

## Appendix tumors in the era of laparoscopic appendectomy

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### Abstract

**Background:** The safety of laparoscopic appendectomy for the management of incidentally discovered appendiceal tumors has not yet been established.

**Methods:** Appendiceal tumor cases managed by laparoscopy or laparotomy over a 10-year period were reviewed.

**Results:** The pathological diagnoses were 23 carcinoid and 20 cancerous lesions. The median patient ages were 36 and 69 years, respectively, for carcinoid and other tumors ( $p < 0.05$ ). Acute appendicitis was present in 70% of carcinoid cases and 35% of other tumors ( $p < 0.05$ ). Eight patients with carcinoid tumors were operated on by laparoscopy, whereas 15 underwent laparotomy. Laparoscopic and open procedures were performed in three and 17 patients with cancerous lesions, respectively. Invaded surgical margins were seen after laparoscopy in 20% of patients and open surgery in 6%. Synchronous colon carcinoma was detected in 14% of the patients with an appendix neoplasm. The 5-year survival rates were similar after both laparoscopic and open appendectomy for either carcinoid or other tumors.

**Conclusion:** Laparoscopic appendectomy for appendiceal tumors seems to have a slightly higher rate of inadequate resection. However, it is not associated with a significantly worse patient prognosis than open appendectomy.

**Key words:** Appendiceal tumor — Carcinoid tumor — Acute appendicitis — Colon cancer — Synchronous cancer — Appendectomy — Laparoscopic appendectomy

Appendectomy is one of the most common abdominal operations [4, 5] accounting for >50% of emergency operations. This procedure is most often performed for the sudden onset of acute appendicitis. While evidence of the benefits associated with the laparoscopic approach continues to accumulate, an increasing number of appendiceal resections are being performed via laparoscopy [5, 6].

Appendiceal tumors are rare entities, occurring in <2% of all appendectomies [3, 4, 9]. They are rarely associated with clinical manifestations; therefore, they are usually discovered incidentally at the time of operation, frequently in association with acute appendicitis [2–4, 9].

As the technique of laparoscopic appendectomy evolves, the feasibility of resecting appendiceal neoplasms via this approach should also be assessed. The aim of this study was to analyze the results of laparoscopic appendectomy for incidentally discovered appendiceal neoplasm in comparison to the classical open procedure.

### Materials and methods

#### Study population

We retrospectively reviewed the data for ~2,500 appendectomy operations, performed between January 1991 and December 2001 in our center. Of these, 43 appendectomies were positive for appendiceal neoplasm. Experienced pathologists reexamined the histological diagnoses. Preoperative, postoperative, and long-term follow-up information was obtained from patients' charts, family physicians, and questionnaires. Patients with appendiceal neoplasms were subdivided into an appendix carcinoid group and an appendix tumor group (appendix cancer or precancerous lesions).

#### Statistical analysis

All statistical analyses were performed using GraphPad InStat (ver. 3.00 for Windows 95; GraphPad Software, San Diego, CA, USA). Variables were compared using the Student *t*-test, Fisher's exact test, or the Mantel-Cox test, as appropriate. A value of  $p < 0.05$  was considered statistically significant.

**Table 1.** Appendiceal tumors resected via the laparoscopic approach

	Cases ( <i>n</i> )	Mean age (yr)	Associated acute appendicitis (%)	Invasion of surgical margins (%)	Complementary surgical procedure (%)
Carcinoid	8	32	88	13 (1 case)	13 (1 case)
Mucinous adenocarcinoma	1	79	100	100	100
Cystadenoma	1	32	0	0	0

**Table 2.** Appendiceal tumors resected via the open approach (laparotomy)

	Cases ( <i>n</i> )	Mean age (yr)	Associated acute appendicitis (%)	Invasion of surgical margins (%)	Complementary surgical procedure (%)
Carcinoid	15	44	60	0	13 (2 cases)
Mucinous adenocarcinoma	2	74	33	50 (1 case)	100 (2 cases)
Cystadenoma	11	79	9	9 (1 case)	0
Adenocarcinoid	3	53	66	0	33 (1 case)
Mucocele with cystadenoma	2	68	100	0	0

## Results

### *Study population and pathological diagnosis*

During the study period, 2,500 patients had an appendectomy for appendiceal pathology. Appendiceal neoplasms were diagnosed in 43 patients (1.7%). Of these, 23 patients (53%) had an appendix carcinoid and 20 (47%) were diagnosed with appendiceal cancer (or precancerous lesions).

The male/female ratio was similar in the two groups. The median patient age at presentation was significantly lower in the carcinoid group than in the appendiceal tumor group, 36 [range, 16–82] vs 69 years [range, 27–92]; ( $p < 0.01$ ). Most of the patients presented with clinical symptoms of acute appendicitis; tumors were not suspected in any of them preoperatively. None of the patients in the carcinoid group had carcinoid syndrome. Associated acute appendicitis was confirmed by pathological examination in 55% of the resected appendices. This rate was higher in the carcinoid group (70%) than in the appendiceal tumor group (35%) ( $p < 0.05$ ). Appendix perforation was found in four cases (2%) in the carcinoid group and two cases (1%) in the appendiceal tumor group, respectively. In the carcinoid group, the mean tumor size was 0.8 cm (range, 0.2–3). Sixteen carcinoid tumors were < 1 cm in diameter, whereas seven were > 1 cm in diameter. Sixteen were localized in the distal third of the appendix (apex), one in the middle third, and six in the proximal third. None were associated with lymph node involvement or mesoappendix invasion. Among the patients in the appendiceal tumor group, the pathological diagnoses were as follows: 12 cystadenocarcinoma, three adenocarcinoma, three adenocarcinoid, and two cystadenoma with mucocele.

### *Treatment*

Surgical treatment was undertaken in all patients as an emergency procedure based on the clinical diagnosis of

acute appendicitis. In the carcinoid group, the appendectomy was conducted via laparoscopy in eight patients (35%) and using the open technique (McBurney or midline incision) in 13 patients (57%) (Tables 1 and 2). In the remaining two cases (8%), the appendectomy was completed by the open approach after conversion from laparoscopy due to dissection difficulties.

In the appendiceal tumor group, the appendices were resected via the laparoscopic approach in two cases (10%) and by the open approach in 15 cases (75%). In the remaining three cases (15%), conversion to the open approach after laparoscopy was necessary either due to technical difficulties during laparoscopic dissection or because of suspicion of an appendix tumor.

Invasion of the surgical margins was seen after two laparoscopic (20%) and two open resections (6%). Among these four cases with invasion, there were one carcinoid tumor and three appendiceal tumors. Complementary surgical treatment (i.e., right hemicolectomy) was required in seven patients, two of them after laparoscopic resection and five of them after an open approach. Complementary resections were performed in three patients with carcinoid tumor. Indications for complementary resection were carcinoid size (lesions > 2 cm) in two cases and invasion of the surgical margins in one case. Complementary resections were performed in four patients with appendiceal tumors. Three of them had invaded surgical margins and one had an invasive appendiceal adenocarcinoma. One patient, in the appendiceal tumor group received chemotherapy after recurrence due to metastasis.

### *Long-term results*

After carcinoid resection, the 5-year actuarial survival rate was 100% for both the laparoscopic and open groups. Median follow-up for the carcinoid group was 60 months. One patient in the carcinoid group died > 6 years after undergoing open appendectomy; death was attributable to colon carcinoma (diagnosed after 3 year's follow-up).

After appendiceal tumor resection, the 5-year survival rate was 100% for the laparoscopic group and 88% for the open group ( $p < 0.05$ ). Median follow-up for the appendix tumor group was 48 months. Three patients died in the appendiceal tumor group. All three underwent appendectomy performed via the open approach. One of them died after 18 month's follow-up due to progression of his appendix malignancy. Of the two other patients, one died without evidence of recurrence after 7 year's follow-up, and the other died of colon cancer 1 year after appendectomy.

### *Associated cancer*

Synchronous colon cancer (adenocarcinoma) was discovered in four patients (20%) in the appendiceal tumor group and two patients (9%) in the carcinoid group. Their median age was 60 years (range, 60–78). One patient in the carcinoid group had a synchronous papillary carcinoma of the right ovary. An additional colon carcinoma was diagnosed 3 years after resection of an appendiceal carcinoid tumor in another patient.

## **Discussion**

In this study, we analyzed the safety of laparoscopic appendectomy for cases of incidentally discovered appendiceal neoplasm. Our data indicate that laparoscopic appendectomy for the management of appendix neoplasms is associated with long-term results comparable to those obtained with open appendectomy.

Appendiceal neoplasms are rare entities, reported in <2% of appendectomies [3, 4, 9]; this rate is in accord with our results. Meanwhile, appendectomy is one of the most common abdominal operations, accounting for >50% of all emergency operations [3–5]. As evidence of the benefits associated with laparoscopic appendectomy accumulates, an increasing number of appendix resections are being performed via laparoscopy [5, 6].

Appendiceal neoplasms are typically associated with acute appendicitis [2–4, 9]. In our series, the rate of associated acute appendicitis was 55%. However, this rate was higher for carcinoid lesions than for other tumors. One possible explanation for this finding is that appendiceal neoplasms are rarely associated with clinical manifestations and are frequently recognized either during operation or during pathological examination of the resected appendix [2]. None of our patients had a preoperative diagnosis of appendiceal neoplasm. Carcinoid tumor tends to be diagnosed at an earlier age than other tumors [4, 9], as was the case in our series. By contrast, cancer of the appendix tends to be diagnosed around the 6<sup>th</sup> decade [8]. In most of the patients in our series, they were not associated with acute appendicitis. Thus, in the older patient, the differential diagnosis of appendiceal neoplasm should be kept in mind in the presence of unclear symptoms of acute appendicitis.

As shown by our data, patients treated for appendiceal neoplasm have a higher rate of associated cancer than

the normal population, especially of synchronous colon carcinoma. Thus, colonoscopic examination plays an important role in patients with incidentally discovered appendiceal tumors; this diagnostic modality seems to be particularly indicated in patients in their 6<sup>th</sup>–8<sup>th</sup> decades.

The indications for the laparoscopic approach to the resection of tumors have not yet been established definitively. Some investigators have argued that laparoscopy does not increase the risk of local recurrence or metastasis after tumor resection over that associated with open surgery [11, 15]. However, data showing an increased rate of peritoneal seeding and abdominal wall metastases after the laparoscopic resection of abdominal cancer have been reported [12]. Paolucci et al. observed high rates of abdominal wall metastases (port side metastases) after the laparoscopic resection of occult gallbladder carcinoma [12]. The data on occult gallbladder cancer are of particular relevance to the role of laparoscopic surgery for appendiceal neoplasm, which is nearly always resected as an occult tumor.

A literature search turned up a few cases of appendiceal neoplasm resection via laparoscopy [1, 14]. Heller et al. [8] reported a small series of appendix carcinoid resections during laparoscopy for gynecologic indications and concluded that this technique was suitable for incidentally discovered appendiceal carcinoid. Although appendiceal carcinoids have been resected via laparoscopy without complications, the role of laparoscopic resection in the management of appendix tumors is not well defined in the literature. Gonzales Moreno et al. presented a case of laparoscopic mucocele resection that was followed by early peritoneal progression, forcing them to conclude that this entity was a contraindication to laparoscopic resection [7]. Other cases of appendix mucocele resection via laparoscopy have been described, but these reports provided no information on the prognosis [10, 13]. Our data indicate that whether the resection of appendiceal carcinoids is accomplished via laparoscopy or the open approach, the long-term results are similar. However, we encountered one case of invasion of the surgical margins by carcinoid after laparoscopic resection, whereas there were no such adverse events open resection. In patients presenting with the other, appendix tumor, the long-term results were similar for laparoscopic and open resection, while the rate of insufficient primary resection was slightly higher in the laparoscopy group. However, only a few cases of appendiceal tumors not of the carcinoid type have been resected thus far by the laparoscopic approach, which could have blinded us to a difference in prognosis. Finally, complementary treatment has been indicated with the same frequency after both laparoscopic and open appendectomy.

Our data suggest that the prognosis of patients treated for appendiceal neoplasms is comparable after laparoscopic and open appendectomy. However, even with our results, it must be acknowledged that experience with the laparoscopic resection of appendiceal neoplasms is still not sufficient, and we must therefore continue to recommend the open approach to these pathologies. Whenever an atypical clinical presentation for acute appendicitis leads the surgeon to entertain a preoperative diagnosis of possible appendiceal neoplasm, the open approach

should be preferred. Alternatively, if a preliminary laparoscopic examination of the appendix is suggestive of an appendiceal neoplasm, conversion to an open appendectomy may be the most prudent surgical judgment [14].

## Conclusion

In this new era when laparoscopic appendectomy is becoming the procedure of choice for acute appendicitis, the preoperative diagnosis of appendiceal tumors is still infrequent; therefore, the surgeon who detects their presence intraoperatively is faced with a decision as to how to proceed with their resection. Laparoscopic appendectomy for appendiceal tumors seems to be associated with a slight increase in the rate of invasion of the surgical margins; however, it does not appear to increase the rate of reoperation or to have a negative impact on long-term patient prognosis. Nevertheless, until there are sufficient data to show the efficacy and safety to this approach, the open technique should be preferred in these cases.

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