Protocol for the Examination of Specimens From Patients with Well-Differentiated Neuroendocrine Tumors (Carcinoid Tumors) of the Duodenum and Ampulla of Vater

Version: 2.0.0.0
Protocol Posting Date: December 2023
CAP Laboratory Accreditation Program Protocol Required Use Date: September 2024

The changes included in this current protocol version affect accreditation requirements. The new deadline for implementing this protocol version is reflected in the above accreditation date.

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

<table>
<thead>
<tr>
<th>Procedure</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Resection</td>
<td>Includes specimens designated segmental duodenum resection, pancreaticoduodenectomy (Whipple resection)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Tumor Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Well-differentiated neuroendocrine tumor of the duodenum and the ampulla</td>
<td></td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th>Procedure</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Biopsy</td>
<td></td>
</tr>
<tr>
<td>Excisional biopsy (includes endoscopic resection, local resection, and ampullectomy)</td>
<td></td>
</tr>
<tr>
<td>Primary resection specimen with no residual cancer (e.g., following neoadjuvant therapy)</td>
<td></td>
</tr>
<tr>
<td>Recurrent tumor</td>
<td></td>
</tr>
<tr>
<td>Cytologic specimens</td>
<td></td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th>Tumor Type</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Well-differentiated neuroendocrine tumors of the jejunum and ileum (consider the Jejunum and Ileum Neuroendocrine Tumor protocol)</td>
<td></td>
</tr>
<tr>
<td>Poorly differentiated neuroendocrine carcinoma including small cell and large cell neuroendocrine carcinoma (consider the Small Intestine protocol)</td>
<td></td>
</tr>
<tr>
<td>Other epithelial carcinomas including mixed neuroendocrine-non-neuroendocrine neoplasms (consider the Small Intestine protocol)</td>
<td></td>
</tr>
<tr>
<td>Lymphoma (consider the Hodgkin or non-Hodgkin Lymphoma protocols)</td>
<td></td>
</tr>
<tr>
<td>Gastrointestinal stromal tumor (GIST) (Consider the GIST protocol)</td>
<td></td>
</tr>
<tr>
<td>Non-GIST sarcoma (consider the Soft Tissue protocol)</td>
<td></td>
</tr>
</tbody>
</table>

Authors
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With guidance from the CAP Cancer and CAP Pathology Electronic Reporting Committees.

* Denotes primary author.
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 (i.e., 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
v 2.0.0.0

- Update to AJCC Version 9 pTNM Staging Classifications
- WHO 5th Edition update to content and explanatory notes
- “Lymphovascular Invasion” question updated to “Lymphatic and / or Vascular Invasion”
Reporting Template
Protocol Posting Date: December 2023
Select a single response unless otherwise indicated.

CASE SUMMARY: (DUODENUM AND AMPULLA NEUROENDOCRINE TUMOR)
Standard(s): AJCC-UICC 9

SPECIMEN (Notes A,B)

Procedure
___ Ampullectomy
___ Endoscopic or local resection
___ Duodenum, segmental resection
___ Pancreaticoduodenectomy (Whipple resection)
___ Other (specify): _________________
___ Not specified

TUMOR

Tumor Site (Note C) (select all that apply)
___ Duodenum: _________________
___ First portion
___ Second portion
___ Third portion
___ Fourth portion
___ Ampulla: _________________
___ Other (specify): _________________
___ Cannot be determined: _________________

Histologic Type and Grade# (Notes D,E)
# For poorly differentiated (high-grade) neuroendocrine carcinomas arising in the small intestine or ampulla, the checklists for carcinomas of those organ sites should be used.
___ G1, well-differentiated neuroendocrine tumor
___ G2, well-differentiated neuroendocrine tumor
___ G3, well-differentiated neuroendocrine tumor
___ GX, grade cannot be assessed
___ Other (specify): _________________
___ Not applicable: _________________

Histologic Grade Determination (Note E)
Mitotic rate and / or Ki-67 labeling index is required to determine histologic grade

Mitotic Rate (required only when Ki-67 labeling index is not reported)#
# Mitotic rate should be reported as number of mitoses per 2 mm2, by evaluating at least 10 mm2 in the most mitotically active part of the tumor (e.g., if using a microscope with a field diameter of 0.55 mm, count 42 high power fields (10 mm2) and divide the resulting number of mitoses by 5 to determine the number of mitoses per 2 mm2 needed to assign tumor grade).
___ Not applicable (Ki-67 labeling index is reported)
___ Specify number of mitoses per 2 mm2: _________________ mitoses per 2 mm2
___ Less than 2 mitoses per 2 mm²
___ 2 to 20 mitoses per 2 mm²
___ Greater than 20 mitoses per 2 mm²
___ Cannot be determined (explain): ____________________________

**KI-67 Labeling Index (required only when mitotic rate is not reported)**
___ Not applicable (mitotic rate is reported)
___ Specify Ki-67 percentage: ________________ %
___ Less than 3%
___ 3% to 20%
___ Greater than 20%
___ Cannot be determined (explain): ____________________________

**Histologic Subtype (Notes C,D)**
___ Somatostatinoma
___ Gastrinoma
___ Composite ganliocytoma / neuroma and neuroendocrine tumor (previously known as Gangliocytic paraganglioma)
___ Other (specify): ________________________

**Tumor Size (Note F)**
Specify size of largest tumor if multiple tumors are present
___ Greatest dimension in Centimeters (cm): ________________ cm
___ Additional Dimension in Centimeters (cm): ____ x ____ cm
___ Cannot be determined (explain): __________________________

**Tumor Focality**
___ Unifocal
___ Multifocal

**Number of Tumors**
___ Specify number: ________________________
___ Other (specify): ________________________
___ Cannot be determined: ________________________
___ Cannot be determined

**Tumor Extent (select all that apply)**
___ Duodenal Tumor
___ Invades mucosa
___ Invades submucosa
___ Invades muscularis propria
___ Invades pancreas
___ Invades peripancreatic adipose tissue
___ Invades visceral peritoneum (serosa)
___ Invades other organ(s) (specify): ________________________
___ Cannot be determined: ________________________
___ Cannot be determined

___ Ampullary Tumor
___ Confined within sphincter of Oddi
___ Invades through sphincter into duodenal submucosa
___ Invades through sphincter into duodenal muscularis propria
___ Invades pancreas
___ Invades peripancreatic adipose tissue
___ Invades visceral peritoneum (serosa)
___ Invades other organ(s) (specify): ____________________
___ Cannot be determined: ____________________
___ No evidence of primary tumor

Lymphatic and / or Vascular Invasion
___ Not identified
___ Present
___ Cannot be determined: ____________________

+Perineural Invasion
___ Not identified
___ Present
___ Cannot be determined: ____________________

+Tumor Comment: ____________________

MARGINS (Note Q)

Margin Status
___ All margins negative for tumor

+Closest Margin(s) to Tumor (select all that apply)
   ___ Proximal: ____________________
   ___ Distal: ____________________
   ___ Radial: ____________________
   ___ Mesenteric: ____________________
   ___ Uncinate (retroperitoneal / superior mesenteric artery): ____________________
   ___ Bile duct: ____________________
   ___ Pancreatic neck / parenchymal: ____________________
   ___ Mucosal: ____________________
   ___ Deep: ____________________
   ___ Other (specify): ____________________
___ Cannot be determined: ____________________

+Distance from Tumor to Closest Margin
   Specify in Centimeters (cm)
   ___ Exact distance in cm: ____________________ cm
   ___ Greater than 1 cm
   Specify in Millimeters (mm)
   ___ Exact distance in mm: ____________________ mm
   ___ Greater than 10 mm
   Other
   ___ Other (specify): ____________________
   ___ Cannot be determined: ____________________
   ___ Tumor present at margin
Margin(s) Involved by Tumor (select all that apply)
___ Proximal: _________________
___ Distal: _________________
___ Radial: _________________
___ Mesenteric: _________________
___ Uncinate (retroperitoneal / superior mesenteric artery): _________________
___ Bile duct: _________________
___ Pancreatic neck / parenchymal: _________________
___ Mucosal: _________________
___ Deep: _________________
___ Other (specify): _________________
___ Cannot be determined: _________________
___ Other (specify): _________________
___ Cannot be determined (explain): _________________
___ Not applicable

+Margin Comment: _________________

REGIONAL LYMPH NODES

Regional Lymph Node Status
___ Not applicable (no regional lymph nodes submitted or found)
___ Regional lymph nodes present
___ All regional lymph nodes negative for tumor
___ Tumor present in regional lymph node(s)

Number of Lymph Nodes with Tumor
___ Exact number (specify): _________________
___ At least (specify): _________________
___ Other (specify): _________________
___ Cannot be determined (explain): _________________
___ Other (specify): _________________
___ Cannot be determined (explain): _________________

Number of Lymph Nodes Examined
___ Exact number (specify): _________________
___ At least (specify): _________________
___ Other (specify): _________________
___ Cannot be determined (explain): _________________

+Regional Lymph Node Comment: _________________

DISTANT METASTASIS

Distant Site(s) Involved, if applicable (select all that apply)
___ Not applicable
___ Liver: _________________
___ Lung: _________________
___ Ovary: _________________
Replaced by version 2.0.0.1 on June 19, 2024, Obsolete as of March 2025 (8 months after newest release date)

___ Nonregional lymph node(s): _________________
___ Peritoneum: _________________
___ Bone: _________________
___ Other (specify): _________________
___ Cannot be determined: _________________

pTNM CLASSIFICATION (AJCC Version 9) (Note H)

Reporting of pT, pN, and (when applicable) pM categories is based on information available to the pathologist at the time the report is issued. As per the AJCC (Chapter 1, 8th Ed.) it is the managing physician’s responsibility to establish the final pathologic stage based upon all pertinent information, including but potentially not limited to this pathology report.

Modified Classification (required only if applicable) (select all that apply)
___ Not applicable
___ y (post-neoadjuvant therapy)
___ r (recurrence)

pT Category#
# Multiple tumors should be designated as such (the largest tumor should be used to assign T category). Use T(#); e.g., pT3(4) N0 M0, OR use the m suffix, T(m); e.g., pT3(m) N0 M0.
___ pT not assigned (cannot be determined based on available pathological information)
___ pT1: Tumor invades the mucosa or submucosa only, and is less than or equal to 1 cm in greatest dimension (duodenal tumors); tumor is less than or equal to 1 cm in greatest dimension and confined within the sphincter of Oddi (ampullary tumors)
___ pT2: Tumor invades the muscularis propria or is greater than 1 cm in greatest dimension (duodenal tumors); tumor invades through sphinter into duodenal submucosa or muscularis propria, or is greater than 1 cm in greatest dimension (ampullary tumors)
___ pT3: Tumor invades the pancreas or peripancreatic adipose tissue
___ pT4: Tumor invades the visceral peritoneum (serosa) or other organs

T Suffix (required only if applicable)
___ Not applicable
___ (m) multiple primary synchronous tumors in a single organ

pN Category
___ pN not assigned (no nodes submitted or found)
___ pN not assigned (cannot be determined based on available pathological information)
___ pN0: No tumor involvement of regional lymph node(s)
___ pN1: Tumor involvement of regional lymph node(s)

pM Category (required only if confirmed pathologically)
___ Not applicable - pM cannot be determined from the submitted specimen(s)
  pm1: Microscopic confirmation of distant metastasis
___ pM1a: Microscopic confirmation of metastasis confined to liver
___ pM1b: Microscopic confirmation of metastasis in at least one extrahepatic site (e.g., lung, ovary, nonregional lymph node, peritoneum, bone)
___ pM1c: Microscopic confirmation of both hepatic and extrahepatic metastases
___ pM1 (subcategory cannot be determined)
ADDITIONAL FINDINGS (Note I)

+Additional Findings (select all that apply)
___ None identified
___ Endocrine cell hyperplasia
___ Tumor necrosis
___ Psammoma bodies
___ Other (specify): ___________________

COMMENTS

Comment(s): ___________________
Explanatory Notes

A. Application and Tumor Location
This protocol applies to well-differentiated neuroendocrine tumors (carcinoid tumors) of the duodenum and the ampulla of Vater. Poorly differentiated neuroendocrine carcinomas (small cell and large cell neuroendocrine carcinomas) and tumors with mixed glandular/neuroendocrine differentiation are not included. Well-differentiated neuroendocrine tumors of the jejunum and ileum use a different CAP cancer protocol.

Because of site-specific similarities in histology, immunohistochemistry, and histochemistry, neuroendocrine tumors of the digestive tract have traditionally been subdivided into those of foregut, midgut, and hindgut origin (Table 1). In general, the distribution pattern along the gastrointestinal (GI) tract parallels that of the progenitor cell type, and the anatomic site of origin of GI neuroendocrine tumors is an important predictor of clinical behavior.

Table 1. Site of Origin of Gastrointestinal Neuroendocrine Tumors

<table>
<thead>
<tr>
<th>Site</th>
<th>Foregut Tumors</th>
<th>Midgut Tumors</th>
<th>Hindgut Tumors</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stomach, Proximal Duodenum</td>
<td>Jejunum, Ileum, Appendix, Proximal Colon</td>
<td>Distal Colon, Rectum</td>
<td></td>
</tr>
<tr>
<td>Immunohistochemistry</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chromogranin A</td>
<td>86%-100% +</td>
<td>82%-92% +</td>
<td>40%-58% +</td>
</tr>
<tr>
<td>Synaptophysin</td>
<td>50% +</td>
<td>95%-100% +</td>
<td>94%-100% +</td>
</tr>
<tr>
<td>Serotonin</td>
<td>33% +</td>
<td>86% +</td>
<td>45%-83% +</td>
</tr>
<tr>
<td>Other Immunohistochemical</td>
<td>Rare, + for pancreatic polypeptide, histamine, gastrin, vasoactive intestinal peptide (VIP), or adrenocorticotropic hormone (ACTH)</td>
<td>Prostatic acid phosphatase + in 20%-40%</td>
<td>Prostatic acid phosphatase + in 20%-82%</td>
</tr>
<tr>
<td>Carcinoid syndrome</td>
<td>Rare</td>
<td>5%-39%</td>
<td>Rare</td>
</tr>
</tbody>
</table>

References

B. Procedure

Depending on tumor size, stage, location, and functional status, the surgical options range from endoscopic resection to pancreatoduodenectomy. In general, duodenal tumors <1 cm are treated by endoscopic or local resection, whereas a lymphadenectomy is included for those >2 cm. The surgical approaches for tumors of 1 cm to 2 cm remain controversial. Small gastrinomas are sometimes excised locally through duodenotomy. Segmental resection with reconstruction can be performed for the tumors in the first, third, and fourth portions of the duodenum without the involvement of ampulla of Vater.

References

1. AJCC Version 9 Neuroendocrine Tumors of the Duodenum and Ampulla Cancer Staging System. Copyright 2023 American College of Surgeons.

C. Site-Specific Features

Duodenal neuroendocrine tumors are relatively uncommon, accounting for roughly 4% of GI neuroendocrine tumors. Most duodenal and ampillary NETs are nonfunctional. The most common functional tumor is the gastrin-secreting neuroendocrine tumor, or gastrinoma, associated with Zollinger-Ellison syndrome in one-third of cases. These gastrin-secreting tumors are often associated with multiple endocrine neoplasia type 1 (MEN1) syndrome, but sporadic tumors also occur. Duodenal somatostatin-producing tumors (somatostatinomas) are less common, accounting for about 1% of GI neuroendocrine tumors, and are seldom associated with the functional syndrome of mild diabetes mellitus, cholelithiasis, and steatorrhea. These tumors often have a pure glandular growth pattern with scattered psammoma bodies and may be confused with conventional adenocarcinomas. They arise almost exclusively in the ampulla or periampullary duodenum and are often associated with neurofibromatosis type 1.

Duodenal neuroendocrine tumors can arise in the first, second, third, or fourth portion of the duodenum, but more than 95% of them are located in the first and second portion, with those in the second portion predominating in the ampullary region. Tumors arising in the third or fourth portion may behave more like
jejunal and ileal neuroendocrine tumors. Most duodenal neuroendocrine tumors are unifocal but can be multifocal, especially in MEN1 patients with duodenal gastrinoma. Metastatic risk is increased by tumor size >2 cm, involvement of the muscularis propria, and mitotic activity.7

References

D. Histologic Type
The World Health Organization (WHO) classifies neuroendocrine neoplasms as well-differentiated neuroendocrine tumors (either the primary tumor or metastasis) and poorly differentiated neuroendocrine carcinomas.1,2,3 Historically, well-differentiated neuroendocrine tumors have been referred to as “carcinoid tumors,” a term which may cause confusion because, clinically, a carcinoid tumor is a serotonin-producing tumor associated with functional manifestations of carcinoid syndrome. The use of the term “carcinoid” for neuroendocrine tumor reporting is therefore discouraged for these reasons.

Classification of neuroendocrine tumors is based upon size, functionality, site, and invasion. Functioning tumors are those associated with clinical manifestations of hormone production or secretion of measurable amounts of active hormone; immunohistochemical demonstration of hormone production is not equivalent to clinically apparent functionality. Most functional tumors arising in the duodenum and the ampulla of Vater are gastrinomas. While somatostatinomas in the pancreas are associated with the functional syndrome of mild diabetes mellitus, cholelithiasis, and steatorrhea, those arising in the duodenum and the ampulla are always nonfunctional.

Composite gangliocytoma/neuroma and neuroendocrine tumor (CoGNET), previously called Gangliocytic paraganglioma, is another rare and unique neuroendocrine tumor arising in the ampulla of Vater or periampullary duodenum with a distinctive histology composed of 3 components: S-100-positive spindle cells, ganglion cells, and paraganglioma.4 These tumors are typically benign, and unlikely to lead to death despite rare patients with nodal metastasis. The endocrine components of the tumor are evaluated similarly to other NETs, and the tumors are staged using this protocol, although any staging data specific to these tumors are lacking.
Immunohistochemistry and other ancillary techniques are generally not required to diagnose well-differentiated neuroendocrine tumors. Specific markers that may be used to establish neuroendocrine differentiation include chromogranin A, synaptophysin, INSM1, and CD56. Because of their relative sensitivity and specificity, chromogranin A and synaptophysin are recommended, although INSM1 is also emerging as a good marker for endocrine differentiation.

Immunohistochemistry for specific hormone products, such as gastrin and somatostatin, may be of interest in some cases. However, immunohistochemical demonstration of hormone production does not equate with the clinical functionality of the tumor.

References

E. Histologic Grade
Cytologic atypia in well-differentiated neuroendocrine tumors has no impact on clinical behavior of these tumors.

The WHO classification and others use mitotic rate and/or Ki-67 index as 1 of the criteria for potential for aggressive behavior. The mitotic rate should be reported as number of mitoses per 2 mm$^2$, by evaluating at least 10 mm$^2$ in the most mitotically active part of the tumor. Only clearly identifiable mitotic figures should be counted; hyperchromatic, karyorrhectic, or apoptotic nuclei are excluded. Because of variations in field size, the number of high-power field (HPF) (at 40X magnification) for 10 mm$^2$ (thereby 2 mm$^2$) must be determined for each microscope (Table 2). For example, if using a microscope with a field diameter of 0.55 mm, count 42 HPF and divide the resulting number of mitoses by 5 to determine the number of mitoses per 2 mm$^2$ needed to assign tumor grade.

<table>
<thead>
<tr>
<th>Field Diameter (mm)</th>
<th>Area (mm$^2$)</th>
<th>Number of HPF for 10 mm$^2$</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.40</td>
<td>0.125</td>
<td>80</td>
</tr>
<tr>
<td>0.41</td>
<td>0.132</td>
<td>75</td>
</tr>
<tr>
<td>0.42</td>
<td>0.139</td>
<td>70</td>
</tr>
</tbody>
</table>

Replaced by version 2.0.0.1 on June 19, 2024, Obsolete as of March 2025 (8 months after newest release date)
<table>
<thead>
<tr>
<th>Ki-67 index</th>
<th>Mitosis</th>
<th>Grade</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.43</td>
<td>0.145</td>
<td>69</td>
</tr>
<tr>
<td>0.44</td>
<td>0.152</td>
<td>66</td>
</tr>
<tr>
<td>0.45</td>
<td>0.159</td>
<td>63</td>
</tr>
<tr>
<td>0.46</td>
<td>0.166</td>
<td>60</td>
</tr>
<tr>
<td>0.47</td>
<td>0.173</td>
<td>58</td>
</tr>
<tr>
<td>0.48</td>
<td>0.181</td>
<td>55</td>
</tr>
<tr>
<td>0.49</td>
<td>0.189</td>
<td>53</td>
</tr>
<tr>
<td>0.50</td>
<td>0.196</td>
<td>50</td>
</tr>
<tr>
<td>0.51</td>
<td>0.204</td>
<td>49</td>
</tr>
<tr>
<td>0.52</td>
<td>0.212</td>
<td>47</td>
</tr>
<tr>
<td>0.53</td>
<td>0.221</td>
<td>45</td>
</tr>
<tr>
<td>0.54</td>
<td>0.229</td>
<td>44</td>
</tr>
<tr>
<td>0.55</td>
<td>0.238</td>
<td>42</td>
</tr>
<tr>
<td>0.56</td>
<td>0.246</td>
<td>46</td>
</tr>
<tr>
<td>0.57</td>
<td>0.255</td>
<td>39</td>
</tr>
<tr>
<td>0.58</td>
<td>0.264</td>
<td>38</td>
</tr>
<tr>
<td>0.59</td>
<td>0.273</td>
<td>37</td>
</tr>
<tr>
<td>0.60</td>
<td>0.283</td>
<td>35</td>
</tr>
<tr>
<td>0.61</td>
<td>0.292</td>
<td>34</td>
</tr>
<tr>
<td>0.62</td>
<td>0.302</td>
<td>33</td>
</tr>
<tr>
<td>0.63</td>
<td>0.312</td>
<td>32</td>
</tr>
<tr>
<td>0.64</td>
<td>0.322</td>
<td>31</td>
</tr>
<tr>
<td>0.65</td>
<td>0.332</td>
<td>30</td>
</tr>
<tr>
<td>0.66</td>
<td>0.342</td>
<td>29</td>
</tr>
<tr>
<td>0.67</td>
<td>0.353</td>
<td>28</td>
</tr>
<tr>
<td>0.68</td>
<td>0.363</td>
<td>28</td>
</tr>
<tr>
<td>0.69</td>
<td>0.374</td>
<td>28</td>
</tr>
</tbody>
</table>

Ki-67 index is reported as percent positive tumor cells in area of highest nuclear labeling ("hot spot"), although the precise method of assessment has not been standardized. A number of methods have been used to assess Ki-67 index, including automatic counting and "eyeballing." Automated counting is not widely available and requires careful modification of the software to circumvent the inaccuracies. Eye-ball can be used for most tumors; however, for tumors with Ki-67 index close to grade cut-offs, it is recommended to perform the manual count on the print of camera-captured image of the hot spot. It has been recommended that a minimum of 500 tumor cells be counted to determine the Ki-67 index, and a notation is made if less cells are available. Grade assigned based on Ki-67 index is typically higher than that based on mitotic count, and the case is assigned to the higher of the 2 if both methods are performed. It is important to note that there are a small group of well-differentiated neuroendocrine tumors with a Ki-67 index >20% and a mitotic rate usually <20 per 10 HPF. In WHO-2010, these tumors were considered as G3 poorly differentiated neuroendocrine carcinomas. However, they have typical morphology of well-differentiated tumors.

Previous studies (most on pancreatic neuroendocrine tumors) have demonstrated that these tumors have a worse prognosis than grade 2 (Ki-67=3-20% and mitosis <20/10 HPF) neuroendocrine tumors, but they are not as aggressive as poorly differentiated neuroendocrine carcinomas. In addition, these tumors do not have the genetic abnormalities seen in poorly differentiated neuroendocrine
carcinomas. Furthermore, unlike poorly differentiated neuroendocrine carcinomas, they are less responsive to platinum-based chemotherapy. In the WHO-2022 Blue Book of Endocrine Tumors, WHO-2019 Blue Book of Digestive System Tumors, and AJCC 9th edition, those with typical morphology of well-differentiated tumors are classified as “well-differentiated neuroendocrine tumor” but as grade 3 (Table 3).  

### Table 3. Recommended Grading System for Well-Differentiated Gastroenteropancreatic Neuroendocrine Tumors

<table>
<thead>
<tr>
<th>Grade</th>
<th>Mitotic Rate (per 2mm²)</th>
<th>Ki-67 index (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>G1</td>
<td>&lt;2</td>
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<td>G2</td>
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<tr>
<td>G3</td>
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</table>

**References**

8. WHO Classification of Tumours Editorial Board (2022) *WHO classification of endocrine and neuroendocrine tumours*. Lyon, France: IARC.

**F. Tumor Size**

For neuroendocrine tumors in any part of the GI tract, size greater than 2.0 cm is associated with a higher risk of lymph node metastasis. For duodenal NETs, nodal metastases occur in 3%, 13%, and 40% of patients with tumors smaller than 1.0 cm, between 1 cm and 2 cm, and larger than 2 cm, respectively. However, duodenal gastrinomas frequently have lymph node metastasis even if they are smaller than 1 cm. In addition, ampullary neuroendocrine tumors may be more likely to metastasize at a smaller size.
References

G. Margins
Circumferential (Radial or Mesenteric) Margin
In addition to addressing the proximal and distal margins, assessment of the circumferential (radial) margin is necessary for the duodenum either incompletely encased by peritoneum (Figure A) or unencased (Figure B). The circumferential margin represents the adventitial soft tissue margin closest to the deepest penetration of tumor and is created surgically by blunt or sharp dissection of the retroperitoneal or subperitoneal aspect, respectively. The distance between the tumor and circumferential (radial) margin should be reported. The circumferential (radial) margin is considered positive if the tumor is present at the inked nonperitonealized surface. This assessment includes tumor within a lymph node as well as direct tumor extension, but if circumferential (radial) margin positivity is based solely on intranodal tumor, this should be so stated.

A. Circumferential (radial) margin (dotted line) in viscus incompletely encased by peritoneum.  B. Circumferential (radial) margin (dotted line) in viscus completely unencased by peritoneum.

Margins for Pancreaticoduodenectomy Specimens
The nonperitonealized surface of the uncinate process (uncinate margin) constitutes the inferior-posterior retroperitoneal margin of pancreaticoduodenectomy specimens. A perpendicular section through the closest approach of tumor to the margin should be taken. This margin has also been referred to as retroperitoneal margin and superior mesenteric artery margin. Complete en face sections through the pancreatic resection margin and the common bile duct margin should also be taken.

H. pTNM Classification
The TNM staging system for neuroendocrine tumors of the duodenum and ampulla of the American Joint Committee on Cancer (AJCC) and International Union Against Cancer (UICC) is recommended.1

By AJCC/UICC convention, the designation “T” refers to a primary tumor that has not been previously treated. The symbol “p” refers to the pathologic classification of the TNM, as opposed to the clinical classification, and is based on gross and microscopic examination. pT entails a resection of the primary tumor or biopsy adequate to evaluate the highest pT category, pN entails removal of nodes adequate to validate lymph node metastasis, and pM implies microscopic examination of distant lesions. Clinical classification (cTNM) is usually carried out by the referring physician before treatment during initial evaluation of the patient or when pathologic classification is not possible.
Pathologic staging is usually performed after surgical resection of the primary tumor. Pathologic staging depends on pathologic documentation of the anatomic extent of disease, whether or not the primary tumor has been completely removed. If a biopsied tumor is not resected for any reason (e.g., when technically unfeasible) and if the highest T and N categories or the M1 category of the tumor can be confirmed microscopically, the criteria for pathologic classification and staging have been satisfied without total removal of the primary cancer.

**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 following initial multimodality therapy (i.e., 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 prior to multimodality therapy (i.e., 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**
Multiple tumors should be designated as such (and the largest tumor should be used to assign the T category):
- If the number of tumors is known, use T(#) e.g., pT3(4)N0M0.
- If the number of tumors is unavailable or too numerous, use the suffix m—T(m)—e.g., pT3(m)N0M0

**N Category Considerations**
The regional lymph nodes for the duodenum and the ampulla of Vater vary with site. For duodenal tumors, the regional lymph nodes are duodenal, hepatic, pancreaticoduodenal, infrapyloric, gastroduodenal, pyloric, superior mesenteric, and pericholedochal nodes.

The regional nodes for the ampulla may be subdivided as follows:

**Superior:** Lymph nodes superior to head and body of pancreas
**Inferior:** Lymph nodes inferior to head and body of pancreas
**Anterior:** Anterior pancreaticoduodenal, pyloric, and proximal mesenteric lymph nodes
**Posterior:** Posterior pancreaticoduodenal, common bile duct or pericholedochal, and proximal mesenteric nodes
**M Category Considerations**
The liver is the most common metastatic site for duodenal and ampullary neuroendocrine tumors. Metastases to extrahepatic sites, such as lung, ovary, peritoneum, and bone, are rare. Involvement of the celiac, para-aortic, and other nonregional lymph nodes is also considered M1 disease. In the AJCC Version 9, M is subcategorized into M1a (hepatic only), M1b (extrahepatic only), and M1c (both hepatic and extrahepatic).

References
1. AJCC Version 9 Neuroendocrine Tumors of the Duodenum and Ampulla Cancer Staging System. Copyright 2023 American College of Surgeons.

**I. Additional Findings**
Psammoma bodies are commonly found in duodenal neuroendocrine tumors, especially periampullary tumors\(^1\) expressing somatostatin and associated with neurofibromatosis type \(^1,\)\(^2\)

References