Protocol for the Examination of Specimens From Patients With Gastrointestinal Stromal Tumor (GIST)

Based on AJCC/UICC TNM, 7th edition
Protocol web posting date: October 2013

Procedures
- Biopsy
- Resection

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The College of American Pathologists offers these protocols to assist pathologists in providing clinically useful and relevant information when reporting results of surgical specimen examinations of surgical specimens. The College regards the reporting elements in the "Surgical Pathology Cancer Case Summary" portion of the protocols as essential elements of the pathology report. However, the manner in which these elements are reported is at the discretion of each specific pathologist, taking into account clinician preferences, institutional policies, and individual practice.

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CAP GIST Protocol Revision History

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

Version: GIST 3.0.2.2

Summary of Changes

The following changes have been made since the June 2012 release.

Biopsy; Resection

Mitotic Rate

"Cannot be determined (explain)" was added, as follows:

Mitotic Rate
Specify: ___ /50 HPF
___ Cannot be determined (explain): _____

Surgical Pathology Cancer Case Summary

Protocol web posting date: October 2013

GASTROINTESTINAL STROMAL TUMOR (GIST): Biopsy

Select a single response unless otherwise indicated.

Procedure
___ Core needle biopsy
___ Endoscopic biopsy
___ Other (specify): _____
___ Not specified

+ Specimen Size
+ Greatest dimension: ___ cm
+ Additional dimensions: ___ x ___ cm
+ ___ Cannot be determined (see "Comment")

Tumor Site
Specify: _____ (Note A)
___ Not specified

+ Tumor Size
+ Greatest dimension: ___ cm
+ Additional dimensions: ___ x ___ cm
+ ___ Cannot be determined (see "Comment")

GIST Subtype
___ Spindle cell
___ Epithelioid
___ Mixed
___ Other (specify): _____

Mitotic Rate
Specify: ___ /50 high-power fields (HPF)
___ Cannot be determined (explain): _____

Note: The required total count of mitoses is per 5 mm^2 on the glass slide section. With the use of older model microscopes, 50 HPF is equivalent to 5 mm^2. Most modern microscopes with wider 40X lenses/fields require only 20 HPF to embrace 5 mm^2. If necessary please measure field of view to accurately determine actual number of fields required to be counted on individual microscopes to count 5 mm^2.

+ Necrosis
+ ___ Not identified
+ ___ Present
  + Extent: ___%
+ ___ Cannot be determined

Histologic Grade (Note B)
___ GX: Grade cannot be assessed
___ G1: Low grade; mitotic rate ≤5/50 HPF
___ G2: High grade; mitotic rate >5/50 HPF

Risk Assessment (Note C)
___ None
___ Very low risk
___ Low risk
___ Intermediate risk
___ High risk
___ Overtly metastatic
___ Cannot be determined

Distant Metastasis (Note D)
___ Cannot be assessed
___ Distant metastasis
Specify site(s), if known: _____

+ Additional Pathologic Findings
+ Specify: _____

Ancillary Studies (select all that apply) (Note E)

Immunohistochemical Studies
___ KIT (CD117)
___ Positive
___ Negative
___ Others (specify): _____
___ Not performed

Molecular Genetic Studies (eg, *KIT* or *PDGFRA* mutational analysis)
___ Submitted for analysis; results pending
___ Performed, see separate report: _____
___ Performed
Specify method(s) and results: _____
___ Not performed

Prebiopsy Treatment (select all that apply)
___ No therapy
___ Systemic therapy performed
Specify type: _____
___ Therapy performed, type not specified
___ Unknown

+ Treatment Effect (Note F)
+ Specify percentage of viable tumor: ___%

+ Comment(s)

Surgical Pathology Cancer Case Summary

Protocol web posting date: October 2013

GASTROINTESTINAL STROMAL TUMOR (GIST): Resection

Select a single response unless otherwise indicated.

Procedure
___ Excisional biopsy
___ Resection
    Specify type (eg, partial gastrectomy): _____
___ Metastasectomy
___ Other (specify): _____
___ Not specified

Tumor Site
Specify (if known): _____
___ Not specified

Tumor Size
Greatest dimension: ___ cm
+ Additional dimensions: ___ x ___ cm
___ Cannot be determined (see "Comment")

Tumor Focality
___ Unifocal
___ Multifocal
    Specify number of tumors: _____
    Specify size of tumors: _____

GIST Subtype
___ Spindle cell
___ Epithelioid
___ Mixed
___ Other (specify): _____

Mitotic Rate
Specify: ___ /50 HPF
___ Cannot be determined (explain): _____

Note: The required total count of mitoses is per 5 mm^2 on the glass slide section. With the use of older model microscopes, 50 HPF is equivalent to 5 mm^2. Most modern microscopes with wider 40X lenses/fields require only 20 HPF to embrace 5 mm^2. If necessary please measure field of view to accurately determine actual number of fields required to be counted on individual microscopes to count 5 mm^2.

+ Necrosis
+ ___ Not identified
+ ___ Present
    + Extent: ___%
+ ___ Cannot be determined

Histologic Grade (Note B)
___ GX: Grade cannot be assessed
___ G1: Low grade; mitotic rate ≤5/50 HPF
___ G2: High grade; mitotic rate >5/50 HPF

Risk Assessment (Note C)
___ None
___ Very low risk
___ Low risk
___ Intermediate risk
___ High risk
___ Overtly malignant/metastatic
___ Cannot be determined

Margins
___ Cannot be assessed
___ Negative for GIST
Distance of tumor from closest margin: ___ mm *or* ___ cm
___ Margin(s) positive for GIST
Specify margin(s): _____

Pathologic Staging (pTNM) (Note G)

TNM Descriptors (required only if applicable) (select all that apply)
___ m (multiple)
___ r (recurrent)
___ y (posttreatment)

Primary Tumor (pT)
___ pTX: Primary tumor cannot be assessed
___ pT0: No evidence for primary tumor
___ pT1: Tumor 2 cm or less
___ pT2: Tumor more than 2 cm but not more than 5 cm
___ pT3: Tumor more than 5 cm but not more than 10 cm
___ pT4: Tumor more than 10 cm in greatest dimension

Regional Lymph Nodes (pN) (Note D)
___ Not applicable
___ pN0: No regional lymph node metastasis
___ pN1: Regional lymph node metastasis

Distant Metastasis (pM) (Note D)
___ Not applicable
___ pM1: Distant metastasis
+ Specify site(s), if known: _____

+ Additional Pathologic Findings
+ Specify: _____

Ancillary Studies (select all that apply) (Note E)

Immunohistochemical Studies
___ KIT (CD117)
    ___ Positive
    ___ Negative
___ Others (specify): _____
___ Not performed

Molecular Genetic Studies (eg, *KIT* or *PDGFRA* mutational analysis)
___ Submitted for analysis; results pending
___ Performed, see separate report: _____
___ Performed
    Specify method(s) and results: _____
___ Not performed

Preresection Treatment (select all that apply)
___ No therapy
___ Previous biopsy or surgery
    Specify: _____
___ Systemic therapy performed
    Specify type: _____
___ Therapy performed, type not specified
___ Unknown

+ Treatment Effect (Note F)
+ Specify percentage of viable tumor: ___%

+ Comment(s)

Explanatory Notes

A. Location

Gastrointestinal stromal tumors may occur anywhere along the entire length of the tubal gut, as well as in extravisceral locations, which include the omentum, mesentery, pelvis, and retroperitoneum.[1-3] Typically, they arise from the wall of the gut and extend inward toward the mucosa, outward toward the serosa, or in both directions. Lesions that involve the wall of the gastrointestinal (GI) tract frequently cause ulceration of the overlying mucosa. Infrequently, lesions invade through the muscularis mucosae to involve the mucosae. Mucosal invasion is an adverse prognostic factor in numerous studies. Because the anatomic location along the GI tract affects prognosis, with location in the stomach having a more favorable prognosis, it is very important to specify anatomic location as precisely as possible.[4]

B. Histologic Grade

Histologic grading, an important component of soft tissue sarcoma staging, is not well suited to GISTs, because most of these tumors have low or relatively low mitotic rates below the thresholds used for grading of soft tissue tumors, and because GISTs often manifest aggressive features with mitotic rates below the thresholds used for soft tissue tumor grading (the lowest tier of mitotic rates for soft tissue sarcomas being 10 mitoses per 10 HPF). In GIST staging, the grade is determined entirely by mitotic activity.

GX: Grade cannot be assessed
G1: Low grade; mitotic rate $\leq$5/50 HPF
G2: High grade; mitotic rate >5/50 HPF

Note: The required total count of mitoses is per 5 mm^2 on the glass slide section. With the use of older model microscopes, 50 HPF is equivalent to 5 mm^2. Most modern microscopes with wider 40X lenses/fields require only 20 HPF to embrace 5 mm^2. If necessary please measure field of view to accurately determine actual number of fields required to be counted on individual microscopes to count 5 mm^2.

C. Risk Assessment

Because GISTs can recur many years after initial excision, we now regard most GISTs as having at least some potential for distant metastasis. This concept was originally the result of a National Cancer Institute-sponsored consensus conference that was held in 2002.[1] More specific data generated by large follow-up studies refined the biologic potential assessment.[4-8] Criteria obtained from those data were adopted in a National Cancer Care Network (NCCN) Task Force report on GIST.[9] We have adopted the criteria for risk stratification, as indicated in the Table.[4-8] The scheme includes anatomic site as a factor, because small bowel GISTs carry a higher risk of progression than gastric GISTs of similar size and mitotic activity. For anatomic sites not listed in this table, such as esophagus, mesentery, and peritoneum, or in the case of "insufficient data," it is best to use risk criteria for jejunum/ileum.

Table 1. Guidelines for Risk Assessment of Primary Gastrointestinal Stromal Tumor (GIST)

Tumor Parameters		Risk of Progressive Disease[#] (%)			
Mitotic Rate	*Size*	*Gastric*	*Duodenum*	*Jejunum/Ileum*	*Rectum*
≤5 per 50 high-power fields (HPF)	≤2 cm	None (0%)	None (0%)	None (0%)	None (0%)
	>2 - ≤5 cm	Very low (1.9%)	Low (8.3%)	Low (4.3%)	Low (8.5%)
	>5 - ≤10 cm	Low (3.6%)	(Insufficient data)	Moderate (24%)	(Insufficient data)
	>10 cm	Moderate (10%)	High (34%)	High (52%)	High (57%)
>5 per 50 HPF	≤2 cm	None[##]	(Insufficient data)	High[##]	High (54%)
	>2 - ≤5 cm	Moderate (16%)	High (50%)	High (73%)	High (52%)
	>5 - ≤10 cm	High (55%)	(Insufficient data)	High (85%)	(Insufficient data)
	>10 cm	High (86%)	High (86%)	High (90%)	High (71%)

[#] Defined as metastasis or tumor-related death.
[##] Denotes small number of cases.

Data based on long-term follow-up of 1055 gastric, 629 small intestinal, 144 duodenal, and 111 rectal GISTs from the pre-imatinib era.[4-6,8]

Note: The required total count of mitoses is per 5 mm^2 on the glass slide section. With the use of older model microscopes, 50 HPF is equivalent to 5 mm^2. Most modern microscopes with wider 40X lenses/fields require only 20 HPF to embrace 5 mm^2. If necessary please measure field of view to accurately determine actual number of fields required to be counted on individual microscopes to count 5 mm^2.

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D. Metastasis

Gastrointestinal stromal tumors generally metastasize to a very limited subset of anatomic sites.[1] They rarely metastasize to lymph nodes, which is important to note because lymphadenectomy is unnecessary except in rare circumstances when an enlarged or otherwise suspicious lymph node is encountered. Gastrointestinal stromal tumors metastasize predominantly to the liver or to the peritoneal surfaces, where there can be disseminated intra-abdominal disease presenting as innumerable metastatic nodules. Very rarely, GISTs metastasize to the lungs. This situation is associated with rectal location or very advanced disease.[5] Metastasis to bone has also been documented, but it is very rare.

E. Ancillary Studies

Immunohistochemistry

Because of the advent of small-molecule kinase inhibitor therapy in the treatment of GIST (see the following), it has become imperative to distinguish GIST from its histologic mimics, mainly leiomyoma, leiomyosarcoma, schwannoma, and desmoid fibromatosis.[10,11] Immunohistochemistry is instrumental in the workup of GIST. Approximately 95% of GISTs are immunoreactive for KIT (CD117).[12] Most KIT-negative GISTs are gastric or extra-visceral GISTs that are positive for the *platelet-derived growth factor receptor A (PDGFRA)* mutation.[13] KIT immunoreactivity is usually strong and diffuse but can be more focal in unusual cases (Figure 1, A and B). It is not unusual for GISTs to exhibit dot-like perinuclear staining (Figure 1, C), while less commonly, some cases exhibit membranous staining (Figure 1, D). These patterns do not clearly correlate with mutation type or response to therapy. Approximately 70% of GISTs are positive for

CD34, 30% to 40% are positive for smooth muscle actin, 5% are positive for S100 (usually focal), 5% are positive for desmin (usually focal), and 1% to 2% are positive for keratin (weak/focal).[1]

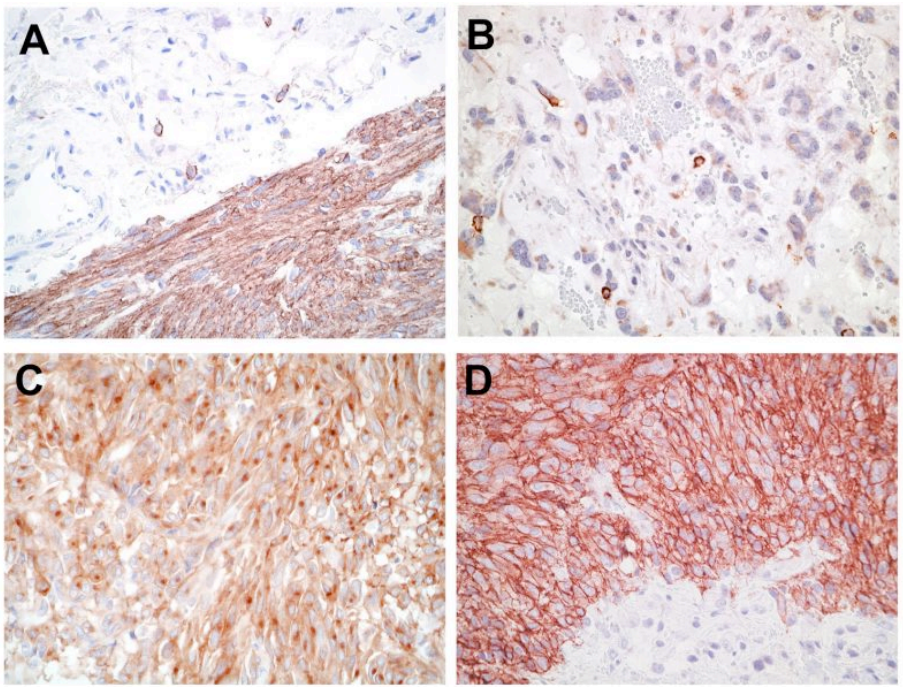

Figure 1. Patterns of KIT staining in gastrointestinal stromal tumor (GIST). A, Diffuse and strong immunoreactivity in a typical GIST. B, Focal and weak pattern in an epithelioid gastric GIST with a *PDGFRA* mutation. C, Dot-like perinuclear staining. D, Membranous pattern. (Original magnification X400.)

Molecular Analysis

Approximately 85% of GISTs possess activating mutations in the *KIT* gene, whereas another 10% have activating mutations in the *PDGFRA* gene.[14-17] These mutations result in virtually full-length KIT proteins that exhibit ligand-independent activation. *KIT* and *PDGFRA* each contain 21 exons. However, mutations cluster within "hotspots": exons 9, 11, 13, and 17 in *KIT*, and exons 12, 14, and 18 in *PDGFRA* (Figure 2). About 5% to 10% of GISTs appear to be negative for both *KIT* and *PDGFRA* mutations. The most recent NCCN Task Force on GIST strongly encourages that *KIT* and *PDGFRA* mutational analysis be performed if imatinib therapy is begun for unresectable or metastatic disease and that mutational analysis be considered for patients with primary disease, particularly those with high-risk tumors. *KIT* and *PDGFRA* mutation status can be determined easily from paraffin-embedded tissue. Secondary or acquired mutations can be associated with development of tumor resistance in the setting of long-term imatinib mesylate treatment. These are usually point mutations that occur most commonly in *KIT* exons 13, 14 and 17.[18] The clinical utility of these mutations is an evolving concept, but it is important not to confuse them with the primary or initial mutation in GIST.

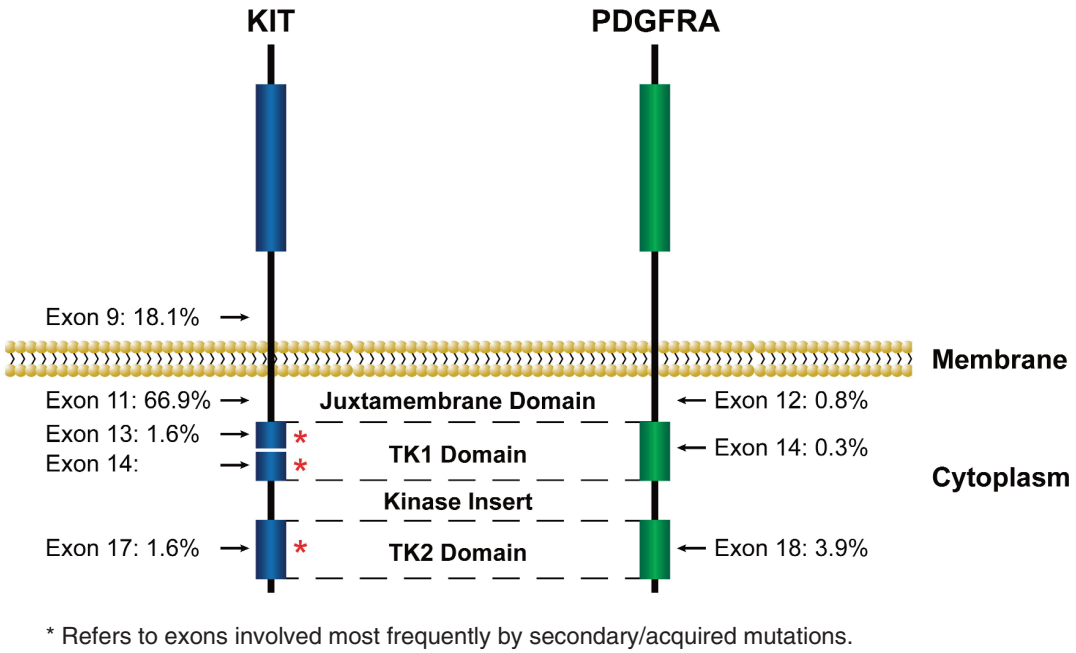

Figure 2. Locations and frequency of activating *KIT* and *PDGFRA* mutations in GIST. Adapteed with permission from Heinrich et al.[14] Copyright 2003 by the American Society of Clinical Oncology. All rights reserved.

KIT and PDGFRA are excellent targets for small-molecule tyrosine kinase inhibitors, and two compounds of this class, imatinib mesylate (Gleevec, Novartis Pharmaceuticals, Basel, Switzerland) and sunitinib malate (Sutent, Pfizer Pharmaceuticals, New York, New York), have shown efficacy in clinical trials and have been approved by the US Food and Drug Administration for the treatment of GIST.[9,19,20] Because different treatments may have more efficacy in genetic subsets of GIST, the molecular era of GIST analysis has arrived, and oncologists may want to know the mutation status of each GIST, because this may impact which drug each patient should receive.[14,21] Secondary resistance mutations may also affect drug selection as their significance is further defined.

F. Treatment Effect

Gastrointestinal stromal tumors respond well to the newer targeted systemic therapies, imatinib mesylate and sunitib malate. The types of treatment effects that have been seen are hypocellularity, myxoid stroma, fibrosis, and necrosis. Nests of viable tumor cells are virtually always seen. Because all of these histologic features can be seen in untreated GISTs, it is not possible to know whether they are due to treatment or not. As a practical compromise, we think it is best to report the percentage of viable tumor after treatment.

G. TNM and Stage Groupings

The American Joint Committee on Cancer (AJCC) and International Union Against Cancer (UICC) GIST staging system is recommended.[22]

TNM Descriptors

For identification of special cases of TNM or pTNM classifications, the “m” suffix and “y” and “r” 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.

T Category Considerations
In the case of ruptured tumors, estimates of tumor size can be obtained from radiologic data, if available.

N Category Considerations
Nodal metastasis is extremely rare in GIST, and there is no routine indication for lymph node biopsy or lymph node dissection. In the absence of information on regional lymph node status, N0/pN0 is appropriate; NX should not be used.

M Category Considerations
Most GISTs metastasize to intra-abdominal soft tissues, liver, or both. Intra-abdominal metastasis refers to tumor involvement in the abdominal cavity away from the primary mass. Such metastasis is usually to the serosal surfaces of the abdomen, pelvis, and retroperitoneum. Multiple primary tumors can be seen in the setting of neurofibromatosis type 1 or familial GIST syndrome and should not be considered intra-abdominal metastasis. Rare cases of multiple independent GISTs at different GI locations have been reported. In the absence of a primary gastrointestinal GIST, solitary omental, mesenteric, pelvic, or retroperitoneal GISTs should be considered primary tumors because extra-gastrointestinal GISTs have been described. Liver metastasis implies the presence of metastatic tumor inside the liver parenchyma as 1 or more nodules. Adherence to liver capsule, even if extensive, as sometimes seen in gastric GISTs, should not be considered liver metastasis.

Staging Grouping: Gastric GISTs

				Mitotic Rate
Stage IA	T1 or T2	N0	M0#	Low
Stage IB	T3	N0	M0	Low
Stage II	T1	N0	M0	High
	T2	N0	M0	High
	T4	N0	M0	Low
Stage IIIA	T3	N0	M0	High
Stage IIIB	T4	N0	M0	High
Stage IV	Any T	N1	M0	Any rate
	Any T	Any N	M1	Any rate

M0 denotes no distant metastasis.

Stage Grouping: Small Intestinal GISTs

				Mitotic Rate
Stage I	T1 or T2	N0	M0	Low
Stage II	T3	N0	M0	Low
Stage IIIA	T1	N0	M0	High
	T4	N0	M0	Low
Stage IIIB	T2	N0	M0	High
	T3	N0	M0	High
	T4	N0	M0	High
Stage IV	Any T	N1	M0	Any rate
	Any T	Any N	M1	Any rate

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