Imaging techniques in the diagnosis, staging and follow up of GI cancers

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Principles of staging of gastrointestinal cancers

- Luminal GI Cancers
  - How does T staging and N staging affect treatment choice and in which cancers
  - What other tests help determine best treatment choices and tailor therapy

- Pancreatobiliary cancers
  - What factors determine resectability and need for adjuvant therapy
General Principles in Staging of Luminal Cancers

- Tumors originate in the inner lining (mucosa) of the lumen

- Prognosis dependent on
  - Depth of invasion (T1-3)
  - Penetration in other organs or serosal surface (T4)
  - Lymph node involvement (N)
  - Distant metastases

- TNM system can be grouped in “Stages”
AJCC TNM Staging Definitions

**Primary tumor (T)**
- **T**\textsubscript{is} Carcinoma in situ
- **T**\textsubscript{1} Tumor invades submucosa
- **T**\textsubscript{2} Tumor invades muscularis propria
- **T**\textsubscript{3} Tumor invades through muscularis propria or subserosa
- **T**\textsubscript{4} Tumor directly invades other organs or structures

**Regional lymph nodes (N)**
- **N**\textsubscript{0} No regional lymph node metastases
- **N**\textsubscript{1} Metastases in 1–3 regional lymph nodes
- **N**\textsubscript{2} Metastases in 4 or more regional lymph nodes

**Distant metastases (M)**
- **M**\textsubscript{0} No distant metastases
- **M**\textsubscript{1} Distant metastases

AJCC = American Joint Committee on Cancer.
National Comprehensive Cancer Network (NCCN), 2008; Greene et al., 2002.
Staging: Example Colon Cancer
| T<sub>1</sub>N<sub>0</sub>M<sub>0</sub> | Stage I | T<sub>1</sub>N<sub>1</sub>M<sub>0</sub> | Stage IIIA |
| T<sub>2</sub>N<sub>0</sub>M<sub>0</sub> | | T<sub>2</sub>N<sub>1</sub>M<sub>0</sub> | |
| T<sub>3</sub>N<sub>0</sub>M<sub>0</sub> | Stage IIA | T<sub>3</sub>N<sub>1</sub>M<sub>0</sub> | Stage IIIB |
| T<sub>4</sub>N<sub>0</sub>M<sub>0</sub> | Stage IIB | T<sub>4</sub>N<sub>1</sub>M<sub>0</sub> | |
| T<sub>any</sub>N<sub>2</sub>M<sub>0</sub> | | |
| T<sub>any</sub>N<sub>any</sub>M<sub>1</sub> | Stage IV | |

NCCN, 2008; Greene et al., 2002.
12.3% of patients presented with recurrent CRC.

2002 data.

Estimated 2008 U.S. incidence (new cases): 148,810
Estimated 2008 U.S. mortality: 49,960

- 12% stage I*
- 24.5% stage II*
- 32.6% stage III*
- 18.6% stage IV*

12.3% of patients presented with recurrent CRC.

*2002 data.

5-Year Relative Survival By AJCC Stage

O'Connell et al., 2004.
<table>
<thead>
<tr>
<th>Stage</th>
<th>Postoperative Therapy</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>No therapy</td>
</tr>
<tr>
<td>IIA</td>
<td>Potentially adjuvant chemotherapy with 6 months of 5-FU/LV or capecitabine</td>
</tr>
<tr>
<td>IIB</td>
<td>Adjuvant chemotherapy recommended&lt;br&gt;(5-FU/LV + oxaliplatin = FOLFOX or 5-FU/LV or capecitabine)</td>
</tr>
<tr>
<td>III</td>
<td>Adjuvant chemotherapy recommended (FOLFOX)</td>
</tr>
<tr>
<td>IV</td>
<td>Palliative chemotherapy&lt;br&gt;(in select cases, cure of metastatic disease with multimodality approach possible)</td>
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Pancreatic Cancer: General Issues Affecting Outcome

- TNM Staging
- Location of tumor (head, body, tail)
  - Earlier symptoms for head cancers (biliary obstruction)
- Resectability
  - For local tumors mainly determined by vessel involvement (SMA)
Pancreatic Cancer: TNM Staging

STAGING PANCREATIC CANCER

Using the TNM (tumor, node, metastasis) system, the American Joint Committee on Cancer has established the following stages for pancreatic cancer.

**Primary tumor**
- TX — primary tumor can’t be assessed
- T0 — no evidence of primary tumor
- T1 — tumor limited to the pancreas
- T1a — tumor 2 cm or less in greatest dimension
- T1b — tumor more than 2 cm in greatest dimension
- T2 — tumor penetrates the duodenum, bile duct, or peripancreatic tissues
- T3 — tumor extends beyond the pancreas, but without involvement of the celiac axis or the superior mesenteric artery
- T4 — tumor involves the celiac axis or the superior mesenteric artery (unresectable primary tumor)

**Regional lymph nodes**
- NX — regional lymph nodes can’t be assessed
- N0 — no evidence of regional lymph node metastasis
- N1 — regional lymph node metastasis

**Distant metastasis**
- MX — distant metastasis can’t be assessed
- M0 — no known distant metastasis
- M1 — distant metastasis

**Staging categories**
Pancreatic cancer progresses from mild to severe as follows:
- Stage 0 — Tis, N0, M0
- Stage Ia — T1, N0, M0
- Stage Ib — T2, N0, M0
- Stage IIA — T3, N0, M0
- Stage IIB — T1, N1, M0; T2, N1, M0; T3, N1, M0
- Stage III — T4, any N, M0
- Stage IV — any T, any N, M1
Pancreatic Cancer: 5-Year Survival by Stage

Pancreatic Cancer: Stage-dependent Therapeutic Options

Resectable
(10-15% of cases)

- Surgery + adjuvant CT (and RT??)

Not resectable

Locally advanced
(≈ 40% of patients)

- Chemotherapy or RT + CT

Metastatic
(≈ 45-50% of patients)

- CT
Michael Kochman (7 minutes)

“EUS and Operator dependence: Why is it important to find a good endosonographer”

- Wide range of variation between accuracy for pancreatic cancer diagnosis
  - Make sure your endosonographer has good and on-site cytology support too
- Cost of mis-staging of luminal cancers
- Absence of immediate feedback mechanism for a “failed” or “suboptimal” EUS exam
  - You might find out the poor results of an endosonographer only when it is too late
Elliot Fishman (7 minutes)

Advances in Radiologic imaging of GI cancers

- Are MDCT and MRI interchangeable in use
- CT with reconstruction vs MR Angiogram
  - How to chose
- What is CT arterial portography and CT hepatic arteriography
  - What are their potential uses in management of GI cancers
Val Lowe (7 mins)

Advances in Nuclear Imaging

- Role of PET scan in
  - Staging
  - Diagnosis
- Caveats in the use of PET scan
- Potential benefits of PET-CT
Case 1

- 52 year old man with progressive dysphagia of 1 month duration

- EGD
  - Malignant appearing stricture in distal esophagus at about 33 to 37 cm from incisors
  - Biopsy – moderately differentiated adenoCa
Case 1

- What further staging tests are needed prior to therapy
  1. CT chest/abdomen
  2. CT chest/abdomen and pelvis
  3. Bone Scan
  4. PET scan
  5. EUS
  6. Serum CEA levels
Axel Grothey

- What are the important pieces of information sought during a staging work-up of esophageal cancer

- Is there an ideal sequence of staging tests

- Are serum markers of any benefit in the management of esophageal cancer
Michael Kochman

- Are there any case scenarios where EUS staging of esophageal cancer is not feasible?

- What is the sensitivity and specificity for EUS staging of esophageal cancer
Val Lowe

What is the value of performing PET scan routinely for staging of esophageal cancers

What is the sensitivity and specificity of PET scan for metastatic lesions

When should PET scan be performed during the work-up for maximum benefit
What is the utility of CT scan for staging esophageal cancer in the era of EUS and PET scan?

Is MRI an acceptable substitute for patients who cannot get IV contrast for CT scan?
Patient found to have T3N1M0 tumor.

- Treated with chemotherapy and radiation in anticipation for surgery
- Had dramatic response with resolution of stricture by EGD
Axel Grothey

- What is the role of repeat EGD after chemoXRT in management

- Is there any information at this time that would influence subsequent management of this patient?
  - Response to treatment?
  - Degree of response?
  - How to best assess response?
Does EUS restaging impact further management of these patients

When should restaging EUS be performed after chemoXRT
Val Lowe

- Does FDG-PET help in:
  - Assessing response during treatment
  - Restaging post Chemo-XRT for further management

- What is the ideal time for restaging PET
Elliot Fishman

- Role of repeat CT scan after chemoXRT and timing of scans

- Are there any potential confounding factors in evaluation of CT scans after chemoXRT treatment
Case 1 contd

Patient undergoes surgery – R0 resection (with margins clear of tumor)

- Surgical pathology staging: Path T2N0
Follow up

The patient should be followed up by

1. Gastroenterologist
2. Surgeon
3. Oncologist
4. Radiation Oncologist
5. Primary Care Physician
Which of these are appropriate for follow up of this patient

- CT scan
- PET scan
- EUS
- EGD
- Serum markers
- History and Physical
Case 2

- Patient 61 year old man found to have anemia

- EGD
  - Ulcerated mass in the body of the stomach.
  - Bx- signet cell adenocarcinoma
What is appropriate work-up for this patient

1. EUS
2. CT chest/abdomen/pelvis
3. CT Chest/abdomen
4. PET scan
5. CT/MRI of brain
6. Serum CEA and CA19-9
Axel Grothey

- What are the staging considerations unique to gastric cancer
  - How do they affect treatment choice and design
Michael Kochman

- What useful information can EUS provide in a patient with gastric cancer

- What is the role of EUS in patients
  - with thickened folds noted on EGD
  - or
  - thickened wall noted on CT scan
Val Lowe

What is the value of PET scan in patients with gastric cancer

- Should it routinely be used in its management
Elliot Fishman
Case 3

- 68 year old man has bloody stools and change in bowel habits.

- Colonoscopy
  - an obstructive mass lesion at 5-9 cm from anal verge.
  - Bx: adenocarcinoma
What is appropriate staging work-up for this patient

1. CT chest/abdomen/pelvis
2. CT abdomen/pelvis
3. PET scan
4. EUS
5. Serum CEA levels
Axel Grothey

- What staging information is important in this patient and how will it influence management
What is the role of EUS in management of rectal cancers
PET

- Is there a role for PET scan in staging and management of rectal cancers
Elliot Fishman

- What is the role of CT chest in patients with rectal cancer?
  - should it routinely be performed for staging?
Case 4

- 65 year old woman found to have a 3 cm sessile polypoid mass in the transverse colon.

- Bx: invasive adenocarcinoma
What is appropriate staging work-up for this patient?

1. **CT chest/abdomen/pelvis**
2. **CT abdomen/pelvis**
3. **PET scan**
4. **EUS**
5. **Serum CEA levels**
What specific information is sought on staging work-up in patients with colon cancer?

What is the role of serum CEA in management of this patient?
Is there a role for EUS staging in management of colon cancers?
Val Lowe

- Is there a role for routine PET scan in staging of colon cancer
Elliot Fishman

- Patient is found to have a 15 mm focal lesion in the liver.
  - What is the next test in this patient
  - PET vs CT guided biopsy vs MRI vs EUS-FNA
Case 4 contd

- CT guided FNA of liver lesion
  - negative for malignancy
- Patient undergoes surgery
  - 2 of 15 nodes were positive
  - Path T3N1M0
- Started on adjuvant chemo-radiation
Axel Grothey

Follow up evaluation of this patient

- By whom?
- How long?
- How often?
- How?
Kochman

What is the role of follow-up colonoscopy in this patient

- When?
- How often?
In follow up of these patient, is there a role for

- CT scan or
- PET scan or
- PET/CT
Case 5

- 53 year old female with mild heartburn
  - EGD
    - 4 cm submucosal mass in the distal stomach
  - EUS-FNA
    - Gastrointestinal Stromal Tumor
What imaging studies are appropriate in GIST tumors before definitive treatment

1. CT chest/abdomen/pelvis
2. PET scan
3. MRI
4. None – just proceed to surgery
Axel Grothey

- What information is sought from staging work-up in patients with GIST
  - How does this impact management
Michael Kochman

- Besides providing diagnosis, what additional useful information is available with EUS exam in patients with GIST
What is the role of PET scans in management of patients with a GIST?

- Staging
- Evaluation of response to treatment
Elliot Fishman

Does the absence of metastatic lesions on CT scan, obviate the need for PET scan in patients with GIST

Should CT scan be performed if the PET scan is negative for metastatic lesions
Case -continued

- Patient underwent distal gastrectomy
- Surgical pathology:
  - 4.6cm in size
  - Margins negative for tumor
  - strongly C-kit positive
  - 30 mitoses per 50 High powered field
Axel Grothy

- How does the pathology influence your plans for surveillance follow-up of GIST patients?
  - Frequency
  - Duration

- What modalities for follow up should be employed?
  - Radiology
  - Serum chemistries, LDH
Case 6

56 year old has idiopathic acute pancreatitis episode.

- CT abdomen
  - dilation of PD in the body and tail.
  - No mass identifiable

- EUS
  - 25mm mass in the body of pancreas.
  - FNA: adenocarcinoma
Pre-operative staging work-up of this patients should include

1. CT chest/abdomen/pelvis
2. PET scan
3. CT abdomen with pancreatic protocol
4. CT arterial portography (CTAP) and CT hepatic arteriography (CTHA)
5. MRI/MRCP of abdomen
What staging information is necessary for treatment planning of this patient
Michael Kochman

- How good is EUS for staging of pancreatic cancer
  - What unique information can it provide
Val Lowe

- What is the role of PET scans in staging of pancreatic cancer staging
  - Are there any caveats to its use
What radiologic tests are adequate for staging of pancreatic cancer
  - Is MRI = CT with pancreatic protocol

What is CT arterial portography and CT hepatic arteriography
  - Is there a role for them in staging of pancreatic cancers
Case 6 contd.

- Patient undergoes Surgery and is found to have a T3N0 tumor.
Axel Grothey

- What is the benefit of scheduled follow-up in this patient population
  - What tests are appropriate?
  - For how long and at what intervals?