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**Low-grade mucinous appendiceal neoplasm mimicking an ovarian lesion: A case report** **and review of literature**

Borges AL *et al*. LAMN mimicking an ovarian lesion

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**Abstract**

BACKGROUND

Appendiceal tumors are rare lesions that may not be easily differentiated from primary ovarian lesions preoperatively, despite the use of advanced diagnostic methods by experienced clinicians.

CASE SUMMARY

A 59-year-old G2P2 woman, with chronic pelvic pain, underwent a pelvic ultrasound that revealed an adnexal mass measuring 58 mm × 34 mm × 36 mm, with irregular borders, heterogeneous echogenicity, no color Doppler vascularization and without acoustic shadowing. Normal ovarian tissue was visualized in contact with the lesion, and it was impossible to separate the lesion from the ovary by applying pressure with the ultrasound probe. Ascites, peritoneal metastases or other alterations were not observed. With the international ovarian tumor analysis ADNEX model, the lesion was classified as a malignant tumor (the risk of malignancy was 27.1%, corresponding to Ovarian-Adnexal Reporting Data System category 4). Magnetic resonance imaging confirmed the presence of a right adnexal mass, apparently an ovarian tumor measuring 65 mm × 35 mm, without signs of invasive or metastatic disease. During explorative laparotomy, normal morphology of the internal reproductive organs was noted. A solid mobile lesion involved the entire appendix. Appendectomy was performed. Inspection of the abdominal cavity revealed no signs of malignant dissemination. Histopathologically, the appendiceal lesion corresponded to a completely resected low-grade mucinous appendiceal neoplasm (LAMN).

CONCLUSION

The appropriate treatment and team of specialists who should provide health care to patients with seemingly adnexal lesions depend on the nature (benign *vs* malignant) and origin (gynecological *vs* nongynecological) of the lesion. Radiologists, gynecologists and other pelvic surgeons should be familiar with the imaging signs of LAMN whose clinical presentation is silent or nonspecific. The assistance of a consultant specializing in intestinal tumors is important support that gynecological surgeons can receive during the operation to offer the patient with intestinal pathology an optimal intervention.

**Key Words:** Adnexal mass; Appendiceal neoplasm; Diagnostic imaging; Pelvic neoplasm; Adnexal diseases; Pelvic neoplasm; Case report

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**Core Tip:** Low-grade mucinous appendiceal neoplasm is one of the rarest intestinal tumors. Our case highlights how this neoplasm can mimic the behavior of a gynecological (adnexal) lesion in terms of clinical and imaging presentation, while the management and teams of professionals offering treatment significantly differ from those appropriate in the case of adnexal pathology.

**INTRODUCTION**

A pelvic mass with adnexal topography may be a primary adnexal lesion or an ovarian metastasis, but also a primary tumor arising from the uterus, bladder or intestine[1]. Meticulous diagnostic procedures should provide a reliable estimate of the lesion’s nature (benign *vs* malignant) and its origin (gynecological *vs* nongynecological), to offer the patient adequate treatment without delay, avoiding unnecessary interventions and reducing the risk of iatrogenic morbidity. Appendiceal tumors are infrequent and, in certain cases, such as the one that we are presenting here, may not be differentiated from primary adnexal lesions despite the use of advanced diagnostic methods and preoperative assessment procedures[2].

**CASE PRESENTATION**

***Chief complaints***

A postmenopausal 59-year-old woman, G2P2, was admitted to our Gynecology Department due to ultrasound evidence of an adnexal mass of uncertain behavior in the context of chronic pelvic pain.

***History of present illness***

Over the past 2-3 mo, the patient experienced mild-to-moderate and persistent pain in the right lower quadrant, without irradiation, which worsened with somatic movements. There was no reference to any specific gastrointestinal, gynecological, urological or other symptom. A right adnexal solid lesion of 5 cm was found on transvaginal ultrasound, which was requested by the general practitioner who referred the patient to our tertiary referral hospital.

***History of past illness***

The patient's past medical history was unremarkable.

***Personal and family history***

The patient's personal and family history was also unremarkable.

***Physical examination***

Pelvic examination revealed that the external genitalia, vagina and cervix were normal. During bimanual palpation, a 5-6 cm, hard, painful and mobile mass was detected in the right ovarian fossa.

***Laboratory examinations***

There was no hematological or biochemical alteration. The levels of tumor biomarkers, including CA-125 (6.7 U/mL), were normal.

***Imaging examinations***

Transvaginal ultrasound revealed a solid lesion measuring 58 mm × 34 mm × 36 mm, in close contact with the normal tissue of the right ovary, with irregular borders, heterogeneous echogenicity, no vascularization visualized by the use of color Doppler (color score 1) and without acoustic shadowing (Figure 1). Ascites, peritoneal metastases or other alterations were not observed. Using the international ovarian tumor analysis (IOTA) ADNEX model[3] and the recommended cutoff of 10%, the lesion was classified as a malignant tumor (Figure 2). The determined risk of malignancy was 27.1%, which corresponded to the Ovarian-Adnexal Reporting Data System 4 risk category (*i.e.,* intermediate risk)[4]. Pelvic magnetic resonance imaging (MRI) showed a tumor apparently originating from the right ovary and measuring 65 mm × 35 mm, while no signs of invasive disease were noted (Figure 3). In both imaging techniques, continuity between the tumor and gastrointestinal tract was not observed or documented.

**FINAL DIAGNOSIS**

The patient underwent an exploratory laparotomy. Normal uterus, fallopian tubes and ovaries were visualized. We found a solid and mobile lesion originating in the appendix (Figure 4). Inspection of the abdominal cavity revealed no signs of malignant dissemination. The lesion histological diagnosis was low-grade mucinous appendiceal neoplasm (LAMN) (Figure 5).

**TREATMENT**

Appendectomy was performed. In accordance with the orientation provided by the general surgery consultant, who was invited to the operative theatre, no other intervention was performed.

**OUTCOME AND FOLLOW-UP**

The patient had an uneventful postoperative clinical course and was discharged from the hospital on the third postoperative day. Currently, six months after surgery, the patient remains asymptomatic.

**DISCUSSION**

Pelvic tumors represent one of the most frequent reasons for referral to gynecology departments. The management strategies are guided by the degree of clinical imaging-based suspicion of malignancy, as well as symptoms; the patient's age; and her desire for fertility preservation. To promote survival and/or quality of life, an adequate characterization and clinical contextualization of the observed lesions must be carried out in order to refer the patients with a malignant neoplasm for treatment by gynecological oncologists or other specialists in their respective subspecialized units to avoid unnecessary surgery in patients with functional adnexal formations and benign adnexal lesions. The case presented in this study highlights how the preoperative assessment of a patient can be challenging and how gynecologists, despite a detailed and dedicated preoperative evaluation of the patient, can face nongynecological lesions during surgery.

Instead of an expected solid ovarian lesion, our patient had a LAMN, which accounts for 1% of gastrointestinal neoplasms[5]. It is a low-grade dysplastic epithelial lesion that, by definition, lacks infiltrative invasion, which would be termed mucinous adenocarcinoma[6]. The PubMed search that we conducted on January 1, 2021, identified 23 reports resembling our case (Table 1). A large case series indicated that the median age at LAMN diagnosis is 61 years, which is close to the age of our patient[7]. In terms of sex, the literature reports a higher prevalence in females (the female/male ratio varies from 7:1[8] to 1.4:1[9]). Similarly, ovarian carcinoma occurs at the median age of 63 years[10]. Regarding clinical presentation, ovarian cancer typically produces symptoms, including nonspecific pelvic/abdominal pain, bloating, urinary urgency or frequency, in the late and advanced stages[11,12]. In the same manner, appendiceal mucocele that mimics an adnexal mass most commonly presents with pelvic/abdominal pain[13]. The complications of LAMN include intussusception, volvulus, small bowel or ureteral obstruction, rupture and mucinous ascites, namely, pseudomyxoma peritonei. The ovarian etiology assumption by routine and epidemiological/clinical overlap can easily lead to an erroneous diagnosis. Preoperatively, LAMN is commonly misdiagnosed as acute appendicitis or an adnexal mass[14], as occurred in our patient. Differential diagnosis may also include mucinous adenocarcinoma of the appendix and a high-grade appendiceal mucinous neoplasm, a pelvic foreign body and a subserous uterine fibroid. The literature consistently reinforces the idea that the presence of a right-sided adnexal mass should allow for the possibility of an appendiceal neoplasm[15,16]. Interestingly, cases of left-sided appendiceal neoplasms mimicking an adnexal mass have recently been reported[17,18].

Imaging modalities for diagnosis include ultrasound, computed tomography (CT) and MRI. Regarding the ultrasound imaging features, it has been described that an appendiceal mucocele (the LAMN includes lesions that were described previously as mucoceles) should be suspected when a cystic mass with concentric echogenic layers (the “onion skin” sign) and a normal ovary are detected in the right lower quadrant[19]. In parallel, the possibility of separating a lesion from the ovary by applying pressure with the ultrasound probe (“split” sign) also indicates its nonovarian origin[20]. In our patient, we observed the “onion skin” sign (Figure 1) but not the “split” sign. The IOTA models have been externally validated and found to be valuable tools for discriminating between benign and malignant ovarian tumors (1); however, they should not be used if nonadnexal lesions with adnexal topography are suspected. We used the IOTA ADNEX model because it seemed a lesion originating from the ovarian parenchyma. The obtained output could not properly assist us. The literature suggest that CT scan are superior to ultrasound evaluations in diagnosing LAMN[21], namely, to distinguish LAMN from acute appendicitis. Nevertheless, CT is diagnostic in less than 50% of cases[22]. We used MRI to complement the ultrasound assessment, and the MRI findings were consistent with a primary ovarian lesion.

Once the appendiceal lesion was confirmed during the explorative intervention, the assistance of a surgeon specializing in intestinal pathology was of fundamental importance to provide an appropriate treatment to the patient. In accordance with the Clinical Practice Guidelines of the American Society of Colon and Rectal Surgeons[23], LAMNs with negative margins and no evidence of perforation or peritoneal involvement are safely treated with appendectomy alone.

**CONCLUSION**

The spectrum of lesions that have adnexal topography is wide, and in addition to diverse adnexal lesions, it includes uterine, bladder and intestinal pathology. LAMN should be suspected when a right adnexal mass with concentric echogenic layers separable from normal ovarian tissue is observed. Despite meticulous preoperative examination, when unexpectedly nongynecological lesions are identified, intraoperative cooperation between gynecologists and other specialists is crucial to offer adequate intervention to the patient. Registering such cases and reviewing the preoperative imaging findings may increase preoperative diagnostic sensitivity and specificity and therefore should not be omitted.

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**Footnotes**

**Informed consent statement:** Consent was obtained from the patient for publication of this report and all accompanying images. The host institution ruled that the approval of the Ethics Committee was not required for this project.

**Conflict-of-interest statement:** The authors declare that there is no conflict of interest.

**CARE Checklist (2016) statement:** The authors have read the CARE Checklist (2016), and the manuscript was prepared and revised according to the CARE Checklist (2016).

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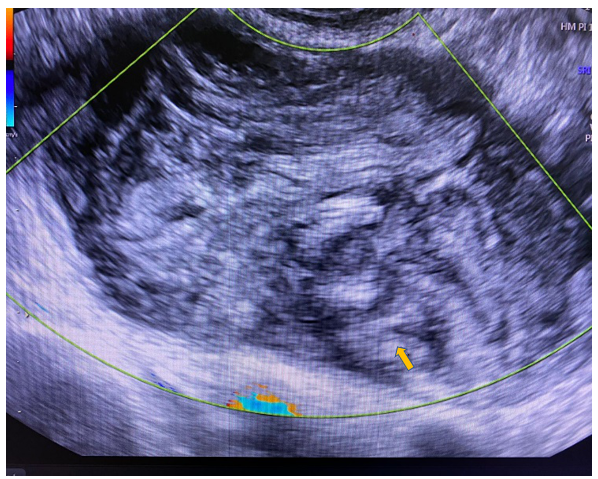
Grade C (Good): C

Grade D (Fair): 0

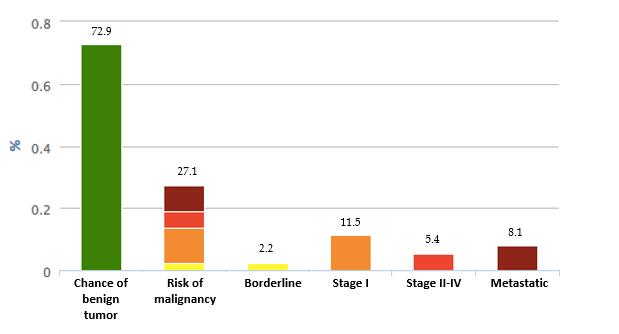
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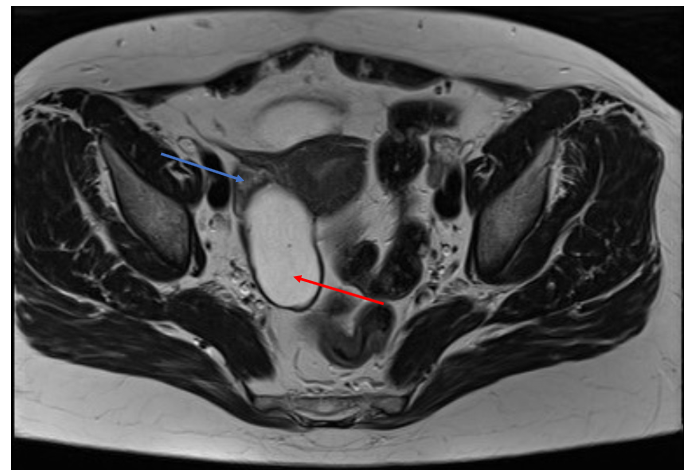
**Figure Legends**



**Figure 1 Low-grade mucinous appendiceal neoplasm presenting as a right adnexal mass (transvaginal ultrasound).**



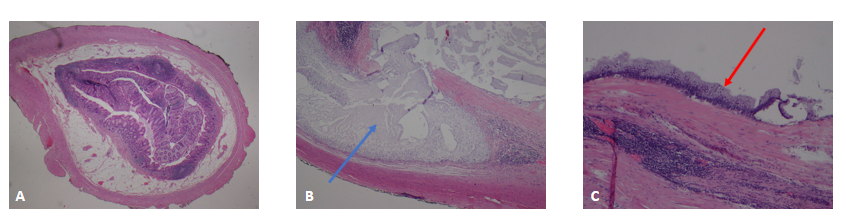
**Figure 2 Low-grade mucinous appendiceal neoplasm assumed as an adnexal neoplasm: Results of the tumor assessment using the international ovarian tumor analysis ADNEX prediction model.**



**Figure 3 Low-grade mucinous appendiceal neoplasm mimicking an ovarian tumor (magnetic resonance imaging presentation).** The blue arrow indicates the right ovary; the red arrow indicates the tumor apparently originating from the right ovary.



**Figure 4 Low-grade mucinous appendiceal neoplasm macroscopic features (appendectomy with tumorectomy specimen).**



**Figure 5 Appendectomy with tumorectomy specimens (histological characteristics).** A: Proximal appendiceal stump with normal histological features [Hematoxylin & eosin (H&E) staining, 20 × magnitude]; B: Low-grade mucinous appendiceal neoplasm (LAMN) (H&E staining, 40 × magnitude, blue arrow showing acellular mucin); C: LAMN (H&E staining, 100 × magnitude, red arrow absence of high-grade epithelial dysplasia).

**Table 1** **Appendiceal neoplasms mimicking adnexal lesions (cases identified by the PubMed search, published in English language until January 2021)**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Case** | **Age** | **Cardinal symptom** | **Clinical context** | **Imaging modality** | **Tumor marker** | **Presumed diagnosis** | **Treatment** | **Appendix: Histopathology** |
| 1[24] | 32 | Abdominal pain | Acute abdomen (38 wk pregnancy) | US (cystic mass 32 mm × 35 mm × 59 mm) | N/A | Right ovarian torsion | Laparotomy: Appendectomy C-Section | Mucocele (torsion) |
| 2[25] | 49 | Pelvic pain | Chronic pain (1 yr) | US (heterogenous mass 70 mm × 35 mm × 40 mm). MRI (cystic mass 70 mm × 63 mm × 29 mm) | CEA 10.5 μg/L (↑). CA125 normal | Right adnexal mass of paraovarian origin | Laparoscopy: Appendectomy. Peritoneal washing | LAMN. Peritoneal citology: Negative |
| 3[2] | 81 | Abdominal pain | Chronic pain (several months) | US (heterogenous cystic mass 110 mm × 90 mm). MRI (heterogenous cystic mass 120 mm × 100 mm) | CA125 13.18 U/mL. CA19.9 20.8 U/mL. CEA 1.76 ng/mL. CA15.3 6.7 U/mL | Right adnexal mass | Laparotomy: Appendectomy and a right hemicolectomy with ileo-transverse anastomosis. Total abdominal hysterectomy and bilateral salpingo-oophorectomy due to pelvic organ prolapse | Appendiceal mucinous neoplasm with low malignancy potential |
| 4[17] | 61 | Incidental imaging finding | Preventive gynecological check-up | US (heterogenous solid mass 104 mm × 40 mm) | CA19.9 40 U/mL (↑). CA125 9 U/mL. CA15.3 13 U/mL. AFP 2 ng/mL | Left adnexal mass | Laparotomy: Appendectomy. Excisional biopsy of the omentum | LAMN |
| 5[26] | 41 | Pelvic pain | Chronic pain | US (cystic mass 60 mm × 28 mm). MRI (70 mm × 40 mm × 30 mm) | CEA and CA19.9 normal | Right adnexal mass | Laparoscopy converted to laparotomy: Right hemicolectomy with side to side ileocolic stapler anastomosis | LAMN |
| 6[27] | 15 | Abdominal pain | Acute abdomen | US; CT (no precise description reported) | N/A | Right ovarian torsion | Laparoscopy: Appendectomy | Mucocele |
| 7[28] | 46 | Incidental pelvic examination finding | Preventive gynecological check-up | US (cystic mass 115 mm × 40 mm) | N/A | Right adnexal mass (hydro-pyosalpinx, tubo-ovarian abscess or ovarian cyst) | Laparotomy: Appendectomy | Mucocele |
| 8[15] | 71 | Pelvic pain | Acute pain | US (cystic mass 50 mm × 70 mm). MRI (cystic mass 40 mm × 80 mm) | CA125 9.1 U/mL. CA19.9 5.09 U/mL. AFP 2.4 ng/mL. β-hCG 0.01 mIU/mL | Righ adnexal mass | Laparotomy: Appendectomy. Total abdominal hysterectomy and bilateral salpingo-oophorectomy due to pelvic organ prolapse | Mucocele |
| 9[29] | 80 | Abdominal pain | Chronic pain (several months) | US (mixed echogenic mass 61 mm × 43 mm × 51 mm). CT (calcified cyst 70 mm × 60 mm × 50 mm) | CA125 normal | Righ adnexal mass (ovarian cyst) | Laparotomy: Appendectomy | Mucinous cystadenoma |
| 10[30] | 61 | Pelvic pain | Chronic pain (several months) | US (cystic mass). CT (homogenous mass 110 mm × 35 mm) | Normal (not specified) | Right adnexal mass (ovarian cyst or hydrosalpynx) | Laparoscopy: Appendectomy | LAMN |
| 11[31] | 26 | Pelvic pain | Chronic pain | US (cystic mass 30 mm × 30 mm) | N/A | Right adnexal mass (ovarian cyst) | Laparoscopy: Appendectomy | Mucinous cystadenoma with mild-moderate dysplasia |
| 12[16] | 70 | Incidental pelvic examination finding | Preventive gynecological check-up | US (solid mass 60 mm × 60 mm × 40 mm) | CA125 120 mg/dL (↑). CEA normal | Right adnexal mass | Laparotomy: Appendectomy. Total abdominal hysterectomy and bilateral salpingo-oophorectomy. | Mucinous cystadenoma |
| 13[32] | 68 | Incidental pelvic examination finding | Abnormal uterine bleeding | US (cystic mass 39 mm) | N/A | Right adnexal mass (ovarian cyst) | Laparoscopy: Appendectomy | Mucocele |
| 14[18] | 50 | Pelvic pain | - | US (tubular mass 96 mm × 40 mm × 33 mm). MRI (no precise description reported) | N/A | Left adnexal mass (hydrosalpynx) | Robotic: Appendectomy Right hemicolectomy | Low grade mucinous adenocarcinoma |
| 15[33] | 42 | Incidental imaging finding | 1st trimester bleeding | US (cystic mass 120 mm × 108 mm × 58 mm) | CA125 16 U/mL | Right adnexal mass (ovarian cyst) | Laparotomy: Appendectomy | Mucocele |
| 16[34] | 31 | Pelvic pain | Fever | US; MRI (no precise description reported) | CA125 12.2 U/mL. CEA 5.2 U/mL. CA19.9 0.8 ng/mL | Right adnexal mass (hydrosalpynx) | Laparotomy: Appendectomy | Mucocele |
| 17[35] | 79 | Incidental imaging finding | Preventive gynecological check-up | US (uniloculated mass, characterized  by dishomogeneous content, distal shadowing 59 mm × 43 mm × 40 mm). MRI (cystic mass 80 mm) | CEA 1.26 ng/mL. CA125 8.1 U/mL. CA19.9 3.44 U/mL. CA15.3 14.1 U/mL | Right adnexal mass (ovarian cyst) | Laparoscopy: Appendectomy | Mucocele |
| 18[36] | 80 | Pelvic pain | Chronic pain | US (cystic/solid mass 83 mm × 65 mm × 64 mm). CT (cystic mass 100 mm × 80 mm) | CEA 54.2 ng/mL | Right adnexal mass | Laparotomy: Appendectomy. Omentectomy, total abdominal hysterectomy, and bilateral salpingo-oophorectomy | LAMN |
| 19[37] | 83 | Incidental imaging finding | Preventive gynecological check-up | US (cystic/solid mass 87 mm). MRI (cystic mass 90 mm) | CEA 5.3 ng/mL (↑). CA15.3 31.4 U/mL | Right adnexal mass | Laparotomy: Appendectomy | LAMN |
| 20[38] | 78 | Asymptomatic | Known adnexal mass on ultrasound follow-up | US (cystic mass 58 mm × 42 mm × 35 mm). MRI (bilocular cystic mass 41 mm × 19 mm) | CEA, CA125 and CA19.9 normal | Right adnexal mass | Laparotomy: Appendectomy. Total abdominal hysterectomy and bilateral salpingo-oophorectomy due to pelvic organ prolapse. | Mucinous cystadenoma |
| 21[39] | 28 | Pelvic pain | Acute abdomen | CT (cystic mass 33 mm × 50 mm) | N/A | Right adnexal mass (ovarin cyst rupture) | Laparoscopy: Appendectomy | Mucocele (torsion: Hemorrhagic transmural necrosis) |
| 22[40] | 36 | Pelvic pain | - | US (cystic complex mass) | CEA ↑; CA19.9 ↑ | Right adnexal mass | Laparotomy: Appendectomy | Mucinous cystadenoma |
| 23[41] | 75 | Asymptomatic | Adnexal mass on ultrasound (investigation due to CEA↑) | US. CT (cystic mass 90 mm) | CEA 17.7 ng/mL (↑). CA125 and CA19.9 normal | Right adnexal mass (ovarian malignancy) | Laparotomy: Appendectomy | Mucinous cystadenoma |

↑: Above the upper limit of normal; AFP: Alpha-Fetoprotein; C-section: Cesarean section; CA125: Cancer antigen 125; CA15.3: Cancer antigen 15.3; CA19.9: Carbohydrate antigen 19.9; CEA: Carcinoembryonic antigen; CT: Computed Tomography; MRI: Magnetic resonance imaging; N/A: Not available; US: Ultrasound; LAMN: Low-grade mucinous appendiceal neoplasm; β-hCG: β-human chorionic gonadotropin.