performed in 1 patient due to tumor continuity in the appendix stump. HIPEC and right hemicolectomy were performed in another patient due to mucin deposits detected in the abdomen on postoperative radiological imaging after appendectomy. In the other cases with a LAMN pathology result, the disease was considered localized, and the patients were called for follow-up between 6 and 12 months. Patients who came for follow-up were monitored with cancer markers (CEA, CA 19-9, Ca-125), computed tomography (CT) scan of the abdomen, or magnetic resonance imaging (MRI). All patients diagnosed with LAMN underwent postoperative follow-up colonoscopies. The case with a pathology result of HAMN was considered a localized disease and followed up like LAMN patients.

The treatment plans for patients with appendiceal adenocarcinoma are as follows. Right hemicolectomy, HIPEC and cytoreductive surgery were recommended for one of the patients with a pathology result of adenocarcinoma, but the patient declined treatment and went to another center for treatment. Right hemicolectomy was performed on the other patient diagnosed with adenocarcinoma.

The patient diagnosed with mucocele (mucinous cystadenoma) was recommended clinical follow-up after appendectomy. Chemotherapy was planned for the patient with malignant breast epithelial tumor metastasis in the appendix due to the detection of intra-abdominal ascites and peritoneal implants. The case with Enterobius vermicularis was treated with mebendazole after appendectomy. The patient diagnosed with granulomatous inflammation underwent postoperative follow-ups at an external center, so no information was available about the treatment process. Gynecological consultation was requested for 4 patients with endometrioma on pathology results. One of these patients received medical treatment (drospirenone) after appendectomy, while the others were only followed up clinically after appendectomy (Table 2).

Table 2. *Treatment management of unexpected pathologies diagnosed after appendectomy*

	Unexpected pathological diagnosis(N=23)	Management
Endometriosis	4 (17.4 %)	3 ⟶ follow-up 1⟶ medical treatment
Adenocarcinoma	2 (8.7 %)	2 ⟶right hemicolectomy + SRC + IPC recommended
Enterobius vermicularis	1(4.3 %)	1⟶Mebendazole
Granulamatous inflammation	1 (4.3 %)	1 ⟶ N/A
Low-Grade Appendiceal Mucinous Neoplasia (LAMN)	12 (52.2 %)	3⟶ right hemicolectomy + SRC + IPC recommended 1 ⟶ right hemicolectomy 8⟶ follow-up (localized disease)
High-Grade Appendiceal Mucinous Neoplasia (HAMN)	1 (4.3 %)	1 ⟶ follow-up (localized disease)
Mucosel(mucinous cystadenoma)	1 (4.3 %)	1 follow-up (localized disease)
Malignant Epithelial Tumor Metastasis (breast)	1 (4.3 %)	1 ⟶Oncological treatment for metastatic disease

Discussion

While acute appendicitis can affect people of all ages, the majority of cases occur between the ages of 10 and 30, which corresponds with the development of the lymphoid system in humans. [5]

Although the rate of acute appendicitis is higher in men, women are more likely to undergo a negative appendectomy.[6] This likely reflects the difficulties in diagnosing acute appendicitis in female patients because of the gynecological disorders that mimic acute appendicitis. [7] A decline in the frequency of negative appendectomies has been observed in recent years, coinciding with a rise in the utilisation of preoperative imaging techniques, including computed tomography (CT).[8]

Appendectomy specimens are among the most frequently examined specimens in routine pathology. While most commonly diagnosed as acute appendicitis, as in our study, histopathological examination of appendectomy materials also allows the detection of rare and unexpected pathological conditions. In the literature, Dincel et al. in 2018 reported 3% unusual results, Patel et al. in 2017 recorded 5% unusual results, and Elfaedy et al. in 2019 recorded 6.2% (256 out of 4012) unusual results in routinely examined appendectomy specimens. In our study, out of the 765 cases, 23 cases (3%) showed unusual results. [6,9,10] The 3% rate of unexpected pathology seen in our series supports the view despite considerable advances in CT-based diagnosis of appendicitis, current imaging modalities remain insufficient for reliably distinguishing mucinous neoplasms, neuroendocrine tumors, or adenocarcinomas from uncomplicated appendicitis. This limitation underscores the need to maintain routine histopathologic evaluation of all appendectomy specimens to prevent clinically significant lesions from being overlooked. [11]

Neoplasms localized in the appendix are extremely rare and appendix tumors are found in less than 3% of cases after appendectomy.[2] Primary appendiceal neoplasms include lymphomas, mesenchymal tumors and epithelial tumors.[12] Neuroendocrine tumours, mucinous tumours and mixed endocrine and glandular tumours are the three classifications of primary epithelial tumours of the appendix [13]. In our study, neoplastic tumors were observed in 17 (2.2%) of the cases, which is consistent with the literature.

Approximately 50-77% of appendiceal neoplasms are neuroendocrine tumors. [14] The most common primary appendiceal tumor is carcinoid tumor. The rate of carcinoid tumor detection in patients undergoing appendectomy is 0.3-0.9%.[8, 15] NETs are frequently diagnosed incidental after appendectomy between the ages of 30-40. It can also be seen in children. They are slightly more common in women than in men. [16] In NETs; tumor diameter, histologic type and mesoapendiceal involvement are of prognostic importance. Regardless of the presence or absence of mesoappendix invasion, appendectomy is sufficient for carcinoid tumors measuring less than 1 cm. A right hemicolectomy is the recommended procedure for cases in which a tumour measuring more than 2 cm has been detected.[2, 17] In our study, no case of neuroendocrine tumor was found in our patients.

Adenocarcinoma of the appendix is rare, accounting for approximately 0.1–0.2% of all appendectomy specimens and corresponding to an estimated annual incidence of 0.2 per 100,000 individuals. It most commonly presents in the sixth to seventh decades of life. Similar to colorectal adenocarcinomas, appendiceal adenocarcinomas exhibit aggressive biological behavior, characterized by early lymphovascular invasion and regional nodal involvement. Therefore, when adenocarcinoma is identified, oncologic resection with right hemicolectomy remains the standard of care, as it ensures adequate lymphadenectomy and achieves superior oncologic control compared with simple.[18] In our study, appendiceal adenocarcinoma was detected in 2 (0.26%) patients, consistent with the literature. One of these patients underwent right hemicolectomy and the other was recommended cytoreductive surgery and HIPEC.

Appendiceal mucocele was first described by Rokitansky in 1842.[19] It represents a pathological entity characterized by progressive obstructive dilatation of the appendix accompanied by luminal accumulation of mucoid material. There are wide varieties of benign and malignant lesions that can produce mucocele. Mucocele usually when ruptures will be associated with pseudomyxoma peritonei.[20] Histopathologically, there are four subtypes. These are retention cyst, mucosal hyperplasia, mucinous cystadenoma and mucinous cystadeno-carcinoma. [21] Mucinous neoplasms are rare lesions and are frequently observed in women over the age of 50 years.[22].The prevalence of appendix mucinous neoplasms after appendectomy was approximately 0.2–0.4%.[16] The management of mucinous appendiceal tumors is determined by histopathologic subtype and disease stage. In early-stage disease, low-grade mucinous neoplasms are primarily treated with surgical resection of the primary tumor, while patients with disseminated peritoneal involvement benefit from cytoreductive surgery combined with hyperthermic intraperitoneal chemotherapy (HIPEC). Appendectomy remains the standard treatment for mucinous cystadenoma, as complete excision is typically curative. In contrast, mucinous cystadenocarcinoma, due to its malignant potential and risk of nodal metastasis, necessitates oncologic resection with right hemicolectomy to ensure adequate lymphadenectomy and optimize oncologic outcomes. [23] In our study, mucinous neoplasia was seen in 14 (1.83%) patients, which is higher than the literature. Of the mucinous neoplasms, 1 was mucinous cystadenoma, 1 was high grade appendiceal mucinous neoplasia and 12 were low grade appendiceal mucinous neoplasia.

The incidence of LAMN in our cohort (1.57%) was considerably higher than the rates generally reported in the literature (0.2–0.4%). This discrepancy may reflect regional epidemiologic differences, referral bias, or meticulous pathological sampling. Such findings suggest that the true incidence of LAMN may be underestimated in routine surgical practice. Given the risk of peritoneal dissemination even in early-stage mucinous neoplasms, long-term multimodal surveillance remains

indispensableTumor markers alone have limited sensitivity for early recurrence; therefore, a combination of serial imaging and biomarker assessment provides a more reliable strategy.[24]

Enterobius vermicularis, also known as pinworms or oxyuriasis, is a common parasitic infection estimated to affect 200 million people worldwide. Enterobius vermicularis is the most common parasite found in the lumen of the appendix and cecum (2-9%). In the late 19th century, it was first demonstrated in the lumen of the appendix. [9] The reported prevalence of *Enterobius vermicularis* (pinworm) in appendectomy specimens from patients undergoing surgery for suspected appendicitis varies widely, ranging from 0.2% to 41.8%. Among appendices infested with pinworms, histopathological evidence of true inflammation has been documented in approximately 13% to 37% of cases, suggesting that while the parasite may occasionally trigger an inflammatory response, it often represents an incidental finding rather than the primary cause of symptoms. [25, 26] Because appendectomy only treats the consequence of the disease and not the cause, patients should receive anthelmintic therapy. In our study, Enterobius vermicularis was seen in 1 (0.13%) patient and the patient was also given mebendazole treatment after appendectomy.

Granulomatous appendicitis is a rare condition and is found in 0.14%-0.3% of patients presenting with acute appendicitis.[27] Many infectious and noninfectious (Crohn's disease, sarcoidosis, etc.) causes, especially tuberculosis, may cause granulomatous reaction in the appendix.[2]Clinically, cases in which no cause for infection is found after exclusion of specific agents are considered as “idiopathic granulomatous appendicitis”. In our study, granulomatous appendicitis was observed in 1 case (0.13%) in accordance with the literature and was evaluated as “idiopathic granulomatous appendicitis” since no underlying cause could be found as a result of the investigations.

Endometriosis is the presence of uterine endometrial tissue in a location outside the uterus. Many women of reproductive age suffer from this disease. Endometriosis is a benign, estrogen-dependent, chronic gynecological disease. The inflammatory reaction caused by ectopic endometrial tissue causes symptoms such as chronic pelvic pain and dysmenorrhea. Endometrial tissue most commonly implants in the pelvic cavity, but may also involve the rectum, ileum, appendix, and cecum extrapelvically. İntestinal endometriosis is considered a form of external endometriosis and is reported in only approximately 10% of women with the disease. The vast majority of gastrointestinal involvement affects the rectum and sigmoid colon, reflecting their close proximity to the posterior pelvis. In contrast, appendiceal endometriosis is rare, but when present, it may mimic acute appendicitis or be identified incidentally following appendectomy. [28-30]Endometriosis rarely causes acute appendicitis. Hormonal therapy is required for postoperative follow-up. [9] In our study,

endometriosis was observed in 4 (0.52%) cases, and only 1 received hormonal therapy after appendectomy. The incidence in our study aligns with previous reports.

Appendiceal diverticulum is an uncommon entity, with a reported incidence of 0.004–2.1% in appendectomy specimens and 0.2–0.6% in routine autopsy series.[31] Appendiceal diverticulum is an uncommon entity, with a reported incidence of 0.004–2.1% in appendectomy specimens and 0.2–0.6% in routine autopsy series. Owing to its nonspecific clinical presentation and the frequent overlap with acute appendicitis, preoperative diagnosis is exceptionally challenging. Consequently, cases of appendiceal diverticulitis are typically identified only on postoperative histopathological examination, where the presence of true or false diverticula and associated inflammatory changes can be confirmed. Increased intraluminal pressure due to feces, proximal tumors, and excessive luminal mucus secretion are the main factors contributing to the formation of the appendiceal diverticulum. The risk of perforation and mortality in the presence of diverticula is higher than in normal acute appendicitis .[32]In our study, appendicular diverticula were not detected in any patient.

Appendiceal metastasis is a very rare condition. In a study by Yoon et al., the most common tumors that metastasize to the appendix are ovarian, colon, and stomach tumors. [33] Breast cancer, although rare, can be one of these metastatic tumors. In the literature, metastasis to the appendix is extremely rare, with only 13 case reports in the past 20 years. [34] In our study, appendiceal metastasis from a malignant epithelial tumor of the breast was observed in 1 (0.13%) case.

The retrospective design, variability in postoperative management, and incomplete long-term follow-up in some patients represent the primary limitations of the study. Pathology reporting differences across centers may affect generalizability of the findings.

Conclusion

While the most common causes of acute appendicitis are lymphoid hyperplasia and fecaloid, some rare causes of acute appendicitis should be kept in mind. Various rare etiologies such as benign and malignant tumors and parasitic infections may also cause acute appendicitis. Among these etiologies, especially oncologic causes should not be overlooked. Therefore, all appendectomy materials should be sent for histopathologic examination and the results should be carefully analyzed so that patients with unusual pathologic diagnoses will have the chance of correct treatment according to the results of the pathology reports.Our study provides one of the larger regional datasets on unexpected appendiceal pathology and offers new insights, particularly regarding the comparatively

high rate of LAMN, which may reflect differences in population characteristics or improved detection practices.

Conflict of interest

The authors declare no competing interests.

Contributions

H.Ç, U.O contributed to data acquisition, H.Ç, U.O, S.Y, O.T. data analysis and interpretation, drafting of the manuscript, and prepared the figures and tables. E.Ç.,H,Ç, U.O and S.Y. contributed to the study concept and design and critically revised the manuscript for important intellectual content. All authors reviewed and approved the final version of the manuscript.

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