Protocol for the Examination of Specimens from Patients with Neuroendocrine Tumors (Carcinoid Tumors) of the Stomach

Protocol applies to well-differentiated neuroendocrine tumors of the stomach. Carcinomas with mixed endocrine/glandular differentiation, poorly differentiated carcinomas with neuroendocrine features, and small cell carcinomas are not included.

Based on AJCC/UICC TNM, 7th Edition
Protocol web posting date: February 1, 2011

Procedures
• Endoscopic Resection
• Gastrectomy (Partial or Complete)

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Gastrointestinal • Neuroendocrine Tumors of the Stomach
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CAP Stomach NET Protocol Revision History

Version Code
The definition of the version code can be found at www.cap.org/cancerprotocols.

Version: StomachNET 3.1.0.0

Summary of Changes
The following changes have been made since the February 2010 release.

Endoscopic Resection, Gastrectomy Checklist

Regional Lymph Nodes (pN)
Specify: Number examined / Number involved, has been changed to:

___ No nodes submitted or found

Number of Lymph Nodes Examined
Specify: ____
___ Number cannot be determined (explain): ______________________

Number of Lymph Nodes Involved
Specify: ____
___ Number cannot be determined (explain): ______________________
Surgical Pathology Cancer Case Summary (Checklist)

Protocol web posting date: February 1, 2011

STOMACH: Endoscopic Resection, Gastrectomy (Note A)

Select a single response unless otherwise indicated.

Specimen (select all that apply)
___ Stomach
___ Portion of stomach
   ___ Gastric body
   ___ Gastric antrum
   ___ Not specified
___ Distal esophagus
___ Proximal duodenum
___ Other (specify): ____________________________
___ Not specified

Procedure
___ Endoscopic resection
___ Partial gastrectomy, proximal
___ Partial gastrectomy, distal
___ Partial gastrectomy, other (specify): ____________________________
___ Total gastrectomy
___ Other (specify): ____________________________
___ Not specified

*Specimen Size (if applicable)
*Specify: ___ (length) x ___ x ___ cm

Tumor Site (select all that apply) (Note B)
___ Gastric cardia
___ Gastric fundus
___ Gastric body
___ Gastric antrum
___ Other (specify): ____________________________
___ Not specified

Tumor Size (Note C)
Greatest dimension: ___ cm (specify size of largest tumor if multiple tumors are present)
*Additional dimensions: ___ x ___ cm
___ Cannot be determined (see “Comment”)

Tumor Focality
___ Unifocal
___ Multifocal (specify number of tumors: _____)
___ Cannot be determined

* Data elements with asterisks are not required. However, these elements may be clinically important but are not yet validated or regularly used in patient management.
Histologic Type (Note D)
___ Carcinoid tumor
___ Other (specify): ____________________________

*Alternative Histologic Classification (Note E)
*___ Well-differentiated endocrine tumor, benign behavior
*___ Well-differentiated endocrine tumor, uncertain behavior
*___ Well-differentiated endocrine carcinoma

*Histologic Grade (Note E)^
___ Not applicable
___ GX: Cannot be assessed
___ G1: Low grade
___ G2: Intermediate grade
___ Other (specify): ____________________________

^ For poorly differentiated (high-grade) neuroendocrine carcinomas, the College of American Pathologists (CAP) checklist for carcinoma of the stomach should be used."

Mitotic Rate (Note E)
Specify: ___/10 high-power fields (HPF)
___ Cannot be determined

Microscopic Tumor Extension
___ Cannot be assessed
___ No evidence of primary tumor
___ Tumor invades lamina propria
___ Tumor invades into but not through muscularis mucosae
___ Tumor invades submucosa
___ Tumor invades muscularis propria
___ Tumor invades subserosal tissue without involvement of visceral peritoneum
___ Tumor penetrates serosa (visceral peritoneum)
___ Tumor directly invades adjacent structures (specify: ______________________)
___ Tumor penetrates to the surface of the visceral peritoneum (serosa) and directly invades adjacent structures (specify: ______________________)

Margins (select all that apply)

Proximal Margin
___ Cannot be assessed
___ Uninvolved by neuroendocrine tumor
___ Involved by neuroendocrine tumor
*___ Involved by neuroendocrine cell hyperplasia/dysplasia

Distal Margin
___ Cannot be assessed
___ Uninvolved by neuroendocrine tumor
___ Involved by neuroendocrine tumor
___ Involved by neuroendocrine tumor
*___ Involved by neuroendocrine cell hyperplasia/dysplasia
Omental (Radial) Margin (Note F)
   ___ Cannot be assessed
   ___ Uninvolved by neuroendocrine tumor
   ___ Involved by neuroendocrine tumor

Other Margin(s) (specify): ______________________
   ___ Not applicable
   ___ Cannot be assessed
   ___ Uninvolved by neuroendocrine tumor
   ___ Involved by neuroendocrine tumor
   *___ Involved by neuroendocrine cell hyperplasia/dysplasia

If all margins uninvolved by neuroendocrine tumor:
   Distance of tumor from closest margin: ___ mm or ___ cm
   Specify margin: ____________________________

Lymph-Vascular Invasion
   ___ Not identified
   ___ Present
   ___ Indeterminate

*Perineural Invasion
   *___ Not identified
   *___ Present
   *___ Indeterminate

Pathologic Staging (pTNM) (Note G)

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/dysplasia (tumor size less than 0.5 mm), confined to
             mucosa
   ___ pT1: Tumor invades lamina propria or submucosa and 1 cm or less in size
   ___ pT2: Tumor invades muscularis propria or more than 1 cm in size
   ___ pT3: Tumor penetrates subserosa
   ___ pT4: Tumor invades visceral peritoneum (serosal) or other organs or adjacent
            structures

* Data elements with asterisks are not required. However, these elements may be
clinically important but are not yet validated or regularly used in patient management.
Regional Lymph Nodes (pN)
___ Cannot be assessed
___ pN0: No regional lymph node metastasis
___ pN1: Metastasis in regional lymph nodes
___ No nodes submitted or found

Number of Lymph Nodes Examined
Specify: ____
___ Number cannot be determined (explain): ______________________

Number of Lymph Nodes Involved
Specify: ____
___ Number cannot be determined (explain): ______________________

Distant Metastasis (pM)
___ Not applicable
___ pM1: Distant metastasis
    *Specify site(s), if known: ______________________

*Ancillary Studies (select all that apply) (Notes E and H)
*___ Ki-67 index
    *___ ≤2%
    *___ >2% to 20%
    *___ >20%
*___ Other (specify): ______________________
___ Not performed

Additional Pathologic Findings (select all that apply) (Note I)
*___ Atrophic gastritis
*___ Intestinal metaplasia of gastric mucosa
*___ Glandular dysplasia of gastric mucosa
*___ Endocrine cell hyperplasia
*___ Absence of parietal cells
*___ Tumor necrosis
*___ Other, specify: ______________________

*Comment(s)
Explanatory Notes

A. Application and Tumor Location
This protocol applies to well-differentiated neuroendocrine neoplasms (carcinoid tumors) of the stomach. Poorly differentiated neuroendocrine carcinomas, small cell carcinomas, and tumors with mixed glandular/neuroendocrine differentiation are not included.

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.²

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>Immunochemistry</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>Neuron-Specific Enolase (NSE)</td>
<td>90%-100% +</td>
<td>95%-100% +</td>
<td>80%-87% +</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>Rarely, + for</td>
<td>Prostatic acid</td>
<td>Prostatic acid</td>
</tr>
<tr>
<td>Markers</td>
<td>pancreatic</td>
<td>phosphatase +</td>
<td>phosphatase +</td>
</tr>
<tr>
<td></td>
<td>polypeptide,</td>
<td>in 20%-40%</td>
<td>in 20%-82%</td>
</tr>
<tr>
<td></td>
<td>histamine,</td>
<td>¹¹,¹²</td>
<td>³-⁵,¹²</td>
</tr>
<tr>
<td></td>
<td>gastrin,</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>somatostatin,</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>vasoactive</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>intestinal</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>peptide (VIP),</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>or adrenocorticotropic hormone (ACTH)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Carcinoid Syndrome</td>
<td>Rare</td>
<td>5%-39% ⁶,⁷</td>
<td>Rare</td>
</tr>
</tbody>
</table>

B. Site-Specific Features
Gastric neuroendocrine tumors are divided into 4 types.³ Type 1 tumors arising in the setting of atrophic gastritis with associated hypergastrinemia are the most common. These lesions are composed of enterochromaffin-like (ECL) cells and are usually found as multiple small nodules in the body of the stomach and limited to mucosa and submucosa. Type 1 lesions are generally benign and may regress following antrectomy; lymph node metastases are very rare and occur only when the tumors are large (greater than 2 cm) and infiltrate the muscularis propria.

Type 2 gastric neuroendocrine tumors are rare. These multifocal small tumors, which are associated with multiple endocrine neoplasia (MEN) type 1 with Zollinger-Ellison syndrome, develop in the body of the stomach, are usually smaller than 1.5 cm, and are confined to the mucosa or submucosa. However, in contrast to type 1 tumors, 30% metastasize. Tumors greater than 2 cm and invading the muscularis propria and exhibiting vascular invasion are more likely to metastasize.
Type 3 gastric neuroendocrine tumors, the second most common neuroendocrine tumor in the stomach, are sporadic solitary tumors that are unassociated with atrophic gastritis or endocrine cell hyperplasia. These tumors may occur anywhere in the stomach. Metastasis is associated with larger mean size, angioinvasion, and invasion of muscularis propria. Surgical resection is usually advised for solitary gastric carcinoid tumors, particularly those larger than 2.0 cm, but tumors smaller than 1.0 cm have been rarely reported to metastasize.4

Type 4 gastric neuroendocrine tumors are rare high-grade neuroendocrine carcinomas that are usually bulky tumors with metastases at diagnosis (the CAP cancer checklist for gastric carcinoma applies1).

C. Tumor Size
For neuroendocrine tumors in any part of the gastrointestinal tract, size greater than 2.0 cm is associated with a higher risk of lymph node metastasis. In the stomach, types 3 and 4 neuroendocrine tumors are significantly larger than type 1 tumors,3 which usually measure 1 cm or less5,6 (Table 2). Tumor size correlates with depth of invasion for gastric neuroendocrine tumors, with larger tumors more likely to be deeply infiltrative and thus at higher risk for metastases. Nodules measuring 0.5 mm or larger are defined as neuroendocrine tumors; lesions measuring less than 0.5 mm are regarded as representing in situ tumor, neuroendocrine cell dysplasia, or hyperplasia.

Table 2. Types of Gastric Neuroendocrine Tumors

<table>
<thead>
<tr>
<th>Type 1</th>
<th>Type 2</th>
<th>Type 3</th>
<th>Type 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Frequency</td>
<td>70%-80% of cases</td>
<td>Rare</td>
<td>10%-15% of cases</td>
</tr>
<tr>
<td>Multiplicity</td>
<td>Multifocal</td>
<td>Multifocal</td>
<td>Solitary</td>
</tr>
<tr>
<td>Size</td>
<td>0.5-1.0 cm</td>
<td>~1.5 cm or less</td>
<td>Variable; one-third are larger than 2 cm</td>
</tr>
<tr>
<td>Location</td>
<td>Corpus</td>
<td>Corpus</td>
<td>Anywhere in stomach</td>
</tr>
<tr>
<td>Associations</td>
<td>Hypergastrinemic states; chronic atrophic gastritis, enterochromaffin-like (ECL) cell hyperplasia, pernicious anemia</td>
<td>Multiple endocrine neoplasia (MEN) type 1, with hypergastrinemia or Zollinger-Ellison syndrome</td>
<td>Sporadic</td>
</tr>
<tr>
<td>Clinical Behavior</td>
<td>Usually benign</td>
<td>30% metastasize</td>
<td>71% of tumors &gt;2 cm with muscularis propria and vascular invasion have lymph node metastases</td>
</tr>
<tr>
<td>Demographic Profile</td>
<td>70%-80% are females in their 50s and 60s</td>
<td>Equally in males and females, mean age 50 y</td>
<td>More common in males, mean age 55 y</td>
</tr>
</tbody>
</table>
D. Histologic Type
The World Health Organization (WHO) classifies neuroendocrine neoplasms as well-differentiated neuroendocrine tumors, well-differentiated neuroendocrine carcinomas, and poorly differentiated neuroendocrine carcinomas. Historically, well-differentiated neuroendocrine neoplasms 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.

Classification of neuroendocrine tumors (NETs) 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.

Alternative Classification for Neuroendocrine Tumors of the Stomach, Adapted from WHO

Well-Differentiated Neuroendocrine Tumor

Benign: Nonfunctioning cytologically bland tumors confined to mucosa or submucosa, without angiovascular invasion, and measuring not more than 1 cm in greatest dimension. Nodules of neuroendocrine cells that measure between 0.5 and 1 cm and are confined to the mucosa are classified by some as microneuroendocrine tumors.

Uncertain malignant potential: Nonfunctioning, cytologically bland tumors confined to mucosa or submucosa, with or without angioinvasion and measuring from 1 to 2 cm.

Well-differentiated Neuroendocrine Carcinoma

Low-grade malignant potential: Nonfunctioning tumors that invade the muscularis propria or beyond, or are metastatic, or measure greater than 2 cm; all sporadic gastric NETs (type 3 tumors) and some type 1 and 2 tumors. All functioning tumors of any type, including gastrinomas.

Histologic Patterns
Although specific histologic patterns in well-differentiated neuroendocrine neoplasms, such as trabecular, insular, and glandular, roughly correlate with tumor location, these patterns have not been clearly shown independently to predict response to therapy or risk of nodal metastasis and are rarely reported in clinical practice.

E. Histologic Grade
Cytologic atypia in low-grade neuroendocrine tumors has no impact on clinical behavior of these tumors. However, grading systems based on mitotic activity have been shown to have utility for foregut tumors. The following grading system is recommended:

<table>
<thead>
<tr>
<th>Grade</th>
<th>Mitotic Count (per 10 HPF) #</th>
<th>Ki-67 Index (%) ##</th>
</tr>
</thead>
<tbody>
<tr>
<td>G1</td>
<td>&lt;2</td>
<td>≤2</td>
</tr>
<tr>
<td>G2</td>
<td>2 to 20</td>
<td>&gt;2 to 20</td>
</tr>
<tr>
<td>G3</td>
<td>&gt;20</td>
<td>&gt;20</td>
</tr>
</tbody>
</table>

# Mitotic count should be based upon counting 50 high-power (40x objective) fields in the area of highest mitotic activity and reported as number of mitoses per 10 HPF.
Ki-67 index is reported as percentage of positive tumor cells in area of highest nuclear labeling. It has been recommended that 2000 tumor cells be counted to determine the Ki-67 index; however, this practice may not be practical for routine clinical purposes, and it is acceptable to estimate the labeling index.

G1 and G2 are well-differentiated tumors with diffuse intense chromogranin/synaptophysin positivity. Punctate necrosis is more typical of G2 tumors. G3 tumors are high-grade neuroendocrine carcinomas (the CAP carcinoma checklist for carcinomas of the stomach applies).

F. Circumferential (Radial) Margin
For surgical resection specimens, margins include the proximal, distal, and radial margins. The radial margins represent the nonperitonealized soft tissue margins closest to the deepest penetration of tumor. In the stomach, the lesser omental (hepatoduodenal and hepatogastric ligaments) and greater omental resection margins are the only radial margins. For endoscopic resection specimens, margins include mucosal margins and the deep margin of resection. It may be helpful to mark the margin(s) closest to the tumor with ink. Margins marked by ink should be designated in the macroscopic description.

G. TNM and Anatomic Stage/Prognostic Groupings
The TNM staging system for gastric neuroendocrine tumors of the American Joint Committee on Cancer (AJCC) and the International Union Against Cancer (UICC) is recommended.

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 (eg, 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 (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 prior to 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.

**N Category Considerations**
The specific nodal areas of the stomach are listed below.\(^\text{10}\)

**Greater curvature of stomach:** Greater curvature, greater omental, gastroduodenal, gastroepiploic, pyloric, and pancreaticoduodenal

**Pancreatic and splenic area:** Pancreaticocolic, peripancreatic, splenic

**Lesser curvature of stomach:** Lesser curvature, lesser omental, left gastric, cardioesophageal, common hepatic, celiac, and hepatoduodenal

Involvement of other intra-abdominal lymph nodes, such as hepatoduodenal, retropancreatic, mesenteric, and para-aortic, is classified as distant metastasis.\(^\text{10}\)

**TNM Anatomic Stage/Prognostic Groupings**

<table>
<thead>
<tr>
<th>Stage</th>
<th>Tis</th>
<th>N0</th>
<th>M0(^#)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stage I</td>
<td>T1</td>
<td>N0</td>
<td>M0</td>
</tr>
<tr>
<td>Stage IIa</td>
<td>T2</td>
<td>N0</td>
<td>M0</td>
</tr>
<tr>
<td>Stage IIb</td>
<td>T3</td>
<td>N0</td>
<td>M0</td>
</tr>
<tr>
<td>Stage IIIa</td>
<td>T4</td>
<td>N0</td>
<td>M0</td>
</tr>
<tr>
<td>Stage IIIb</td>
<td>Any T</td>
<td>N1</td>
<td>M0</td>
</tr>
<tr>
<td>Stage IV</td>
<td>Any T</td>
<td>Any N</td>
<td>M1</td>
</tr>
</tbody>
</table>

\(^\#\) M0 is defined as no distant metastasis.

**H. Ancillary Studies**
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, neuron-specific enolase, synaptophysin, and CD56.\(^6\) Because of their relative sensitivity and specificity, chromogranin A and synaptophysin are recommended.

Immunohistochemistry for Ki-67 may be useful in establishing tumor grade (Note E) and prognosis\(^8\) but is not currently considered standard of care.\(^6\)

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

**I. Additional Pathologic Findings**
Most gastric neuroendocrine tumors arise in the setting of chronic atrophic gastritis (see Note B). Atrophic gastritis may be associated with glandular dysplasia, and in rare cases, gastric adenocarcinoma. Coagulative tumor necrosis, usually punctate, may indicate more aggressive behavior⁹ and should be reported.

References