A Low-Grade Appendiceal Mucinous Neoplasia
and Neuroendocrine Appendiceal Collision Tumor: A Case Report and Review of the Literature

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Patient: Female, 31-year-old
Final Diagnosis: Appendiceal neuroendocrine tumor • low-grade appendiceal mucinous neoplasm
Symptoms: Abdominal pain • dysuria
Medication: —
Clinical Procedure: Laparoscopic appendicectomy • laparoscopic right hemicolecction
Specialty: Oncology • Surgery

Objective: Rare co-existence of disease or pathology

Background: Incidental appendiceal neoplasms account for 1–2% of appendectomies. Mucinous neoplasms and carcinoids are the most frequent lesions, with an incidence of 0.6% and 0.3–0.9%, respectively. Appendiceal collision tumors are extremely rare and result from the proliferation of 2 different cellular lines. This report describes a young woman with a collision tumor composed of a low-grade appendiceal mucinous neoplasia (LAMN) and an appendiceal neuroendocrine tumor (ANET).

Case Report: A 31-year-old woman was admitted to our institution presenting with abdominal pain and dysuria. After ultrasound assessment of a dilated appendix with wall thickening and distension by anechoic material, a diagnosis of acute appendicitis was made. The patient, after a period of antibiotic therapy and observation, underwent an urgent laparoscopic appendectomy due to worsening condition. Surprisingly, the histological examination revealed a Tis LAMN extending from the base of the appendix to the resection margins, and a T3 grade-1 ANET, chromogranin-A and synaptophysin-positive, with a Ki67 less than 1%. On the basis of histological examination and European Neuroendocrine Tumor Network guidelines, in light of the positive LAMN resection margins and ANET mesoappendiceal invasion, an elective laparoscopic hemicolecction was indicated. The patient is now in good condition following a regular 5-year follow-up.

Conclusions: A collision LAMN and ANET is an exceedingly rare condition. The heterogeneity of clinical presentation and lack of solid evidence seem to recommend a tailored management. Laparoscopy is a safe and useful tool in localized mass excision.

MeSH Keywords: Adenocarcinoma, Mucinous • Appendiceal Neoplasms • Carcinoma, Neuroendocrine

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Background

Primary appendiceal neoplasms are infrequent tumors, found in around 1–2% of all appendectomy specimens [1,2]. Most benign and malignant appendiceal neoplasms are discovered incidentally during appendectomy with preoperative diagnosis of appendicitis. Malignant appendiceal neoplasms can present with distant spread, peritoneal involvement, or direct invasion, although this is an uncommon presentation [1].

The most common clinical onset is acute appendicitis caused by appendicular luminal obstruction by the neoplastic mass. A carcinoid syndrome is rarer and is caused by vasoactive peptides produced by appendiceal neuroendocrine tumors (ANETs), while mucocele and pseudomyxoma peritonei are a typical finding of mucinous neoplasms [1].

Mucinous neoplasms and carcinoids are the most frequent benign and malignant appendiceal lesions, respectively found in 0.6% and 0.3–0.9% of appendectomy specimens [3].

Rarely, collision or combined neoplasms can occur. The former are the result of 2 distinct but adjacent neoplasms, without any transition zone, resulting from the proliferation of 2 different cellular lines (biclonal malignant transformation), while the latter are the result of a multidirectional differentiation of cells from a single tumor [4,5]. Since combined and collision tumors are exceptional cases, a consensus on their treatment has not yet been reached.

Here, we present the case of a 31-year-old woman undergoing laparoscopic appendectomy for assumed appendicitis and afterward, a laparoscopic right hemicolectomy for a collision low-grade appendiceal mucinous neoplasm (LAMN) and an ANET. In addition, a review of similar cases reported in the literature was performed.

Case Report

A 31-year-old woman presented at the emergency room of our institution with abdominal pain associated with dysuria. She had had 2 pregnancies, no comorbidities, and no previous history of surgery. Physical examination revealed a painful and tender abdomen, particularly in the right iliac fossa with local peritonism, a positive Blumberg’s sign, and no signs of bowel obstruction. The patient was afebrile and vitals were normal, as were blood sample tests that showed a slight neutrophilia with a normal white blood cell count. A pelvic ultrasound scan revealed a 5.5-cm-long appendix with wall thickening, without any surrounding free fluid, that was distended by an anechoic material (Figure 1).

Three months later, a complete colonoscopy showed no pathological findings and a staging abdominal contrast computed tomography (CT) scan revealed no pathological enhancements but some subcentimetric paraaortic and interaortocaval nodes. After multidisciplinary team discussion of the case, a laparoscopic right hemicolectomy was planned as suggested by American Joint Committee on Cancer (AJCC) guidelines [6], since the resection margins were involved by the LAMN and the ANET was extended to the periappendiceal fat tissue. The postoperative course was regular and the patient was discharged in good condition on the fourth postoperative day.

Macroscopic specimen examination showed a 4-centimeter-long appendix, filled with a dense acellular mucoid fluid, with a 1.5-centimeter yellowish bulk on its tip. This was found to be a well-differentiated ANET that was chromogranin-A- and synaptophysin-positive, with a Ki67 of less than 1% (ANET-1, WHO 2010 guidelines), no perineural or lymphovascular infiltration, and full-thickness invasion extended to the periappendiceal fat tissue (pT3Nx). Surprisingly, the histopathological examination also revealed a synchronous Tis LAMN (Armed Forces Institute of Pathology (AFIP) 2017 and WHO 2010 guidelines), no perineural or lymphovascular infiltration, and full-thickness invasion extended to the periappendiceal fat tissue (pT3Nx). Surprisingly, the histopathological examination also revealed a synchronous Tis LAMN (Armed Forces Institute of Pathology (AFIP) 2017 and WHO 2010 guidelines).

Figure 1. Abdominal ultrasound showing an appendix 5.5 cm long, dilated, and distended by an anechoic material with wall thickening.
ileocolic anastomosis was performed. At the histopathological examination, margins were negative as were the 6 lymph nodes retrieved. Extracellular mucinous fluid was found in the colic submucosal layer, surrounded by a fibrotic nodular area in the site of the previous resection.

After the surgical procedure and multidisciplinary team discussion, no further treatment was considered necessary, so the patient was referred to an oncologic specialist who scheduled a 5-year follow-up period. There was no sign of recurrence after 1 year.

**Discussion**

Since collision tumors are such rare entities, one hypothesis is that the blind-ended tubular structure of the appendix favors prolonged exposure to carcinogens, although a common agent able to promote both LAMN and ANET is still unknown [7].

There are other situations in which 2 concomitant appendiceal pathologies can occur, such as ANET and endometriosis. As with collision tumors, the incidence of this condition is extremely rare [8].

LAMNs are found in 0.6% of all appendectomies and account for around 20% of appendiceal neoplasms. Women are more
often affected and the peak incidence is in the sixth decade of life. The usual clinical presentation is as a palpable mass or tenderness in the right iliac fossa [1]. LAMNs represent up to 73% of mucinous epithelial neoplasms. They are usually non-invasive and have a good prognosis, although up to 18% of cases present with peritoneal mucinous deposits or pseudomixoma peritonei. Their treatment depends on different neoplastic features such as the grade of their cellular atypia, nodal involvement, and peritoneal spread, and LAMNs confined to the appendix mainly require only appendectomy. However, if nodes are involved or R0 resection is not achieved, a right hemicolectomy is required. In the case of peritoneal involvement, without extraperitoneal masses, patients should undergo cytoreductive surgery and hyperthermic intraperitoneal chemotherapy, while extraperitoneal metastatic disease is treated with the same regimens used for metastatic colorectal chemotherapy [3,9,10].

ANETs comprise approximately 30–80% of all appendiceal tumors [11] and are the most frequent among all kinds of NETs. Most of these neoplasms have an excellent prognosis, with a 5-year survival rate close to 100% in the lower tumor stages [12]. Usually detected intraoperatively or during histological examination after appendectomy, ANETs typically do not present with tumor-related symptomatology [11].

For well-differentiated ANETs between 1 and 2 cm, further treatment after appendectomy is still recommended. In our case, the negative prognostic factors of mesoappendiceal invasion and LAMN extension to the resection margin indicated a laparoscopic right hemicolectomy, which was carried out after multidisciplinary team discussion and patient consent.

Retrospectively reviewing the literature, to the best of our knowledge, only 9 other cases of collision LAMN and ANET are reported in the literature (see Table 1) [2,7,13–17]. Of the cases reported, the patient age ranged between 23 and 60 years, with a mean age of 38.5 years and no significant differences in sex (6 female and 4 male). In none of these cases was preoperative workup able to diagnose both neoplasms: in 6 cases, the diagnosis was made postoperatively after appendectomy performed in an acute setting; in 3 cases, it was an incidental finding during surgery performed for other reasons; and in 1 case, a high level of carcinoembryonic antigen (CEA) prompted a diagnostic laparoscopy.

A pathognomonic ultrasound-scan sign for mucinous appendiceal neoplasms is the “onion-skin appearance” typical of mucocoele. CT scan is furthermore able to detect mucocoele as low-attenuated material filling the appendix, and is useful in detecting mucinous distant implants as low-attenuated deposits [18–20]. ANETs in CT scan appear like small submucosal masses or nodular wall thickenings and can eventually show calcifications; usually these lesions are difficult to visualize radiologically because of their small size, and are difficult to discriminate from appendicitis [21].

In 3 of the reported cases, the patients were simply treated with appendectomy; 2 cases further required a right hemicolectomy; and in the remaining 5 cases, peritoneal mucin invasion required extensive surgery and chemotherapy.

### Table 1. Cases of collision ANET and LAMN.

<table>
<thead>
<tr>
<th>Authors and year</th>
<th>Sex</th>
<th>Age (years)</th>
<th>Presentation</th>
<th>Histology</th>
<th>Surgical treatment</th>
<th>Follow-up</th>
</tr>
</thead>
<tbody>
<tr>
<td>Baena-del-Valle et al. 2015 [14]</td>
<td>F</td>
<td>49</td>
<td>Acellular mucin during epigastric hernia repair</td>
<td>Appendiceal perforation, PCI 27 + LAMN (cytokeratin 20 and CDX-2 +, cytokeratin 7 –) and NET (CgA and synaptophysin +)</td>
<td>First appendectomy + CRS + HIPEC</td>
<td>Not available</td>
</tr>
<tr>
<td></td>
<td>F</td>
<td>45</td>
<td>Epigastric hernia and free abdominal fluid</td>
<td>Multiple abdominal mucinous implants + tumor-like lesion on the tip of the appendix + LAMN (cytokeratin 20 and CDX-2 +, cytokeratin 7 –) and NET (CgA and synaptophysin +)</td>
<td>First diagnostic laparoscopic appendectomy + omentectomy + CRS + HIPEC</td>
<td>One year later: progression of disease with perihepatic and pleural recurrences</td>
</tr>
<tr>
<td>Tan et al. 2015 [13]</td>
<td>M</td>
<td>52</td>
<td>Elevated CEA trend</td>
<td>LAMN (3.5–5 cm diameter) without involvement of either the appendiceal base nor the surrounding structures + absence of peritoneal disease + carcinoid 3 mm</td>
<td>Appendectomy</td>
<td>Regular CT scan at 6 months after the surgery</td>
</tr>
</tbody>
</table>
In our experience, in the case of localized presentation, the use of laparoscopy to perform second-step surgery is safe, feasible, and results in a faster postoperative recovery. The lack of a linear clinical pattern and the rarity of cases makes it difficult to trace a standard of care and follow-up. At this stage, management should be tailored to each patient, although a landmark seems to be whether the LAMN is disseminated. CEA and chromogranin-A could be useful tools to manage postoperative follow-up and check potential recidivism for LAMN and ANET, respectively [1].

Conclusions

The presence of a collision LAMN and ANET is exceedingly rare. Often diagnosed as an incidental finding after appendectomy,
optimal management remains a challenge. We recommend tailoring the postoperative treatment and follow-up on a case-by-case basis, since solid evidence is lacking and clinical patterns differ greatly. In our case, laparoscopy has proven to be an excellent tool in performing appendectomy and right hemicolectomy for localized appendiceal collision neoplasms.

References:

11. Tan HL, Tan GHC, Teo M: Two rare cases of appendiceal collision tumours involving an appendiceal mucinous neoplasm and carcinoid. BMJ Case Rep, 2016; 2016: bcr2015213938

Conflict of interest

None.

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