Gastrointestinal Carcinoid Tumor: The Role of CT and MR

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Purpose
1. To present imaging protocols and the role of newer imaging techniques in the diagnosis, staging, and management of patients with gastrointestinal carcinoid tumors.
2. To present the MR and CT imaging findings of gastrointestinal carcinoid tumors with special attention to the detection of the primary tumor: desmoplastic reaction and metastatic disease.

Clinical Background
• Carcinoids are malignant neuroendocrine tumors arising from enterochromaffin cells of Kulchitsky in the crypts of Lieberkühn.
• 9th - 10th decade
• African-Americans >> Whites
• Women > Men
• 2% of GI tract tumors
• Appendicitis (60-70%)
• Small bowel (20-30%) - terminal ileum
• 30% are multiple
• 40-50% of small bowel carcinoids spread to the mesentry at the time of diagnosis.

Staging (TNM) – Small Bowel Carcinoid

T – Primary Tumor
• TX: Primary tumor cannot be assessed
• T0: No evidence of primary tumor
• T1: Tumor invades lamina propria (1a) or submucosa (1b) and size ≤1 cm
• T2: Tumor invades muscularis propria or size >1 cm
• T3: Tumor invades subserosa, mesentry or retroperitoneum; extension < 2cm
• T4: Tumor invades peritoneum or other organs
• For any T, add (m) for multiple tumors

N – Regional Lymph Nodes
• N0: Regional lymph nodes cannot be assessed
• N1: Regional lymph node metastasis
• N2: Regional lymph node metastasis with 4 or more lymph nodes involved

M – Distant Metastases
• M0: No distant metastases
• M1: Distant metastases

DECT of the primary tumor
1. Primary tumor is scanned in the late arterial phase and tumor is isodense.
2. Secondary to bowel wall involvement.
3. Optimum visualization of the primary tumor.

DECT of the metastases
1. Low iodine enhancement.
2. Secondary to bowel wall involvement.
3. Optimum visualization of the metastases.

Hematomagnetic Spread: DECT and MDCT

Primary Tumor
1. Solitary or multiple, well-defined early enhancing lesion(s) in the bowel wall.
2. Optimum visualization with a negative contrast oral agent (0.1% barium or water).
3. Lymphatic Spread
4. Mesenteric Mass
5. Ill-defined, spiculated heterogeneous mass
6. 70% contain calcifications
7. Desmoplastic reaction

Hematomagnetic Spread
1. Liver metastases
2. Variable intense late arterial enhancement
3. Become isodense on portal phase and hypodense on delayed venous phase
4. Peritumoral spread
5. Late development.
6. Small, discrete nodular lesions without significant ascites.

Lymphatic Spread: MRI
1. Primary tumor may mimic benign or malignant colorectal disease due to liver metastases.
2. The primary mass may mimic benign or malignant gastrointestinal disease due to liver metastases.

Hemotomagnetic Spread: DECT and MDCT
1. Axial post contrast DECT images of the primary tumor.
2. The lymphatic spread is seen as a solid mass in the peritoneal nodal station (a, arrowhead). The primary tumor is identified in the rectum (b, arrow).
3. Detection of lymphatic spread aids in localization of the primary tumor.
4. The primary mass may mimic benign or malignant colorectal disease due to liver metastases.
5. There are multiple bilateral hepatic metastatic lesions (arrow).

Lymphatic Spread: MRI
1. MRI of the abdomen. (a) Axial T1W DDP, (b) Axial T2W, (c) Axial post-ESVi Late Arterial Phase, (d) Axial post-ESVi Hepatobiliary Phase, (e) Axial DWI (B = 800sec/mm2), and (f) Axial ADC Map. There is a metastatic mass (arrow) with spironolactone and relaxation; the relaxation represents the desmoplastic reaction.
2. Lymphatic spread shows optimum contrast on the DWI; high b values. There is confirmation of restricted diffusion on the ADC map.
3. The post-Gd images show hyperintense signal in the late arterial phase. On the hepatobiliary phase, the mass is isointense to muscle.

Hematomagnetic Spread: MRI
1. MRI of the abdomen. (a) Axial T1W DDP, (b) Axial T2W, (c) Axial post-ESVi Early Arterial Phase, (d) Axial post-ESVi Hepatobiliary Phase, (e) Axial DWI (B = 500sec/mm2). There is restricted diffusion. There is a metastatic mass (arrow) in the liver (arrows).
2. The metastases enhances in the late arterial phase of contrast administration. The metastases is better defined in the hepatobiliary phase.

Teaching Point
• Astinal post contrast DECT images of the primary tumor with enhancing mass in the ileocecal region (yellow arrow). There are several dilated small bowel loops (‘) representing mesenteric vascularity secondary to the primary tumor.

Teaching Point
• Axial post contrast MR images of the primary tumor with enhancing mass in the ileocecal region (yellow arrow). There is a hyperintense mass (arrow) in the liver (arrow).

Teaching Point
• Axial post contrast T1W image of the primary tumor with enhancing mass in the ileocecal region (yellow arrow). There is a hyperintense mass (arrow) in the liver (arrow).

Teaching Point
• Axial post contrast T1W image of the primary tumor with enhancing mass in the ileocecal region (yellow arrow). There is a hyperintense mass (arrow) in the liver (arrow).

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