EUS for Cancer Staging and Tumor Management

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Learning Objectives

1. Staging malignant disease (T+N stage) with EUS
2. Tumor diagnosis & treatment with EUS
3. Therapeutic applications of EUS for oncologic disease
Tumor Staging and EUS

- Luminal Gastrointestinal Tract
  - Esophageal Cancer*
  - Gastric Adenocarcinoma
  - Rectal Adenocarcinoma*

- Extra-luminal
  - Pancreas cancer*
  - Non-small cell lung carcinoma (NSCLC)*

TNM staging system

- Depth of tumor invasion (T stage)
- Presence/absence of regional lymph nodes (N)
- Presence or absence of distant metastasis (M)
Principles of Luminal GI EUS

Esophageal Tumor Staging with EUS
EUS Impact of Staging on Esophageal Cancer:
*Management Scheme*

- Superficial (T1NO): Local Therapy or Surgery
- Locally Invasive (T1-3, N1): Combined Chemotherapy/RT + Surgery
- Advanced (T4): Chemotherapy, palliative

**EUS is only modality capable of accurate pre-surgical staging**

Accuracy of Staging with EUS

- Highest in the esophagus
- T-stage accuracy 82-86%
- N-stage accuracy 70-86%
- EUS superior to CT in comparative studies
N stage – Prognostic implications

• N1 disease as classified by EUS have poorer survival

• # of LNs detected is a predictor of survival

• LN characteristics on EUS can be helpful in classifying benign from malignant LNs.

Criteria for malignant lymph nodes

• Diameter > 10 mm

• Uniform hypoechoogenicity

• Rounded shape

• Nodes with a sharp border
M stage

- Imaging of medial 2/3 of the liver
- Metastasis to certain lymph nodes is classified as M1a or M1b disease

Staging Rectal Cancer
Pretreatment staging: Rectal cancer

- CT Scan - distant metastatic spread and tumor-related complications

- TRUS versus high resolution MRI for T staging

EUS Impact on Staging Rectal Cancer:

Management scheme

- Superficial (T1-2N0): Local Therapy, usually surgery
- Locally Invasive (T3N0 or T1-3, N1): Combined Chemotherapy/RT + Surgery
- Advanced (T4)/Metastatic: Chemotherapy, palliative
**EUS Staging Accuracy: Rectal**

<table>
<thead>
<tr>
<th>EUS T Stage</th>
<th>CT T stage</th>
<th>EUS N stage</th>
<th>CT N stage</th>
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<tbody>
<tr>
<td>79%*</td>
<td>61%</td>
<td>66%</td>
<td>82%</td>
</tr>
<tr>
<td>91%**</td>
<td>71%</td>
<td>82%</td>
<td>76%</td>
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</tbody>
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31% change in management with pre-op EUS staging**

* Hawes, 1993  
** Harewood, 2002

**Circumferential Resection Margin (CRM)**

- Distance from the tumor to the CRM -> *prognostic implications*

- Positive (+) CRM -> (tumor invades or is in close proximity to the mesorectal fascia) (MRF)  
  -> *most important risk factor for local recurrence after rectal cancer surgery*
EUS versus MRI for CRM

- EUS
  - Anterior tumors

- MRI
  - Posterior, posterolateral tumors

Staging NSCLC: Rationale for EUS

- Precise mediastinal staging of NSCLC is critical as lymph node metastasis are common

- Pet scan alone – false + results

- Lower posterior mediastinum is ideally suited to EUS
Stations accessible with EUS

- Subcarinal (7)
- Lower Para tracheal (5)
- Para esophageal (8,9)
Pancreatic Cancer and EUS

- **Diagnosis**
  - EUS-FNA

- **Therapeutic applications**
  - EUS-guided biliary drainage
  - EUS-Celiac Plexus Neurolysis (EUS-CPN)

- **Treatment**
  - EUS-guided fiducial placement
  - EUS-guided brachytherapy (EUS-BTx)
  - EUS-guided ablation
  - EUS-guided antitumor agent injection (FNI)

Algorithm

- **Suspected Pancreatic Cancer**
  - sCT or MDHCT
    - Normal
    - Other causes
      - If suspicion persists
        - Negative
          - Follow-up
        - Positive
          - Staging
          - EUS + FNA
          - Surgery
    - Resectable pancreatic mass (≥ 2 cm)
    - Unresectable
      - EUS
      - FNA
TNM Staging of Pancreatic Tumors

Tumor (T)
- T1 – tumor confined to pancreas < 2 cm
- T2 – tumor confined to the pancreas > 2 cm
- T3 – tumor extends beyond the pancreas (duodenum, bile duct, or stomach) but without involvement of the CA or SMA
- T4 – tumor infiltrating major vessels including celiac axis or the superior mesenteric artery

Nodal (N)
- N0 – No lymph node involvement
- N1 – Regional lymph node involvement

Metastasis (M)
- M0 – No distant metastasis
- M1 – Distant metastasis
- Mx – Distant metastasis cannot be assessed

Application of Endoscopic Ultrasound (EUS) in Pancreatic Cancer

- EUS can detect small pancreatic tumors and EUS-FNA permits histological confirmation
- Accuracy: 78% to 94% (T) and 64% to 82% (N)
- Can help define vascular involvement in patients in whom vascular invasion is questionable on CT scan
Fine Needle Aspiration

Fine Needle Aspiration Technique
Fine Needle Aspirate Evaluation

Applications of EUS in Pancreatic Cancer
EUS guided biliary drainage

Pain Control: EUS celiac plexus neurolysis

- 78-88% improvement in pancreatic cancer pain
- Major complications CPN <1%
  - Transient diarrhea and hypotension from sympathetic blockade
EUS celiac plexus neurolysis

Gold fiducial marker placement

- Stereotactic body radiotherapy for locally advanced pancreatic cancer
- EUS-guided fiducial marker placement successful 84.6%
Eileen M. Janec, MD

EUS-guided brachytherapy (EUS-BrTx)

• Results in temporary pain relief and a marginal survival benefit

• EUS-BrTx is used for treating tumors such as head and neck cancer, esophageal cancer, rectal cancer, and pancreatic cancer
EUS-guided ablation

- Photodynamic therapy (PDT)
- Radiofrequency ablation (RFA)
- Ng:YAG laser & High Intensity Focused US (HIFU)

FNI of chemotherapeutics

- TNFrade
  - Injectable agent that is injected into unresectable pancreatic tumors under EUS-guidance
- LC Beads
  - Designed for the delivery of chemotherapeutic agent irinotecan, to transport the agent into pig pancreas
- OncoVex-GMCSF or 5-FU
EUS-guided fine needle tattoo (EUS-FNT)

- Small pancreatic tumors may be difficult to locate due to minimally invasive surgery
- Injection of India ink, purified carbon particles (SPOT), methylene blue or indocyanine green to tattoo tumor
- Minimizes resected pancreatic parenchyma

Take Home Points

- Staging cancers of the esophagus, rectum, and lung with EUS is accurate and impacts the clinical management
- EUS/FNA is a safe (<1/1000 complications) diagnostic modality and has applications within and beyond the GI tract
- Therapeutic applications of EUS for cancer patients are expanding and currently include pain control (CPN), biliary drainage, and tumor identification (tattoos), and fine needle injectable.