Neuroendocrine Tumors (NETs)

Neuroendocrine tumors (NETs) are a group of malignancies that arise from neuroendocrine cells, which have characteristics of both nerve cells and hormone-producing cells. These tumors can occur in various parts of the body, including the gastrointestinal tract, lungs, pancreas, and other organs. NETs are typically slow-growing but can be aggressive, especially when diagnosed at advanced stages.

Symptoms of Neuroendocrine Tumors:

- Flushing: Redness and warmth of the skin, usually affecting the face and upper body.
- Diarrhea: Often watery and persistent.
- Wheezing: Due to bronchoconstriction from serotonin release.
- Right-sided heart disease (Carcinoid heart disease): Due to long-term serotonin exposure, leading to tricuspid valve dysfunction and pulmonary valve fibrosis.
- Abdominal pain and cramping: Often due to serotonin and other hormone effects on the gut.
- Pellagra-like symptoms (niacin deficiency): Due to excessive serotonin metabolism, which depletes tryptophan (a precursor for niacin).
- Flushing and wheezing may be aggravated by stress, alcohol, or certain foods.

- Insulinomas: These are insulin-producing tumors of the pancreas. Symptoms of hypoglycemia occur when excess insulin is secreted, including:
    - Sweating, tremors, palpitations.
    - Confusion, dizziness, and seizures if the hypoglycemia becomes severe.
    - Fatigue and weakness.
- Gastrinomas (Zollinger-Ellison Syndrome): These are gastrin-producing tumors, usually located in the pancreas or duodenum. They lead to:
    - Severe peptic ulcers (often multiple and refractory to treatment).
    - Abdominal pain, diarrhea, and heartburn.
    - Weight loss and malnutrition due to impaired nutrient absorption.
- Glucagonomas: These are glucagon-secreting tumors that can cause:
    - Hyperglycemia (leading to diabetes).
    - Weight loss, anemia, and diarrhea.
    - A characteristic necrotic migratory rash on the skin (often affecting the groin and perineal area).
- VIPomas: These secrete vasoactive intestinal peptide (VIP), causing:
    - Severe diarrhea (also known as pancreatic cholera).
    - Hypokalemia and dehydration due to the fluid loss.

Non-functioning NETs may be asymptomatic or present with local effects due to tumor growth, including:

- Abdominal pain or discomfort.
- Bloating or fullness, especially if the tumor is in the gastrointestinal tract.
- Unintentional weight loss.
- Obstruction: Especially in the small bowel or pancreas, leading to nausea, vomiting, and constipation.
- Palpable mass: If the tumor is located in the abdomen, a mass may be felt.

Investigations for Neuroendocrine Tumors:

- Clinical History and Physical Examination:
- Laboratory Tests:
    - 24-hour urinary 5-HIAA (5-hydroxyindoleacetic acid)
    - Chromogranin A (CgA)
    - Plasma serotonin
    - Insulin and C-peptide
    - Gastrin levels
    - VIP levels
    - Blood glucose levels
- Imaging Studies:
    - Abdominal Ultrasound
    - CECT Scan (Computed Tomography)
    - MRI
    - Somatostatin Receptor Scintigraphy (Octreoscan)
    - Positron Emission Tomography (PET)
- Endoscopy
- Biopsy:
    - A biopsy of the tumor (if accessible) or metastatic tissue is essential for confirming the diagnosis. Histopathological examination of the tumor often reveals neuroendocrine cells with immunohistochemistry for chromogranin A and synaptophysin markers.

Diagnosis of Neuroendocrine Tumors:

Diagnosis is based on a combination of clinical presentation, biomarkers, imaging studies, and histopathological examination. Key diagnostic points include:

- Elevated serum chromogranin A.
- Elevated urinary 5-HIAA (for carcinoid tumors).
- Characteristic imaging findings on CT, MRI, Octreoscan, or PET scan.
- Biopsy showing neuroendocrine cells with positive staining for chromogranin A, synaptophysin, or other neuroendocrine markers.

Management of Neuroendocrine Tumors:

The treatment of neuroendocrine tumors depends on the location, size, functionality, grade, and stage of the tumor. Treatment strategies often involve a combination of surgery, medical therapy, and radiation therapy.

Surgery:

- Surgical resection is the primary treatment for localized, non-metastatic NETs. Surgical options include:
- Resection of the primary tumor (e.g., pancreatico duodenectomy for pancreatic NETs, resection of ileal tumors).
- Liver metastasectomy: For liver metastases that are limited in number and resectable.
- Bowel resection: If the tumor is causing obstruction or bleeding in the GI tract.

Surgery is performed (MIS) Minimal invasive surgery by *Robotic/Laparoscopic*

Robotic Pancreatic duodenectomy for pancreatic NET's or ileal resection

Benefits of Robotic Surgery:

Enhanced Precision and Accuracy

- Robotic surgery provides the surgeon with high-definition 3D visualization and magnified views of the esophagus, surrounding tissues, and organs.
- The robotic system's fine control and ability to perform highly precise movements can reduce the risk of damaging nearby structures like the trachea, aorta, or Vagus nerve during the procedure.
- Robotic arms have enhanced dexterity and stability, making it easier for the surgeon to navigate through the chest and abdomen, which can be particularly challenging in esophageal surgery.

Minimally Invasive Approach

- Robotic esophagectomy is performed using small incisions, reducing the need for large surgical cuts (as seen in traditional open surgery). This leads to:
    - Less pain post-surgery.
    - Reduced risk of infection due to smaller wounds.
    - Shorter hospital stays, with some patients being able to leave the hospital sooner than after open surgery.

Faster recovery and Shorter Hospital Stay

- The minimally invasive nature of the procedure often results in a quicker recovery time compared to traditional open surgery. Patients generally experience less postoperative pain and can return to normal activities much sooner.
- The shorter hospital stay is a major advantage, as it reduces the risk of hospital-acquired infections and speeds up the recovery process.

Reduced Blood Loss

- Robotic surgery tends to result in less blood loss compared to traditional open surgery. The precision of robotic instruments and the ability to visualize the surgical site in greater detail help minimize the risk of bleeding.
- Reduced blood loss may also reduce the need for blood transfusions during or after the surgery.

Better Visualization

- Robotic surgery provides high-definition, 3D views of the surgical field, allowing the surgeon to clearly see the tumor or problem area, as well as surrounding vital structures.
- The enhanced visualization makes it easier for the surgeon to perform complex maneuvers, such as the removal of the esophagus or the reconstruction of the digestive tract, with greater accuracy and safety.

More Precise Tissue handling

- The robotic instruments used in the procedure have an increased range of motion and are more flexible than traditional laparoscopic tools. This allows the surgeon to handle tissues delicately, which is particularly important when working around the esophagus, lungs, and other critical structures.
- The ability to make more precise cuts and sutures leads to better wound healing and fewer complications post-surgery.

Lower Risk of Complications

- The precision and minimally invasive nature of robotic surgery help reduce the risk of complications such as:
    - Infection,
    - Respiratory issues
    - Anastomotic leaks (where the newly connected parts of the digestive tract do not heal properly)
    - Bleeding
- The robotic system also helps avoid nerve damage, especially to the recurrent laryngeal nerve, which controls vocal cord movement and can affect a patient's ability to speak.

Smaller Scars

- Since robotic surgery uses smaller incisions than traditional open surgery, the resulting scars are typically much smaller and less noticeable.
- The cosmetic benefits of smaller scars can be significant, especially for patients concerned about the appearance of surgical scars after a major procedure.

Potential for fewer post-Operative complications

- Some studies suggest that robotic esophagectomy may be associated with fewer postoperative complications (e.g., respiratory problems, heart issues) compared to traditional open surgery. This is particularly important since the esophagus is located near the lungs, heart, and major blood vessels.

Reduced Risk of Long- Term Digestive issues

- Robotic esophagectomy may offer more precise removal and reconstruction of the digestive tract, potentially leading to better long-term function of the digestive system compared to open surgery.
- This can lead to fewer digestive complications and improved nutritional recovery after surgery.