ORIGINAL ARTICLE

Neoplasms of the appendix: Single institution and ten-year experiences results

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ABSTRACT

BACKGROUND: Appendix neoplasms are rare tumors of the gastrointestinal system. Appendiceal adenocarcinoma, appendiceal mucinous neoplasm, and neuroendocrine tumors (NETs) are the most encountered appendix-related neoplasms. The patients are usually got diagnosed after histopathological examination. This study aimed to explore the epidemiology, pathological subtypes, and treatment modalities of appendix neoplasms.

METHODS: A retrospective examination was made with 2821 patients who underwent appendectomy between April 2010 and August 2020. Demographic, clinical, radiological, surgical findings, and histopathological results were collected from the patient files.

RESULTS: Appendix neoplasms were detected in 1.06% of the patients included in the study. The mean age was 44.6±17.5 (17–83) years. Eight NETs, seven adenocarcinomas, fourteen mucinous neoplasms, and one neuroma were diagnosed with patients.

CONCLUSION: Appendiceal neoplasms are generally asymptomatic and often diagnosed with postoperative histopathological examination. If the result is adenocarcinoma, right hemicolectomy recommends. Treatment of NETs depends on factors such as tumor size, location, mesoappendix invasion, and lymph node involvement. In the presence of mucinous neoplasm, surgical intervention is determined according to the pathological subtype and involvement of mesoappendix. The need for additional surgical intervention or medical treatment for patients with tumor, histopathological results must be followed carefully after appendectomy.

Keywords: Appendiceal adenocarcinoma; appendiceal mucinous neoplasm; appendiceal neoplasm; appendiceal neuroendocrine tumor.

INTRODUCTION

Acute appendicitis is one of the leading causes of acute abdomen. Patients are treated successfully with appendectomy and removed appendices are histopathologically evaluated. In studies, after appendectomy 0.9–1.4% of patients are diagnosed with appendix neoplasm.[1] Although diagnostic methods have improved since appendix adenocarcinoma was first described by Berger in 1882, appendix neoplasms are remain rare.[2] The incidence of neoplasms is reported between 0.12 and 9.7/million people/year.[3,4]

Appendix tumors include adenocarcinoma, high and low grade mucinous neoplasm, and well and poorly differentiated neuroendocrine tumors (NETs).[1]

NETs are the most common type of appendix neoplasms and constitute approximately 50% of all appendiceal neoplasms.[5] While NETs are generally slow-growing tumors, some types have aggressive behavior. Histological grade and differentiation determine clinical features.[6] Right hemicolectomy is recommended when the tumor size is larger than two cm and in the presence of lymph node involvement. If the surgical margin is positive or there is a mesoappendix invasion or a lymphovascular invasion, right hemicolectomy is recommended, even if the diameter is smaller than two cm.[7]

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Appendix adenocarcinoma shows similar features to colonic adenocarcinoma. It usually develops from an adenoma. It is more common in men over the age of 60 years.[8] Generally accepted treatment is right hemicolectomy for all patients with appendix adenocarcinoma, although the treatment is still controversial in adenocarcinomas that have not metastasized, have not ruptured, and have been completely resected by appendectomy.[9]

The course of mucinous neoplasms is determined according to the histopathological subtype. While appendectomy is sufficient in localized appendix mucinous neoplasms, authors suggest a wider resection when the root of the appendix is involved in surgical exploration.[10]

Mucinous adenocarcinoma is treated like adenocarcinoma in the colon. Careful resection of the lesion is crucial, as rupture of mucinous neoplasms during surgery can lead to pseudomyxoma peritonei (PMP).[11]

In our study, we planned to analyze the prevalence of appendix neoplasms, demographic characteristics, histopathological distribution, preoperative and peroperative findings of 2821 patients who underwent appendectomy with the diagnosis of acute appendicitis.

MATERIALS AND METHODS

Study Design and Population

Appendectomy performed 2821 patients between April 2010 and August 2020 at Gaziosmanpasa Training and Research Hospital for acute appendicitis were included in the study. All patients were evaluated with acute abdomen in the emergency department and abdominal ultrasonography (US) and/or computed tomography (CT) were performed. Medical history, age, gender, clinical and radiological findings, the performed surgical method, findings at surgical exploration, tumor size and histopathological results and colonoscopy reports, if any, were collected from the medical records of the patients.

Surgery

Surgical interventions performed were categorized as open appendectomy, laparoscopic appendectomy, and right hemicolectomy. The benefits of laparoscopic surgery for acute appendicitis are known in the current approach. However, since the approach to emergency operations in the past was open surgery in our department, laparoscopic surgery was planned and applied to only one of the patients. In other 26 patients, an open appendectomy was planned and performed, and an open right hemicolectomy was performed in three patients.

Pathologic Examination

The patients were evaluated in three groups as appendiceal adenocarcinoma, mucinous neoplasm, and NETs. The staging was performed using the American Joint Commission on Cancer staging system, for appendix cancer.[12]

Mucinous neoplasms were grouped as serrated polyp-dysplasia, low grade (grade 1) appendiceal mucinous neoplasm (LAMN), and high grade (Grade 2–3) appendiceal mucinous neoplasm (HAMN). The presence of signet ring cells was included in the poorly differentiated group.[13] None of the patients had PMP. It also stated if the tumor ruptured.

NETs; was graded according to the Ki-67 index and the mitotic ratio Grade 1 NET: the Ki-67 index is 2% or less and the mitotic ratio <2/10 HPF, Grade 2 NET: the Ki-67 index is between 3% and 20%, a mitotic ratio between 2/10 HPF and 20/10 HPF, Grade 3 NET: the Ki-67 index greater than 20% and a mitotic ratio >20/10 HPF.[14]

Statistical Analyses

All data were saved in an Excel file and subsequently analyzed with SPSS 21 for Windows software. The Chi-square test was used for categorical data. Statistical significance was set at $p<0.05$. For homogenous distributions, mean and standard deviation were used, and for heterogeneous distributions median and range were preferred. In the comparisons of mean values showing normal distribution according to the groups, the Student's t-test was applied.

RESULTS

Demographic Findings

Appendix neoplasms were histopathologically detected in 30 (1.06%) of 2821 patients who were operated on with the diagnosis of acute appendicitis. The gender distribution of patients is equal (15/15). The mean age was 44.6±17.5 (17–83) years. The demographic, clinical, radiological, and histopathological results of patients are summarized in Table 1.

Preoperative Examination and Radiological Features

All the patients were evaluated with US after physical examination, and twenty-four of these patients were also evaluated by CT. Radiological evaluation was performed in consideration of both US and CT. The comparison of the radiological, peroperative findings, and histopathological results are summarized in Table 2.

Intraoperative Findings

The appendix was evaluated as catarrhal in two patients, phlegmonous in seventeen and perforated in three patients peroperatively, and masses were suspected in eight patients. Two patients with a preliminary diagnosis of plastrone appendicitis or intra-abdominal mass and one patient with a preliminary prediagnosis of acute appendicitis a tumor was noticed and right hemicolectomy was performed.

Table 1. Demographic, clinical, radiological and histopathological evaluation results of all 30 patients

Case	Age (years)	Gender	Syptoms	Clinical sign	Radiollogical diagnosis (US and/or CT)	Opereative procedure	Localization and tumour size (mm)	Histopathological diagnosis
1	54	M	Localized pain, nausea, vomiting	Tenderness, defense, rebound	Appendicitis	Appendectomy	Root, 3 mm	Grade 1 NET
2	36	M	Localized pain, nausea	Tenderness, defense, rebound	Appendicitis	Appendectomy	Middle, 30 mm	Serrated adenoma
3	58	F	Localized pain	Tenderness, Mass?	Plastrone? Mass?	Appendectomy, elective right hemicolectomy	Middle, 90 mm	HAMN
4	83	F	Localized pain, nausea, vomiting	Tenderness, defense, rebound	Appendicitis, Mass?	Appendectomy, elective right hemicolectomy	Root, 40 mm	Adenocarcinoma
5	21	F	Localized pain, nausea, vomiting	Tenderness, defense, rebound	Appendicitis	Appendectomy, elective right hemicolectomy	Tip, 40 mm	Adenocarcinoma
6	47	F	Localized pain, nausea	Tenderness, defense, rebound	Appendicitis	Appendectomy	Tip, 45 mm	Serrated adenom
7	64	F	Localized pain, nausea, vomiting	Tenderness	Plastrone? Mass?	Right hemicolectomy	Middle, 28 mm	Adenocarcinoma
8	60	M	Localized pain, nausea	Tenderness, defense, rebound	Appendicitis	Appendectomy	Middle, 40 mm	Serrated adenom
9	54	F	Localized pain, nausea	Tenderness	Appendicitis	Laparoscopic Appendectomy	Tip, 20 mm	LAMN
10	77	F	Localized pain, nausea	Tenderness	Plastrone? Mass?	Appendectomy	Middle, 50 mm	Mucosel
11	38	M	Localized pain, nausea, vomiting	Tenderness, defense, rebound	Appendicitis	Appendectomy	Root, 20 mm	Serrated adenom
12	26	F	Localized pain, nausea, vomiting	Tenderness, defense, rebound	Invaginasyon, Plastrone? Mass?	Right hemicolectomy	Root, 65 mm	Adenocarcinoma
13	40	F	Localized pain, nausea	Tenderness, defense, rebound	Appendicitis	Appendectomy	Tip, 27 mm	Grade 1, NET
14	29	F	Localized pain, nausea	Tenderness, defense, rebound	Appendicitis	Appendectomy	Tip, 10 mm	Grade 1, NET
15	24	M	Localized pain, nausea, vomiting	Tenderness, defense, rebound	Appendicitis	Right hemicolectomy	Root, 40 mm	Adenocarcinoma
16	34	M	Localized pain, nausea	Tenderness, defense, rebound	Appendicitis	Appendectomy	Tip, 50 mm	LAMN
17	44	M	Localized pain	Tenderness, defense	Appendicitis	Appendectomy	Tip, 4 mm	Grade 1, NET
18	46	M	Localized pain, nausea	Tenderness, defense, rebound	Normal	Appendectomy	Root, 10 mm	Serrated adenom
19	67	M	Localized pain, nausea, vomiting	Tenderness, defense, rebound	Appendicitis	Appendectomy, elective right hemicolectomy	Tip, 10 mm	Neuroma
20	31	M	Localized pain	Tenderness, defense, rebound	Appendicitis	Appendectomy	Tip, 40 mm	Serrated adenom
21	65	M	Localized pain, nausea	Tenderness, defense, rebound	Plastrone? Mass?	Appendectomy, elective right hemicolectomy	Tip, 70 mm	Adenocarcinoma
22	40	M	Localized pain, nausea, vomiting	Tenderness, defense, rebound	Appendicitis	Appendectomy, elective right hemicolectomy	Root, 8 mm	Adenocarcinoma
23	51	M	Localized pain, nausea, vomiting	Tenderness, defense, rebound	Appendicitis	Appendectomy	Root, 60 mm	Serrated adenom
24	27	F	Localized pain	Tenderness, defense, rebound	Appendicitis	Appendectomy	Root, 50 mm	Serrated adenom
25	64	F	Localized pain	Tenderness, distension	Plastrone? Mass?	Appendectomy	Middle, 150 mm	LAMN
26	56	F	Localized pain, nausea	Tenderness, defense, rebound	Appendicitis	Appendectomy	Root, 80 mm	LAMN
27	28	F	Localized pain, nausea	Tenderness, defense, rebound	Appendicitis	Appendectomy	Root, 10 mm	Grade 1, NET
28	17	F	Localized pain, nausea, vomiting	Tenderness, defense, rebound	Plastrone? Mass?	Appendectomy	Middle, 12 mm	Grade 1, NET
29	31	M	Localized pain, nausea	Tenderness, defense, rebound	Normal	Appendectomy	Root, 7 mm	Grade 1, NET
30	25	M	Localized pain	Tenderness, defense, rebound	Appendicitis	Appendectomy	Root,4 mm	Grade 1, NET

US: Ultrasonography; CT: Computed tomography; F: Female; M: Male; NET: Neuroendocrine tumor; LAMN: Low grade appendiceal mucinous neoplasm; HAMN: High grade appendiceal mucinous neoplasm.

Table 2. Comparison of the radiological data and perioperative findings of the patients with histopathological results

Histopathological results	n	Radiological diagnosis	n	Intra-operative findings	n
Neuroendocrine tumor	8	Normal appendix	1	Phlegmone	1
		Acute appendicitis	5	Catarrhal	1
				Phlegmone	5
		Plastrone/Mass	1	Phlegmone	1
		Plastrone/Mass	1	Phlegmone	1
Adenocarcinoma	7	Acute appendicitis	3	Mass	1
				Phlegmone	1
				Perforated	1
		Invaginasyon	1	Mass	1
		Plastrone/Mass	3	Mass	1
				Perforated	1
				Phlegmone	1
Mucinousneoplasm	5	Acute appendicitis	3	Phlegmone	2
				Mass	1
		Plastrone/Cystic mass	2	Mass	2
Mucosel	1	Plastrone/Mass	1	Mass	1
Serrated adenoma	8	Normal appendix	1	Phlegmone	1
		Acute appendicitis	7	Catarrhal	1
				Perforated	1
				Phlegmone	5
Neuroma	1	Acute appendicitis	1	Mass	1

Pathological Results

Among the patients diagnosed with appendiceal neoplasm, eight patients had NETs, seven patients had adenocarcinomas, fourteen patients had mucinous neoplasm (eight sessile serrated polyps, one mucocele, four LAMNs, and one HAMN) and one patient had neuroma. All patients diagnosed with NETs were well-differentiated and Grade 1. The distribution of appendix neoplasms was shown in Figure 1, and histopathological examinations were shown in Figure 2. Analysis of the histopathological data of the patients is shown in Table 3. When the data were examined, tumor size was significantly lower in NETs than in other groups (p=0.02). The depth of invasion was statistically higher in the high-grade adenocarcinoma group (p=0.04 and p=0.008, respectively).

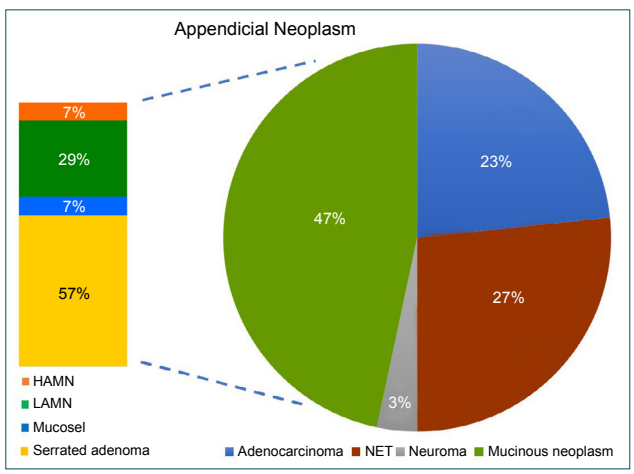

Figure 1. Distribution of appendix neoplasms.

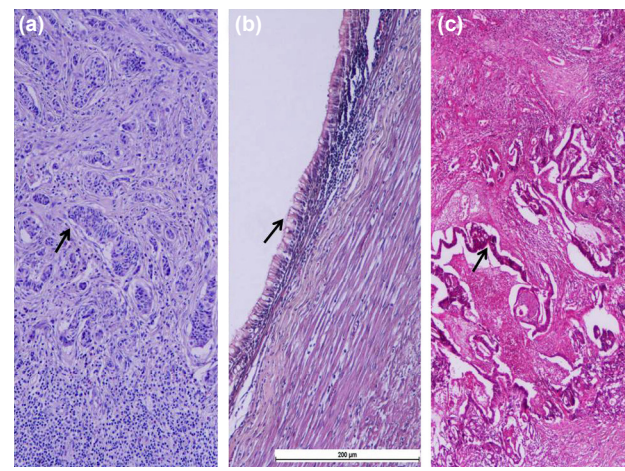

Figure 2. Appendix neoplasms in histopathological specimens. **(a)** Neuroendocrine tumor grade 1 (HE ×200), **(b)** Low-grade mucinous neoplasm (HE ×200), **(c)** Non-mucinous adenocarcinoma (HE ×200).

Table 3. Comparison of demographic findings and histopathological data of the patients

	All patient		NET		Adenocarcinoma		Mucinous neoplasm						Neuroma		p-value
							Serrated adenom		Mucosel		LAMN-HAMN				
	Mean±SD		Mean±SD		Mean±SD		Mean±SD		Mean±SD		Mean±SD		Mean±SD		
Age (year)	44.6±17.5 (17–83)		33.5±11.8 (17–54)		46.1±24.5 (21–83)		42±10.9 (27–60)		54		57.8±15.6 (34–77)		67		=0.11[a]
Tumor size (mm)	37.1±32.1 (3–150)		9.6±7.8 (3–27)		41.6±21.1 (8–70)		36.9±16.2 (10–60)		20		84±40.9 (50–150)		10		=0.02[a*]
Follow-up period (month)	49.6±31.9 (9–132)		62.4±39.1 (21–132)		47.9±40.6 (9–131)		41.7±23.9 (12–88)		43		46.2±27.1 (19–82)		45		
	n (30)	%	n (8)	%	n (7)	%	n (8)	%	n (1)	%	n (5)	%	n (1)	%	
Gender															
Female	15	50.0	4	50.0	4	57.1	2	25.0	1	100	4	80.0	–	–	=0.767[a]
Male	15	50.0	4	50.0	3	42.9	6	75.0	–	–	1	20.0	1	100	
Tumor localization															
Tip	10	33.3	3	37.5	2	28.6	2	25.0	1	100.0	1	20.0	1	100	=0.632[a]
Middle	7	23.3	1	12.5	1	14.3	2	25.0	–	–	3	60.0	–	–	
Root	13	43.3	4	50	4	57.1	4	50.0	–	–	1	20.0	–	–	
Depth of invasion															
No invasion	13	43.3	1	12.5	–	–	8	100.0	1	100.0	2	40.0	1	100	=0.04[a*]
Submucosa	2	6.6	1	12.5	–	–			–	–	1	20.0	–	–	
M.propria	3	10.0	2	25.0	1	14.2			–	–	–	–	–	–	
Subserosa	7	23.3	3	37.5	3	42.9			–	–	1	20.0	–	–	
Mesoappendix	5	16.6	1	12.5	3	42.9			–	–	1	20.0	–	–	
Grade															
Low	22	73.3	8	100.0	1	14.2	7	87.5	1	100.0	4	80.0	1	100	=0.008[a*]
Intermediate	1	3.3	–	–	1	14.2	–		–	–	–	–	–	–	
High	7	23.3	–	–	5	71.5	1	12.5	–	–	1	20.0	–	–	

[a]Chi-square test. *Refers to the higher ratio ($p<0.05$). Statistical analysis has been made between four groups which are named NET adenocarcinoma, mucinous neoplasm and neuroma. NET: Neuroendocrine tumor; LAMN: Low grade appendiceal mucinous neoplasm; HAMN: High grade appendiceal mucinous neoplasm; M.propria: Muscularis propria; SD: Standard deviation.

Surgery

In the first session, an appendectomy was performed on 27 patients and a right hemicolectomy was performed in three patients due to the suspicious mass. Right hemicolectomy was performed in four patients with adenocarcinoma, one patient with a mucinous neoplasm nine cm in diameter, and one patient with a diagnosis of neuroma in the second session. Hemicolectomy was recommended to a patient with 27 mm NET, but the patient was out of follow-up. The pathological diagnosis of the patients and the applied surgical methods were shown in Table 4.

Postoperative Follow-up

Patients underwent right hemicolectomy in the first session colonoscopy was performed in the postoperative period. Patients underwent right hemicolectomy in the second session, a pre-operative colonoscopy was performed for screening a synchronous tumor. In a patient diagnosed with adenocarcinoma with a positive surgical margin, cecum invasion was detected by colonoscopy, and a synchronous second tumor was observed in the ascending colon in another patient. A synchronous tumor was not detected in any other patient. The mean follow-up period of 30 patients was 49.6±31.9 (9–132) months. During the follow-up, one patient died due to heart failure. Other patients have no signs of metastasis, recurrence, or metachronous tumors.

DISCUSSION

Appendix neoplasms are rare tumors. Its incidence is reported between 0.12 and 9.7/million people/year.[3,4]

The study conducted by Kunduz et al.[15] showed 0.78% of 3554 patients who underwent appendectomy had appendix neoplasms. It was more common in men. They diagnosed 60.8% of the patients had NET, 28.5% of the patients had low-grade mucinous neoplasm and 17.7% of the patients had adenocarcinoma The mean age of the patients was 33 (15–91) years. Brunner et al.[16] found 2.7% of the patients have an appendiceal neoplasm and 1.5% have a malignant tumor in 1033 appendectomies. Among the patients with appendiceal neoplasm, NET was found in 56%, adenocarcinoma was defined in 31% and peritoneal carcinomatosis was identified in 0.6% of patients. The mean age of patients diagnosed with malignant tumors was 57 years, and there was no difference in gender distribution. In another study, 2154 patients were evaluated and they found 0.1% of the patients have a malignant tumor. They stated that malignant tumor was more common in women and the mean age was 58 years. In the study, 41% of the patients were diagnosed with NET, 36% adenocarcinoma, 10% goblet cell carcinoma, 13% malignant lymphoma.[17] In our case series, 1.06% of 2821 patients were diagnosed with appendix neoplasm and 23.3% had adenocarcinoma, 26.6% had NET, 46.6% had mucinous neoplasm and 3.3% had neuroma. When benign serrated adenomas were

Table 4. Summary of pathological findings and surgical treatments

Pathological finding		Surgical procedure		
		Emerging surgery	Planning surgery	Right hemicolectomy indication
Mucinous neoplasm (n)	Serrated adenoma (8)	Appendectomy		
	Mucosel (1)	Appendectomy		
	LAMN (4)	Appendectomy		
	HAMN (1)	Appendectomy	Right hemicolectomy	Tumor diameter, high grade neoplasm
NET (n)	Grade 1 (8)	Appendectomy		
Adenocarcinoma	Case 1, pT4 N0 M0	Appendectomy	Right hemicolectomy	Adenocarcinoma, tumor diameter, perforation
	Case 2, pT4 N0 M0	Appendectomy	Right hemicolectomy	Adenocarcinoma tumor diameter
	Case 3, pT3 N0 M0	Right hemicolectomy		Perioperative palpable tumor
	Case 4, pT3 N0 M0	Right hemicolectomy		Perioperative palpable tumor
	Case 5, pT4 N0 M0	Right hemicolectomy		Perioperative palpable tumor
	Case 6, pT4 N0 M0	Appendectomy	Right hemicolectomy	Adenocarcinoma tumor diameter
	Case 7, pT2 N0 M0	Appendectomy	Right hemicolectomy	Adenocarcinoma, perforation, positive margin
Neuroma		Appendectomy	Right hemicolectomy	Unknown

NET: Neuroendocrine tumor; LAMN: Low grade appendiceal mucinous neoplasm; HAMN: High grade appendiceal mucinous neoplasm.

excluded, the most common tumor was NET with 36.4% and adenocarcinoma with 31.8%.

When we evaluate each group within; appendix adenocarcinomas constitute less than 0.5% of gastrointestinal tract cancers. They are associated with adenomas similar to colonic adenocarcinomas.[8] The incidence of primary adenocarcinomas of the appendix is reported between 0.05% and 0.2% of appendectomies.[17,18] In the study performed by Chang and Attiyeh[18] they explored 22 patients with appendix adenocarcinoma, they found the malignancy rate 2.7 times higher in men. They observed that a second primary neoplasm developed in three of 22 patients, two patients had a synchronous tumor and one patient was diagnosed with a metachronous tumor during the follow-up. Three of 22 patients underwent appendectomy alone, seven patients underwent right hemicolectomy and the remaining twelve patients underwent partial small bowel resection for palliative purposes.

Benedix et al.[8] reported analyzed 196 patients with appendix neoplasms, 99 patients had adenocarcinoma and 45 patients had mucinosis adenocarcinoma. In the same study, the mean age of the patients was 62–64 years and reported that it was more common in men. They performed right hemicolectomy on non-carcinoid tumors and carcinoid tumors larger than two cm in diameters. In an epidemiological study, Marmor et al.[4] evaluated 4765 patients with appendix cancer diagnosed between 2000 and 2009 and found that 27% of the patients had adenocarcinoma and 38% had mucinous adenocarcinoma. Mucinous adenocarcinoma was more common in women and adenocarcinoma in men. Most of the patients were diagnosed over the age of 50. In the study, advanced age, male gender, large tumor size, and metastasis at the time of diagnosis significantly decreased survival.

In our patient population, 23.3% of the patients diagnosed with appendix neoplasm were adenocarcinoma. The rate of adenocarcinoma among appendectomies was 0.24%. Although there was no significant difference between genders, contrary to the literature, it was seen more in women. The average age was 46.14 years and it was lower than the literature. Right hemicolectomy was performed in all patients as recommended in current guidelines.[9] Concomitant second primary cancer was not detected peroperatively. A synchronous tumor was detected in the ascending colon in one patient and cecum invasion was observed with colonoscopy in another patient with a positive surgical margin whose tumor was located in the root of the appendix by colonoscopy. Only one patient died in the 4th postoperative year due to cardiac disease.

NETs are the most common tumors of the appendix in most studies.[1] In ENEST consensus, 80% of all appendix neoplasms reported being NET. It is stated that these tumors, which are encountered 0.3–0.5% of all appendectomies, are slightly more common in women and the average age ranges between 40 and 50 years. The 5-year survival of the patients with NETs is 100% or close to it.[19] In a study conducted in 2018, NET was detected in 35 (0.68%) of 5131 appendectomies. NET was seen 1.5 times more in men than women and the mean age was 27.3 years. 90% of the patients included in the study were diagnosed with grade 1 NET and most of the tumors were located at the tip of the appendix. The average tumor size in the study was six mm. Only three patients underwent right hemicolectomy due to lymphovascular invasion and one patient underwent total colectomy.[20] Kunduz et al.[15] analyzed 3554 appendectomies and detected 28 neoplasms. NETs were diagnosed 60.8% of them. All patients were evaluated as acute appendicitis before surgery. Since all the patients had grade 1 well-differentiated NETs after pathological diagnosis, additional surgery was not performed after appendectomy. Raoof et al.[21] examined 573 patients with NETs, and found that 64% of the patients were female and approximately two-thirds were diagnosed over the age of fifty. Tumor size was under one cm in 45% of the patients. They reported that as the tumor size increases, lymph node metastasis is more common. While the tumor size is less than one cm lymph node metastasis is only 2.7%, and the size is bigger than two cm, lymph node involvement is detected up to 64%. In this case series, it was stated that 54% of the patients underwent appendectomy and the rest underwent hemicolectomy or additional resection.

In our study, 0.28% of all appendectomies were NETs and it covered 26.6% of the patients diagnosed with appendix neoplasm. It was the second most common appendix tumor after mucinous appendix neoplasms. The mean age of NET patients was 33.5 years, and gender distribution was equal. Tumor sizes were <20 mm, except for one patient. All patients had preliminary acute appendicitis and none of the patients had additional surgery.

In a meeting held with more than 70 participants from different countries in 2016, appendix mucinous neoplasms were divided into four groups as adenoma, LAMN, HAMN, and mucinous adenocarcinoma. In the same study, PMP was defined as the presence of mucinous deposit or mucinous acid in the peritoneal cavity and evaluated under a separate title. It was emphasized that ovarian mucinous cancers are another etiology of PMP, in addition to appendix mucinous cancers.[13] In a study involving 138 patients with appendix mucinous neoplasm, the median age was 59.7 years and 41% of the patients were male. It was stated that 95% of the patients had a tumor larger than two cm and 5% had PMP. In the study, 75 patients were treated with appendectomy, 26 patients underwent cecectomy (appendectomy with cecum), 37 patients underwent right hemicolectomy, seven patients with peritoneal invasion underwent cytoreductive surgery. There was no difference in survival between patients who underwent right hemicolectomy and appendectomy.[22] Li et al.[23] re-examined 50 patients with LAMN, and they found that thirteen of these patients have PMP. The median age of the patients was 56.7

years and the gender distribution was equal. In the study, thirty patients underwent only appendectomy, thirteen patients underwent colectomy and seven patients underwent right hemicolectomy. Gonzalez-Moreno and Sugarbaker evaluated 501 patients diagnosed with appendix mucinous cancer, and found 198 of the patients had an only appendectomy, 280 of them had right hemicolectomy and 23 patients had no surgical intervention. It has been reported that right hemicolectomy does not provide a survival advantage in these patients if there is no lymph node involvement and the resection margin is sufficient.[24] In meta-analyzes for appendiceal mucinous neoplasm (AMN), LAMN is the most common mucinous neoplasm, and the gender distribution approximately equal. Right hemicolectomy has been recommended for moderate or poorly differentiated histology, increased mitotic activity, appendix root involvement, lymph node metastasis, tumor size larger than two cm, or perforation.[25,26]

In our study, appendix mucinous neoplasms were 46.6% (14 patients) of all appendix tumors and eight of the tumors were serrated adenoma (26.6%), one mucocele (3.3%), four LAMN (13.3%), and one HAMN (3.3%). Nine of the patients were female and five were male. The age of the patients ranged from 27 to 77 years, and the average age was 48.1 years. Peroperative perforation was detected only in 1 patient with serrated adenoma. None of the patients had PMP. Firstly, appendectomy was performed on all of the patients and right hemicolectomy was performed in one patient with HAMN due to the large tumor size in the second session.

Although colonoscopy is recommended to evaluate synchronous tumors in patients diagnosed with adenocarcinoma or NET, most studies did not mention the postoperative colonoscopic evaluation. Kunduz et al.[15] performed colonoscopy in all patients with an appendix-related malignant tumor and they did not detect any synchronous tumor. Sandor and Modulin[27] reported that they detected 12% of the patients with appendix adenocarcinoma had synchronous colorectal tumors.

In our analysis, it was observed that colonoscopy was not performed for all patients as in literature except those diagnosed with adenocarcinoma. In one patient diagnosed with adenocarcinoma, a suspicion of invasion to the cecum was detected in the colonoscopy before right hemicolectomy. Another patient had a synchronous tumor in the ascending colon. None of the patients had additional tumors who underwent colonoscopy.

Conclusion

When we evaluated the data of our study, it was seen that patients with appendix tumors may not be recognized by preoperative evaluation or peroperative findings. Although appendiceal tumors are rare neoplasms, the histopathological examination must be followed carefully. Additional surgery requirement depends on tumor subtype, location, size, grade, mesoappendix involvement, presence of positive surgical margins, lymphovascular involvement, and lymph node involvement. Colonoscopy should be planned in these patients, especially for adenocarcinoma and NET, to catch synchronous tumors.

Ethics Committee Approval: This study was approved by the Gaziosmanpasa Training and Research Hospital Ethics Committee (Date: 05.05.2021, Decision No: 277).

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ORİJİNAL ÇALIŞMA - *ÖZ*

Appendiks neoplazmları: Tek merkez ve on yıllık deneyim sonuçları

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AMAÇ: Appendiks neoplazileri gastrointestinal sistemin nadir görülen tümörleridir. Bunlar içinde adenokanser, musinoz neoplazm ve nöroendokrin tümörler sık olarak karşımıza çıkar. Tanı genellikle ameliyat sonrası histopatolojik inceleme sonrası konur. Bu çalışmada, insidental olarak tanı konan appendiks neoplazilerinin epidemiyolojisini, patolojik subtiplerini ve tedavi modalitelerini araştırmayı amaçladık.
GEREÇ VE YÖNTEM: Nisan 2010–Ağustos 2020 tarihleri arasında apendektomi yapılan 2821 hasta geriye dönük olarak değerlendirildi. Hastaların demografik verileri, ameliyat öncesi klinik ve radyolojik bulguları, ameliyat bulguları, histopatoloji sonuçları, ek ameliyat ve tıbbi tedavi uygulamaları geriye dönük olarak hasta dosyalarından toplandı.
BULGULAR: Çalışmaya dahil edilen hastaların %1.06'sında appendiks neoplazmı saptandı. Ortalama yaş 44.6±17.5 (dağılım, 17–83) olarak bulundu. Hastalardan sekizi nöroendokrin tümör, yedisi adenokanser, ondördü müsinöz neoplazi ve biri nöroma tanısı almıştı.
TARTIŞMA: Appendiks neoplazileri genellikle asemptomatik ve sıklıkla ameliyat sonrası histopatolojik inceleme ile tanı alan tümörlerdir. Patoloji adenokanser ise tedavide sağ hemikolektomi önerilirken nöroendokrin tümörlerin tedavisi tümör boyutu, yerleşimi, mezoappendiks invazyonu ve lenf nodu tutulumu gibi faktörlerden etkilenir. Musinöz neoplazm varlığında patolojik alt tipe ve tutuluma göre cerrahi yöntem belirlenir. Patolojik inceleme sonucu tümör saptanan hastalarda ek tedavi ve takip gereksinimi apendektomi sonrası histopatolojik sonucun takip edilmesi gerekliliğini bir kez daha vurgulamaktadır.
Anahtar sözcükler: Appendiks adenokanseri; appendiks neoplazmı; musinöz neoplazi; nöroendokrin tumor.

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