



## Protocol for the Examination of Specimens From Patients With Carcinoma of the Appendix

Version: Appendix 4.1.0.0

Protocol Posting Date: February 2020

CAP Laboratory Accreditation Program Protocol Required Use Date: November 2020

Includes pTNM requirements from the 8<sup>th</sup> Edition, AJCC Staging Manual

For accreditation purposes, this protocol should be used for the following procedures AND tumor types:

Procedure	Description
Excision	Includes specimens designated appendectomy with or without segmental resection (right hemicolectomy)
Tumor Type	Description
Carcinoma	Includes low grade mucinous neoplasm (LAMN), adenocarcinoma (including mucinous and signet ring cell variants), goblet cell adenocarcinoma, undifferentiated carcinoma, small cell and large cell (poorly differentiated) neuroendocrine carcinoma

This protocol is NOT required for accreditation purposes for the following:

Procedure
Biopsy
Primary resection specimen with no residual cancer (eg, following neoadjuvant therapy)
Cytologic specimens

The following tumor types should NOT be reported using this protocol:

Tumor Type
Well-differentiated neuroendocrine tumors (consider the Appendix NET protocol)
Lymphoma (consider the Hodgkin or non-Hodgkin Lymphoma protocols)
Gastrointestinal stromal tumor (GIST) (consider the GIST protocol)
Non-GIST sarcoma (consider the Soft Tissue protocol)

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### Accreditation Requirements

This protocol can be utilized for a variety of procedures and tumor types for clinical care purposes. For accreditation purposes, only the definitive primary cancer resection specimen is required to have the core and conditional data elements reported in a synoptic format.

- Core data elements are required in reports to adequately describe appropriate malignancies. For accreditation purposes, essential data elements must be reported in all instances, even if the response is “not applicable” or “cannot be determined.”
- Conditional data elements are only required to be reported if applicable as delineated in the protocol. For instance, the total number of lymph nodes examined must be reported, but only if nodes are present in the specimen.
- Optional data elements are identified with “+” and although not required for CAP accreditation purposes, may be considered for reporting as determined by local practice standards.

The use of this protocol is not required for recurrent tumors or for metastatic tumors that are resected at a different time than the primary tumor. Use of this protocol is also not required for pathology reviews performed at a second institution (ie, secondary consultation, second opinion, or review of outside case at second institution).

### Synoptic Reporting

All core and conditionally required data elements outlined on the surgical case summary from this cancer protocol must be displayed in synoptic report format. Synoptic format is defined as:

- Data element: followed by its answer (response), outline format without the paired "Data element: Response" format is NOT considered synoptic.
- The data element should be represented in the report as it is listed in the case summary. The response for any data element may be modified from those listed in the case summary, including “Cannot be determined” if appropriate.
- Each diagnostic parameter pair (Data element: Response) is listed on a separate line or in a tabular format to achieve visual separation. The following exceptions are allowed to be listed on one line:
  - Anatomic site or specimen, laterality, and procedure
  - Pathologic Stage Classification (pTNM) elements
  - Negative margins, as long as all negative margins are specifically enumerated where applicable
- The synoptic portion of the report can appear in the diagnosis section of the pathology report, at the end of the report or in a separate section, but all Data element: Responses must be listed together in one location

Organizations and pathologists may choose to list the required elements in any order, use additional methods in order to enhance or achieve visual separation, or add optional items within the synoptic report. The report may have required elements in a summary format elsewhere in the report IN ADDITION TO but not as replacement for the synoptic report ie, all required elements must be in the synoptic portion of the report in the format defined above.

## Summary of Changes

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### Version 4.1.0.0

#### The following data elements were modified:

Histologic Type (WHO 2019)

## Surgical Pathology Cancer Case Summary

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Protocol posting date: February 2020

### APPENDIX:

Select a single response unless otherwise indicated.

#### Procedure (Note A)

- Appendectomy  
 Appendectomy and right colectomy  
 Other (specify): \_\_\_\_\_

#### + Tumor Site (select all that apply) (Note B)

- +  Proximal half of appendix  
     +  Base of appendix involved by tumor  
     +  Base of appendix uninvolved by tumor  
     +  Involvement of base of appendix cannot be assessed  
 +  Distal half of appendix  
 +  Diffusely involving appendix  
 +  Appendix, not otherwise specified  
 +  Other (specify): \_\_\_\_\_

#### Tumor Size

- Greatest dimension (centimeters): \_\_\_ cm  
 + Additional dimensions (centimeters): \_\_\_ x \_\_\_ cm  
 Cannot be determined (explain): \_\_\_\_\_

#### Histologic Type (Note C)

- Adenocarcinoma  
 Mucinous adenocarcinoma  
 Low-grade appendiceal mucinous neoplasm  
 High-grade appendiceal mucinous neoplasm  
 Signet-ring cell carcinoma  
 Goblet cell adenocarcinoma  
 Large cell neuroendocrine carcinoma  
 Small cell neuroendocrine carcinoma  
 Mixed neuroendocrine-non-neuroendocrine neoplasm (Mixed adenoneuroendocrine carcinoma)  
 Medullary carcinoma  
 Adenosquamous carcinoma  
 Undifferentiated carcinoma  
 Other histologic type not listed (specify): \_\_\_\_\_  
 Carcinoma, type cannot be determined (explain): \_\_\_\_\_

#### Histologic Grade (Note D)

- G1: Well differentiated  
 G2: Moderately differentiated  
 G3: Poorly differentiated  
 Other (specify): \_\_\_\_\_  
 GX: Cannot be assessed  
 Not applicable

#### Tumor Extension (select all that apply)

- No evidence of primary tumor  
 Tumor invades lamina propria or muscularis mucosa

+ Data elements preceded by this symbol are not required for accreditation purposes. These optional elements may be clinically important but are not yet validated or regularly used in patient management.

- Tumor invades submucosa
- Tumor invades muscularis propria
- Acellular mucin invades subserosa or mesoappendix but does not extend to the serosal surface
- Tumor invades through the muscularis propria into the subserosa or mesoappendix but does not extend to the serosal surface
- Acellular mucin invades the visceral peritoneum (serosa)
- Tumor invades the visceral peritoneum (serosa)
- Tumor directly invades adjacent organs or structures (specify): \_\_\_\_\_
- Cannot be assessed

**Margins (Note E)**

**Proximal Margin (select all that apply)**

- Cannot be assessed
- Uninvolved by invasive carcinoma
- Involved by invasive carcinoma
- Involved by high-grade dysplasia
- Uninvolved by appendiceal mucinous neoplasm
- Involved by low-grade appendiceal mucinous neoplasm
- Involved by high-grade appendiceal mucinous neoplasm
- Involved by acellular mucin

**Mesenteric Margin (required only if applicable) (select all that apply)**

- Cannot be assessed
- Uninvolved by invasive carcinoma
  - + Distance of invasive carcinoma from closest mesenteric margin (millimeters *or* centimeters):  
 mm *or*  cm
- Involved by invasive carcinoma
- Uninvolved by appendiceal mucinous neoplasm
- Involved by low-grade appendiceal mucinous neoplasm
- Involved by high-grade appendiceal mucinous neoplasm
- Involved by acellular mucin

**Other Margin(s) (required only if applicable)**

- Specify margin(s): \_\_\_\_\_
- Cannot be assessed
  - Uninvolved by invasive carcinoma
  - Involved by invasive carcinoma

**Lymphovascular Invasion (select all that apply) (Note F)**

- Not identified
- Present
- Cannot be determined

**Tumor Deposits (Note G)**

- Not identified
- Present
  - Specify number of deposits: \_\_\_\_\_
  - Number of tumor deposits cannot be determined (explain): \_\_\_\_\_
- Cannot be determined

**+ Perineural Invasion (Note H)**

- +  Not identified
- +  Present
- +  Cannot be determined

+ Data elements preceded by this symbol are not required for accreditation purposes. These optional elements may be clinically important but are not yet validated or regularly used in patient management.

**Regional Lymph Nodes**

No lymph nodes submitted or found

Lymph Node Examination (required only if lymph nodes are present in the specimen)

**Number of Lymph Nodes Involved:** \_\_\_\_\_

Number cannot be determined (explain): \_\_\_\_\_

**Number of Lymph Nodes Examined:** \_\_\_\_\_

Number cannot be determined (explain): \_\_\_\_\_

**Pathologic Stage Classification (pTNM, AJCC 8<sup>th</sup> Edition) (Note I)**

*Note: Reporting of pT, pN, and (when applicable) pM categories is based on information available to the pathologist at the time the report is issued. Only the applicable T, N, or M category is required for reporting; their definitions need not be included in the report. The categories (with modifiers when applicable) can be listed on 1 line or more than 1 line. Assignment of Pathologic Prognostic Stage Group is the responsibility of the managing physician and not the pathologist.*

TNM Descriptors (required only if applicable) (select all that apply)

m (multiple primary tumors)

r (recurrent)

y (posttreatment)

**Primary Tumor (pT)**

pTX: Primary tumor cannot be assessed

pT0: No evidence of primary tumor

pTis: Carcinoma in situ (intramucosal carcinoma; invasion of the lamina propria or extension into but not through the muscularis mucosae)

pTis(LAMN): Low-grade appendiceal mucinous neoplasm confined by the muscularis propria. Acellular mucin or mucinous epithelium may invade into the muscularis propria. T1 and T2 are not applicable to LAMN. Acellular mucin or mucinous epithelium that extends into the subserosa or serosa should be classified as T3 or T4a, respectively.

pT1: Tumor invades the submucosa (through the muscularis mucosa but not into the muscularis propria)

pT2: Tumor invades the muscularis propria

pT3: Tumor invades through the muscularis propria into the subserosa or mesoappendix

pT4: Tumor invades the visceral peritoneum, including the acellular mucin or mucinous epithelium involving the serosa of the appendix or mesoappendix, and/or directly invades adjacent organs or structures

pT4a: Tumor invades through the visceral peritoneum, including the acellular mucin or mucinous epithelium involving the serosa of the appendix or serosa of the mesoappendix

pT4b: Tumor directly invades (or adheres to<sup>#</sup>) adjacent organs or structures

*# The text in parentheses is not applicable to pT determination. A tumor grossly adherent to other organs or structures is classified as cT4b; however, if no tumor is identified on pathological examination of the adhesion, the T category assigned based on the depth of wall invasion observed on microscopic examination (typically pT1-3).*

**Regional Lymph Nodes (pN)**

pNX: Regional lymph nodes cannot be assessed

pN0: No regional lymph node metastasis

pN1: One to three regional lymph nodes are positive (tumor in lymph nodes measuring  $\geq 0.2$  mm), or any number of tumor deposits is present, and all identifiable lymph nodes are negative

pN1a: One regional lymph node is positive

pN1b: Two or three regional lymph nodes are positive

pN1c: No regional lymph nodes are positive, but there are tumor deposits in the subserosa or mesentery

pN2: Four or more regional lymph nodes are positive

+ Data elements preceded by this symbol are not required for accreditation purposes. These optional elements may be clinically important but are not yet validated or regularly used in patient management.

**Distant Metastasis (pM) (required only if confirmed pathologically in this case)**

- pM1: Distant metastasis
- pM1a: Intraperitoneal acellular mucin, without identifiable tumor cells in the disseminated peritoneal mucinous deposits<sup>#</sup>
- pM1b: Intraperitoneal metastasis only, including peritoneal mucinous deposits containing tumor cells
- pM1c: Metastasis to sites other than peritoneum  
Specify site(s), if known: \_\_\_\_\_

*# Note: For specimens containing acellular mucin without identifiable tumor cells, efforts should be made to obtain additional tissue for thorough histologic examination to evaluate for cellularity.*

**+ Additional Pathologic Findings (select all that apply) (Note J)**

- +  None identified
- +  Appendicitis
- +  Perforation, not at tumor
- +  Ulcerative colitis
- +  Crohn disease
- +  Diverticulosis
- +  Other (specify): \_\_\_\_\_

**+ Ancillary Studies (Note K)**

- + Specify: \_\_\_\_\_
- +  Not performed

**+ Comment(s)**

+ Data elements preceded by this symbol are not required for accreditation purposes. These optional elements may be clinically important but are not yet validated or regularly used in patient management.

## Explanatory Notes

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### A. Anatomic Site

Tumors located at the base of the appendix must be distinguished from cecal carcinomas extending into the appendix, a distinction based primarily on a careful gross examination of the specimen with determination of the location of the bulk of the tumor. Microscopic examination may reveal a precursor lesion, and its location may indicate the primary site of origin.

### B. Tumor Location

Appendiceal tumors located in the base of the appendix may cause obstruction of the lumen early in their course, resulting in acute appendicitis and their early recognition, with a resultant better prognosis compared to tumors located either in the colon or distal appendix.

### C. Histologic Type

For consistency in reporting, the histologic classification of appendiceal carcinomas proposed by the World Health Organization (WHO) is recommended.<sup>1</sup> However, this protocol does not preclude the use of other systems of classification or histologic types.

This protocol is applicable to low-grade (or high-grade) appendiceal mucinous neoplasms as well as invasive carcinomas. Low-grade appendiceal mucinous neoplasm (LAMN) is considered a low-grade carcinoma. Adenomatous proliferation with an intact muscularis mucosa is considered an appendiceal adenoma.<sup>1</sup> Tumors with obliteration of muscularis mucosa in which the adenomatous epithelium rests on fibrous tissue or tumors with nondestructive mural or peritoneal involvement qualify for the diagnosis of LAMN.<sup>1</sup> Tumors with destructive invasion and desmoplasia are classified as invasive adenocarcinoma. Both LAMN and invasive carcinomas should be staged as per this protocol.<sup>1</sup> If the histologic features qualify for LAMN, the histologic type in the tumor synoptic should be selected as LAMN even if there is peritoneal involvement. High-grade appendiceal neoplasms (HAMNs) are rare tumors that resemble LAMN in lacking destructive invasion but show high-grade cytologic features. This term is not part of the current WHO terminology, but has been recommended in a recent consensus publication and has been included in the AJCC 8<sup>th</sup> edition.<sup>2</sup>

High grade appendiceal mucinous neoplasm is included in WHO 2019 (5<sup>th</sup> edition) but is not included in the AJCC 8<sup>th</sup> edition. For practical purposes, these could likely be incorporated into Adenocarcinoma NOS or Mucinous adenocarcinoma depending on a given patient's specific findings. Per the WHO 5<sup>th</sup> edition, "HAMN's are rare, and there are limited data regarding when they are confined to the appendix.... HAMN's that have disseminated to the peritoneal cavity are likely to behave like other mucinous tumours that have spread to the peritoneum."

Goblet cell adenocarcinoma (WHO 5<sup>th</sup> edition) has replaced goblet cell carcinoid and mixed goblet cell carcinoid/adenocarcinoma terms, which are still listed in AJCC 8<sup>th</sup> edition.<sup>3,4</sup>

Adenocarcinoma subtypes are included in the menu of diagnostic terms of AJCC 8<sup>th</sup> edition but are not included as independent diagnostic options in WHO 5<sup>th</sup> edition. Some studies have shown that mucinous carcinomas in the appendix have a better prognosis than nonmucinous adenocarcinomas<sup>5,6</sup> and are less likely to demonstrate lymphatic or hematogenous spread.<sup>5,7</sup> One of the most critical prognostic factors in mucinous appendiceal neoplasms is the presence or absence of mucinous epithelial cells in extra-appendiceal mucin.<sup>8-11</sup> Hence the presence or absence of epithelial cells in mucin should be clearly noted in the surgical pathology report.

### References

1. WHO Classification of Tumours Editorial Board. *Digestive system tumours*. Lyon (France): International Agency for Research on Cancer; 2019. (WHO classification of tumours series, 5th ed.; vol. 1).
2. Carr NJ, Cecil TD, Mohamed F, et al; Peritoneal Surface Oncology Group International. A consensus for classification and pathologic reporting of pseudomyxoma peritonei and associated appendiceal neoplasia: the results of the Peritoneal Surface Oncology Group International (PSOGI) Modified Delphi Process. *Am J Surg Pathol*. 2016;40(1):14-26.
3. Carr NJ, Sobin LH. Neuroendocrine tumors of the appendix. *Semin Diagn Pathol*. 2004;21(2):108-119.
4. Tang LH, Shia J, Soslow RA, et al. Pathologic classification and clinical behavior of the spectrum of goblet cell carcinoid tumors of the appendix. *Am J Surg Pathol*. 2008;32(10):1429-1443.

5. Kabbani W, Houlihan PS, Luthra R, Hamilton SR, Rashid A. Mucinous and nonmucinous appendiceal adenocarcinomas: different clinicopathological features but similar genetic alterations. *Mod Pathol.* 2002;15(6):599-605.
6. McGory ML, Maggard MA, Kang H, O'Connell JB, Ko CY. Malignancies of the appendix: beyond case series reports. *Dis Colon Rectum.* 2005;48(12):2264-2271.
7. Gonzalez-Moreno S, Sugarbaker PH. Right hemicolectomy does not confer a survival advantage in patients with mucinous carcinoma of the appendix and peritoneal seeding. *Br J Surg.* 2004;91(3):304-311.
8. Carr NJ, McCarthy WF, Sobin LH. Epithelial noncarcinoid tumors and tumor-like lesions of the appendix: a clinicopathologic study of 184 patients with a multivariate analysis of prognostic factors. *Cancer.* 1995;75:757-768.
9. Misraji J, Yantiss RK, Graeme-Cook FM, Balis UJ, Young RH. Appendiceal mucinous neoplasms: a clinicopathologic analysis of 107 cases. *Am J Surg Pathol.* 2003;27(8):1089-1103.
10. Yantiss RK, Shia J, Klimstra DS, Hahn HP, Odze RD, Misraji J. Prognostic significance of localized extra-appendiceal mucin deposition in appendiceal mucinous neoplasms. *Am J Surg Pathol.* 2009;33(2):248-55.
11. Pai RK, Beck AH, Norton JA, Longacre TA. Appendiceal mucinous neoplasms: clinicopathologic study of 116 cases with analysis of factors predicting recurrence. *Am J Surg Pathol.* 2009;33(10):1425-1439.

#### D. Histologic Grade

Although rigorous criteria for grading have not been applied, histologic grade has been shown to be a prognostic factor in several series of appendiceal carcinoma.<sup>1-6</sup>

**Nonmucinous tumors:** These tumors are graded as well differentiated (G1, >95% gland formation), moderately differentiated (G2, 50-95% gland formation), and poorly differentiated (G3, <50% gland formation).

Appendiceal mucinous tumors have been graded as low or high grade based on cytologic features in the WHO 2010 scheme. For mucinous tumors involving the peritoneum, the AJCC recommends a 3-tier grading scheme as the prognostic significance of three groups has been shown in multiple studies for mucinous tumors involving the peritoneum. The proposed 3-tier grading scheme by AJCC is modified from Davison et al<sup>5</sup> and is based on cytologic features, tumor cellularity, and presence of signet-ring component. The grade of the appendiceal and peritoneal tumors is concordant in most instances, but some cases may show discordant grades in the appendix and peritoneum. In case of discordance of grades, the highest grade should be assigned to the tumor for staging (see note I).

Table: Three-Tier Grading Scheme Recommended by AJCC<sup>7</sup> (based on scheme proposed by Davison et al<sup>5</sup>)

Well-differentiated (G1)	Low-grade cytologic atypia, no signet-ring cells. Tumors involving peritoneum show acellular mucin or low cellularity (typically <20%) and lack infiltrative invasion of the peritoneum or other organs are considered G1.
Moderately differentiated (G2)	Mix of low- and high-grade cytologic atypia or diffuse high-grade cytologic atypia, no signet-ring cells.
Poorly differentiated (G3)	High-grade cytologic atypia, usually with signet-ring cell component.

In the appendix, G1 tumors usually lack typical features of invasion and are classified as LAMNs. In the peritoneum, G1 tumors may involve peritoneal surface or organs with a pushing front without desmoplasia, and lack infiltrative invasion. Perineural invasion and lymphovascular invasion are not seen. G1 tumors with peritoneal involvement have been variously termed as LAMN with peritoneal involvement, low-grade mucinous carcinoma peritonei and disseminated peritoneal adenomucinosis (DPAM). In cancer protocols, the histologic type of these tumors is best recorded as LAMN. G2 mucinous tumors in the appendix may correspond to high-grade mucinous appendiceal neoplasms (HAMN) or mucinous adenocarcinomas with destructive invasion and associated desmoplasia. The latter often shows complex architecture, such as cribriform glandular spaces and complex papillary structures. G3 mucinous tumors in the appendix are high-grade, invasive tumors that usually have a signet ring cell component. With extra-appendiceal spread, G2 and G3 tumors can show invasion (with desmoplasia) into the peritoneum or other organs, perineural invasion, and lymphovascular invasion. Most



mucinous G2 and G3 tumors with peritoneal involvement would correspond to terms such as high-grade mucinous carcinoma peritonei and peritoneal mucinous adenocarcinoma.

By convention, signet-ring cell carcinomas are grade 3. The above grading schemes are not applicable to poorly differentiated neuroendocrine carcinoma and goblet cell carcinoid. Tumors with no differentiation (undifferentiated carcinomas) are categorized as grade 4 in the WHO 2010 classification, but G4 is not included in the AJCC 8<sup>th</sup> edition.

#### References

1. Sugarbaker PH, Chang D, Koslowe P. Prognostic features for peritoneal carcinomatosis in colorectal and appendiceal cancer patients when treated by cytoreductive surgery and intraperitoneal chemotherapy. *Cancer Treat Res*. 1996;81:89-104.
2. Ronnett BM, Yan H, Kurman RJ, Shmookler BM, Lee W, Sugarbaker PH. Patients with pseudomyxoma peritonei associated with disseminated peritoneal adenomucinosis have a significantly more favorable prognosis than patients with peritoneal mucinous carcinomatosis. *Cancer*. 2001;92:85-91.
3. Bradley RF, Stewart JH, Russell GB, Levine EA, Geisinger KR. Pseudomyxoma peritonei of appendiceal origin: a clinicopathologic analysis of 101 patients uniformly treated at a single institution, with literature review. *Am J Surg Pathol*. 2006;30(5):551-559.
4. Shetty S, Natarajan B, Thomas P, Govindarajan V, Sharma P, Loggie B. Proposed classification of pseudomyxoma peritonei: influence of signet ring cells on survival. *Am Surg*. 2013;79(11):1171-1176.
5. Davison JM, Choudry HA, Pingpank JF, et al. Clinicopathologic and molecular analysis of disseminated appendiceal mucinous neoplasms: identification of factors predicting survival and proposed criteria for a three-tiered assessment of tumor grade. *Mod Pathol*. 2014;27(11):1521-1539.
6. Asare EA, Compton CC, Hanna NN, et al. The impact of stage, grade, and mucinous histology on the efficacy of systemic chemotherapy in adenocarcinomas of the appendix: Analysis of the National Cancer Data Base. *Cancer*. 2016;122(2):213-221.
7. Amin MB, Edge SB, Greene FL, et al, eds. *AJCC Cancer Staging Manual*. 8th ed. New York, NY: Springer; 2017.

#### E. Margins

Margins in a simple appendectomy specimen include the proximal and, in some cases, radial margin. It is recommended that the proximal margin on a simple appendectomy specimen be taken en face in order to evaluate the entire appendiceal mucosa and muscularis circumferentially. In the vast majority of cases, the appendix is entirely peritonealized, and the mesenteric resection margin represents the radial margin. The closest distance between the invasive carcinoma and this margin should be measured. Even retrocecal appendices are usually invested by peritoneum but have adhered to the posterior cecum, either because of inflammation or tumor. Exceptionally, a retrocecal appendix may be retroperitoneal, in which case the nonperitonealized surface is the radial resection margin. The distance between the invasive carcinoma and this margin should be measured.

In right hemicolectomy specimens, the ileal and colonic margins are the proximal and distal margins, respectively. The distance between the tumor and the ileal and colonic margins should be measured, and these margins are considered to be grossly negative if they are greater than 5 cm from the tumor.

#### F. Lymph-Vascular Invasion

Lymph-vascular invasion (LVI) includes small vessel (lymphatic or vascular) invasion and large vessel (venous) invasion. The prognostic significance of lymph-vascular invasion has not been widely studied in appendiceal carcinoma. However, given their significance in colorectal carcinoma, this feature should be reported in all cases.

#### G. Tumor Deposits

A tumor focus in the periappendiceal fat or mesoappendix, but without identifiable lymph node tissue or vascular structure, is considered a tumor deposit. If the vessel wall or its remnant is identified (H&E, elastic, or any other stain), it should be classified as vascular (venous) invasion, and not as tumor deposit. Similarly, a tumor focus is present in or around a large nerve, should be classified as perineural invasion and not as tumor deposit. Size and shape of the tumor focus are not relevant for classification as a tumor deposit. The presence of tumor deposits in the absence of any regional node involvement is categorized as N1c, irrespective of T category. The significance of tumor deposits has not been specifically examined in appendiceal tumors. In view of the established prognostic

significance of tumor deposits in colorectal cancer, this feature has been adopted into the AJCC staging scheme for the appendix.<sup>1</sup>

#### References

1. Amin MB, Edge SB, Greene FL, et al, eds. *AJCC Cancer Staging Manual*. 8th ed. New York, NY: Springer; 2017.

### H. Perineural Invasion

The prognostic significance of perineural invasion has not been widely studied in appendiceal carcinomas. Based on limited studies<sup>1</sup> and its prognostic significance in colorectal cancer, its presence or absence should be recorded for appendiceal carcinomas.

#### References

1. Davison JM, Choudry HA, Pingpank JF, et al. Clinicopathologic and molecular analysis of disseminated appendiceal mucinous neoplasms: identification of factors predicting survival and proposed criteria for a three-tiered assessment of tumor grade. *Mod Pathol*. 2014;27(11):1521-1539.

### I. Pathologic Stage Classification

A revised TNM staging system has been developed by the American Joint Committee on Cancer (AJCC) for the 8<sup>th</sup> edition of the *AJCC Cancer Staging Manual*.<sup>1</sup> This system also incorporates tumor grade to subclassify stage IV tumors.

#### TNM Descriptors

For identification of special cases of TNM or pTNM classifications, the “m” suffix and “y,” “r,” and “a” prefixes are used. Although they do not affect the stage grouping, they indicate cases needing separate analysis.

The “m” suffix indicates the presence of multiple primary tumors in a single site and is recorded in parentheses: pT(m)NM.

The “y” prefix indicates those cases in which classification is performed during or after initial multimodality therapy (ie, neoadjuvant chemotherapy, radiation therapy, or both chemotherapy and radiation therapy). The cTNM or pTNM category is identified by a “y” prefix. The ycTNM or ypTNM categorizes the extent of tumor actually present at the time of that examination. The “y” categorization is not an estimate of tumor before multimodality therapy (ie, before initiation of neoadjuvant therapy).

The “r” prefix indicates a recurrent tumor when staged after a documented disease-free interval and is identified by the “r” prefix: rTNM.

The “a” prefix designates the stage determined at autopsy: aTNM.

#### T Category Considerations

When confined to muscularis propria, LAMN is classified as Tis (LAMN) as there is no significant risk of extra-appendiceal spread and designated as T3 or T4a if it extends beyond muscularis propria. Tumors (including acellular mucin) that involve the serosal surface (visceral peritoneum) or directly invade adjacent organs or structures are assigned to the T4 category. T4a tumors are characterized by localized involvement of the serosal surface (visceral peritoneum) in the area of the primary tumor by acellular mucin or cellular tumor. Serosal involvement of the appendix by acellular mucin may demonstrate an excellent outcome with only localized surgical resection.<sup>2,3</sup> In view of the small risk of recurrence, this localized involvement is categorized as T4a along with tumors with cellular mucinous involvement of appendiceal serosa. Tumors with perforation in which tumor cells or acellular/cellular mucin is continuous with the serosal surface through inflammation also are considered T4a. Acellular mucin involving the serosal surface is considered as T4a, due to a small risk of peritoneal recurrence. In some instances, acellular mucin may be seen on the serosal surface due to “carryover” related to specimen handling or sectioning artifact. In these instances, mucin dissection into the stroma and tissue reaction such as inflammation, mesothelial hyperplasia and neovascularization can help in this distinction.

Tumors that directly invade other organs or structures are categorized as T4b. However, luminal or mural spread into adjacent parts of the bowel (e.g., appendiceal tumor extending into the cecum through the lumen or wall) is

not considered T4b and should be categorized by the deepest area of invasion. Direct invasion of other segments of the colorectum via the serosa (e.g., invasion of adherent ileum) is considered T4b. A tumor grossly adherent to other organs or structures is classified as cT4b; however, if no tumor is identified on pathological examination of the adhesion, the T category is assigned based on the depth of wall invasion observed on microscopic examination (typically pT1–3).

#### N Category Considerations

The regional lymph nodes for the appendix include the anterior cecal, posterior cecal, ileocolic, and right colic lymph nodes.

The presence of lymph node metastasis is relatively rare in appendiceal carcinoma<sup>4</sup> but is an adverse prognostic finding.<sup>5</sup> Among patients with high-stage disease (peritoneal spread of appendiceal carcinoma), lymph node status appears to have less impact on overall survival.<sup>6,7</sup>

#### M Category Considerations

Seeding of peritoneum or abdominal organs is considered distant metastasis. Extensive sampling should be performed before using the designation of M1a. Peritoneal mucinous deposits containing tumor cells should be staged as M1b and are grouped based on tumor grade as stage IVA (mucinous G1 tumors) or stage IVB (nonmucinous G1 and all G2/G3/G4 tumors). The highest grade is used in case if there is a discordance in tumor between the appendix and peritoneum. Peritoneal implants involving abdominopelvic organs, such as the serosa of the small or large bowel and the surfaces of the ovary, spleen, or liver, should be classified as M1b, even if the implants demonstrate infiltration of underlying tissue. M1c designation is used for metastasis to nonperitoneal sites.

#### References

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#### **J. Additional Pathologic Findings**

Appendiceal perforation may be an adverse prognostic factor, but its adverse significance as an independent prognostic is not well established.<sup>1,2,3</sup>

Diverticula are a common finding in the appendix and may represent a route of egress for mucin in cases of LAMN.<sup>4</sup> Ruptured diverticula can show extraappendiceal mucin with or without epithelium and should not be mistaken for LAMN.<sup>5</sup>

Appendiceal adenocarcinomas have been reported in the setting of inflammatory bowel disease, although causation has not been established.<sup>6</sup>

Well-differentiated neuroendocrine tumors (typical carcinoid tumor) of any size should be reported using the CAP protocol for neuroendocrine tumors of the appendix.<sup>7</sup>

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**K. Ancillary Studies**

A minority of appendiceal carcinomas show high levels of microsatellite instability, but MSI testing is not currently recommended as standard of care for these tumors.<sup>1,2</sup>

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