Introduction

Why a Clinical Practice Guideline?

The practice of radiology has changed remarkably over the years.

Who has developed this guideline?

These guide lines have been developed by Members of the Committee on Guidelines of the Sri Lanka College of Radiologists. The Committee had a widely ranging representation of very senior to junior Radiologists who had worked in different parts of the country at different levels of hospitals to ensure that the guidelines are applicable throughout the country.

For whom is this guideline intended?

It is intended to guide all the health care providers in institutions where radiological imaging is offered. Although it is targeted for the institutions under the MoH, guidelines are encouraged to be used in any private health facility where availability of adequate facilities are ensured.

Objectives

Provide evidence based recommendation to clinicians and radiologists to decide on the best sequence of radiological imaging, in order to arrive at a correct diagnosis at an early stage, in the management of patients to reduce morbidity and mortality

1. USING SPIRAL CT

2.1 Introduction

2.1.1 What Is Spiral CT?

- This is an improvement over conventional CT scanning, the patient lies on an examination table that passes through a scanner while an x ray tube rotates around the table. This movement results in a spiral shaped continuous data set without any gaps at all.
- Single slice Spiral CT is about 8 to 10 times faster than a conventional CT.
- Multi-slice spiral CT provides ultra high resolution images and numerous other facilities
- With the spiral helical CT there is less likelihood to miss small lesions than with conventional CT.
- This procedure is specially beneficial to the elderly, very young, and acutely injured patients who are sensitive to longer examination times.

2.1.2 It is available in the following hospitals. (Early 2007)

Teaching hospitals

- NHSL
- Karapitiya
- Kalubowila
- Ragama
- Kandy
- Rathnapura
- Kurunagala
- Jaffna

Provincial General hospitals

- Kaluthara
- Badulla
- Ampara
- Anuradhapura

Special hospitals

- National cancer Institute, Maharagama
- Lady Ridgeway Hospital
- Sri Jayawardenapura general hospital
- Srimavo Bandaranaike hospital,

2.1.3 High risk patients

- **Diabetes**

- **Myeloma**

- **Renal failure**

  Specific but expensive contrast media eg (visipaque) are available for patients in renal failure

- **Allergy and asthma**

  (If the patient has an allergic tendency or has a history of asthma special preparation is necessary prior to the examination. **Grade (X)**

  At present non ionic contrast media is used through out the island which produces relatively less contrast reactions than ionic contrast which was used previously).

- **Pregnancy?**

  CT is contraindicated in pregnancy except to save the life of the mother **Grade (X)**

2.1.4 Difficult patients

- Claustrophobia
- Extreme nervousness
- Patients in severe pain
- Extremely ill patients.
- Lack of co-operation (deliberate)
- Mental retardation
- Physical retardation
- Disorientation
- Children

Sedation and anesthesia may be necessary for the above patients. General anesthesia or sedation may be required for the children up to the age of ten years.

2.1.5 Benefits

- Unlike conventional x-rays, CT scanning provides very detailed images of a wide range of body organs and tissues.
- Spiral CT is fast. This is especially important for patients with chest injury, because internal damage or bleeding can be diagnosed in time
- There is no pain from CT. Apart from an intravenous injection if needed, the procedure is non-invasive.
- CT scanning is a convenient way of guiding needle biopsies.
- CT helps in planning radiotherapy.
- A CT diagnosis may eliminate the need for exploratory surgery.

2.1.6 Risks

1. Radiation

Although CT represents only 4% of radiological investigations, it accounts for almost 40% of medical diagnostic radiation. Therefore decision to request a CT scan has to be done cautiously. Benefit of the CT has to be greater than the risk

Effective radiation doses in spiral CT scan

Region	Dose	CXR equivalent
Head	>2mSv	>100 CXRs
Chest	>8mSv	>400 CXRs
Abdomen and pelvis	>10mSv	>500 CXRs

2. Allergic reactions to contrast media.

It is a known risk where precautions should be taken. An alternative investigation may be substituted whenever possible.(Grade X)

If not an appointment has to be arranged 3 days in advance to make necessary arrangements and to take precautions.(Grade Y)

2.2 Spiral Computed Tomography of the head

Done either with or without intravenous contrast medium, which is decided by the radiologist. Generally intravenous contrast is not given in suspected intra cranial haemorrhage,
Generally axial CT is done for the brain unless multi planar imaging is needed. (Grade X)

2.2.1 When is it used?

1. **Congenital lesions**:
   hydrocephalus
   craniocerebral malformations.

2. **Vascular lesions:**
   infarcts
   subarachnoid haemorrhage
   aneurysms
   arteriovenous malformations

- In patients with CVA, non contrast CT is mandatory to exclude hemorrhage. (X)

Perfusion, diffusion CT is done to evaluate acute infarcts and is mandatory to decide on therapy.

- If subarachnoid haemorrhage is suspected non contrast CT is carried out.(Grade X)
- CT angiogram is performed to exclude AV malformations and aneurysms (Grade X)

Trauma: CT scan is a very useful radiological modality in head injuries. It should be performed after an initial clinical evaluation. (Grade X)

a) **Face**

- In the initial evaluation of facial trauma plain radiography is the modality of choice, providing a comprehensive survey and usually sufficient information for diagnostic purposes with relative economy. **Grade (X)**
- Multiple views are often necessary in order to reduce the difficulty in interpretation because bony structures overlap.
- CT is needed for the diagnosis of some facial injuries when radiographs are non specific, yet clinical suspicion remains and for the planning of surgical treatment. 3D computer tomography is useful for planning reconstruction procedures. (Grade X)

b) Head

Radiological investigations for the head injured patient should be performed after the initial clinical assessment has been completed. (Grade X)

The purpose of radiological investigations is to establish associated brain injury rather than to demonstrate a fracture.

- GCS (Glasgow coma scale) is one of the important parameters to indicate urgency of the imaging examination.
- CT when available is the investigation of choice in patients with serious head injuries.

- In a patient with an object impacted on the head the object should not be removed to facilitate imaging unless with the consultation of the neurosurgeon. (Grade X)
- Sub dural haematomas, extra dural haematomas, cerebral oedema, vault fractures foreign bodies are demonstrated in the non contrast CT

- Acute intra cerebral bleeding is seen as high density on CT but in patients who are moderately anaemic with a haemoglobin level of 8- 10 g, an acute haematoma can appear iso dense with rest of the cerebral cortex.

MRI is generally inappropriate as a first line of investigation in acute head trauma but is valuable in sub acute and chronic setting particularly in situations when CT findings fail to explain the level of neurological deficits.

3. Infections

In suspected meningitis, encephalitis and cerebral abscesses patients should be kept fasting for 4 hours as a contrast study has to be done. (Grade X)

4. Neoplasms

- Contrast CT is required in suspected astrocytomas, gliomas , meningiomas, pituitary macro adenomas, acoustic neuromas and metastases etc

- Pituitary microadenoma are best demonstrated by MRI scan (Grade X)

2.3 Spiral Computed Tomography of the spine

2.3.1 When is it used?

1. Trauma

a) ***Neck-**

Plain radiography is the most readily available and cost effective modality in the initial evaluation of the cervical spine. All 7 cervical vertebrae must be visualized on the lateral cervical spine radiograph. If proper evaluation is not possible as some fractures are not detectable on a radiograph, cervical immobilization should be continued (Grade X

- Spiral CT scans with multi planar reformation is useful to demonstrate significant or unstable injuries requiring immediate treatment or precautionary measures. It is useful to visualize the C7/T1 and C1 /C2 regions.

If the plain radiographs and CT findings cannot explain the neurological deficits MRI scan is useful to evaluate the spinal cord injury. (Grade X)

b) *Thoracic and Lumbar spine

- Evaluation of trauma to the thoracic and lumbar spine is less complex than cervical spine injuries. In general same imaging principles apply.
- Plain radiograph is the initial imaging modality of choice for injuries to the spine. Movement of the whole spine can be avoided by the proper immobilization and if turning is needed the patient must be log rolled in a co-ordinated manner. (Grade X)

2. Neoplasms

- If the patient is suspected to have a neoplasm in the spine, MRI imaging is the modality of choice. (Grade Y) Where MRI scan is not available CT myelography is used to demonstrate mass lesions in the spinal canal. (Grade Y) The level of the lesion should be judged clinically and must be clearly mentioned on the request form. (Grade X)

3. Infections

- Infections of the spine can be demonstrated by CT examination(Grade Y) though MRI is the modality of choice (Grade Y)
- Para vertebral and psoas abscesses are well demonstrated and CT guided biopsy gives definite diagnosis.
- Bone erosions calcifications and foreign bodies specially metallic foreign bodies are demonstrated in the CT scans.

2.4 Spiral Computed Tomography of the Chest

2.4.1 When is it used?

CT of the chest is used to take a closer look at findings detected on conventional chest x-rays or may be used to investigate and try to explain clinical signs or symptoms of disease of the chest. The CT examination may provide more specific information regarding the nature and extent of the chest lesions. Negative CT scan when it is technically adequate excludes structural lesions in the chest.

1. Neoplasms :

CT is used to

- detect and evaluate the extent of tumors that arise in the lung, mediastinum, pleura, pericardium and thoracic cage.
- evaluate metastatic deposits in the chest.
- assess tumour response to treatment.
- screen for lung cancer in high risk individuals
- guide biopsies

CT is able to detect even very small abnormalities that could be early lung cancer, which would not be visible on a conventional chest x-ray. A special low-dose CT technique is used for lung cancer screening in some countries.

CT of the chest is not able to detect every cancer.

a) *Solitary pulmonary nodule

- A solitary pulmonary nodule (SPN) is an intraparenchymal lung lesion <3 cm in diameter
- Review all previous chest x-rays when a SPN is found (Grade X)
- Spiral CT is used to evaluate and characterize SPN.
- CT guided biopsy is used to arrive at a histological diagnosis
- A solitary pulmonary nodule (SPN) with benign central calcification does not require further diagnostic testing

- Magnetic resonance imaging (MRI) is not indicated (Grade X)
- Positron-emission tomography (PET) scan is not recommended for SPN <1 cm in size (Grade X)

b) Multiple pulmonary nodules

CT is used to consider the suitability for resection, to assess infiltration of the mediastinum and the thoracic cage.

2. Pulmonary embolism

a. Pulmonary angiography.

The gold standard for diagnosing pulmonary embolism (PE) is pulmonary angiography. Pulmonary angiography is used less often because of wider acceptance of CT scans, which are non-invasive. CT pulmonary angiography (CTPA), is increasingly used as the mainstay in diagnosis]. This procedure can be extended to image lower limb veins to detect DVT (Grade Z).

b. Doppler scan

Doppler scan is the imaging modality of choice.

c. CT

CT is best for proximal and main pulmonary artery clot but less accurate for segmental and subsegmental clots where it can be difficult to distinguish clot from lymph nodes, atelectasis, and mucus plugs

Advantages are:

1. clinical equivalence
2. non-invasive nature
3. greater availability to patients
4. A major advantage of helical CT over ventilation-perfusion scanning is the ability to diagnose other lung diseases, especially in patients with pre-existing cardiopulmonary disease (Grade X)

3. Lung disorders-:

- old or new pneumonias to look for the cause and complications,
- tuberculosis,
- emphysema,
- bronchiectasis
- diffuse interstitial lung disease.

When the clinical findings and regular chest x-ray are inconclusive, CT may clarify the situation.

4. Inflammation or other diseases of the pleura.

5. Diffuse lung disease

These can be acute or chronic
Spiral CT is useful to arrive at a diagnosis.

Acute causes include

- pulmonary edema,
- diffuse alveolar damage (adult respiratory distress syndrome),
- diffuse pulmonary hemorrhage
- hypersensitivity pneumonitis
- acute interstitial pneumonia
- acute infectious bronchiolitis.
- pulmonary disease,
- obliterative bronchiolitis etc

Chronic causes include

- chronic infiltrative lung disease
- emphysema
- chronic obstructive airway disease
- bronchiolitis obliterans etc.

2.4.2 Special Spiral Ct Examinations Of The Chest

- High-resolution CT (HRCT) is used to assess diffuse lung disease. This uses thinner slices with possible expiratory and prone views. (Grade X)
- Virtual bronchoscopy is used to image the tracheobronchial tree. .
- A CT angiogram **(CTA)**

This is performed to evaluate the blood vessels (arteries and veins) in the chest. This involves injecting the contrast medium into a vein and spiral CT is carried out during appropriate phases.

Uses of CTA are

- location of a pulmonary embolus
- detection of aneurysms in the aorta or in other major blood vessels and cardiac chambers
- to detect dissection of the Aorta or it's major branches
- to detect small aneurysms and arteriovenous malformations
- to assess atherosclerotic disease of arteries including the coronary arteries
- When a stent has been placed to restore blood flow in a diseased artery CTA will show whether it is serving the purpose
- In trauma to look for damage to vessels

- In tumours to find details of the arteries supplying it
- In congenital vascular anomalies – such as coarctation of the aorta suspected on echocardiography for assessment
- To detect vascular anomalies causing stridor and dysphagia
- In partial anomalous venous drainage
- In aortitis and Vasculitis
- To detect thrombi in the cardiac chambers
- To detect Intracardiac masses

- CAICIUM SCORING

Cardiac CT for calcium scoring is a non-invasive way of obtaining information about the location and extent of calcified plaque in the coronary arteries. Calcium is a marker of coronary artery disease. The findings on cardiac CT **are the extent of calcified plaque in the coronary** arteries. The findings on cardiac CT, expressed as a calcium score, may help to decide on further management. Another name for this test is coronary artery calcium scoring.

some common uses of the procedure

The goal of cardiac CT for calcium scoring is to detect coronary artery disease (CAD) at an early stage when there are no symptoms and to determine its severity. It is a screening study that may be recommended by a physician if you have risk factors for CAD but no clinical symptoms yet.

It is most often suggested for men aged 45 years or older and for women who are aged 55 and above or are postmenopausal. (Grade y)

The major risk factors for CAD, other than age, are:

- Abnormally high blood cholesterol levels
- A family history of heart disease
- Diabetes
- High blood pressure
- Cigarette smoking
- Being overweight or obese
- Being physically inactive

Negative cardiac CT scan that shows no calcification within the coronary arteries suggests that atherosclerotic plaque is minimal at most, and that the chance of coronary artery disease developing over the next two to five years is very low. A positive test means that coronary artery disease is present even if you have no symptoms. The amount of calcification expressed as a score may help to predict the likelihood of a myocardial infarction in the coming years.

Diasadvantage

Soft plaques cannot be detected.

Risks

Radiation. The dose is 10% to 20% of that received by diagnostic cardiac catheterization.

2.4.3 Spiral computed tomography in abdominal pathology

Spiral CT is a very useful modality to assess abdominal pathology

When is it done?

1. **Acute Abdomen**

The differential diagnosis includes an enormous spectrum of disorders ranging from benign self-limiting diseases to conditions that require emergency surgery

Sonography generally detects pathology of the gallbladder in all patients, the appendix in children and acute abdominal conditions in pregnancy (ectopic pregnancy, placental abruption, appendicitis etc). (Grade X)

CT scan makes the accurate diagnosis in most patients with acute abdomen. It has to be requested when ultrasonography is inconclusive. (Grade X)

CT has earned this role because it can provide a global perspective of the:

- GUT
- mesenteries
- omenta
- peritoneum,
- retro peritoneum,
- extra peritoneum uninhibited by the presence of bowel gas and fat.

Contrast enhanced spiral CT is helpful in the diagnosis and assessment of

- splanchnic venous thrombosis
- bowel ischemia,
- aneurysms
- active arterial extravasations.
- Inflammatory mural changes in appendicitis,
- cholecystitis,
- diverticulitis,
- Crohn's disease
- infectious enterocolitis
- neoplasms, abscesses, and infarcts in the liver, spleen, and kidneys

2. Acute appendicitis

Although the correct diagnosis can be made in most patients on the basis of history, physical examination, and laboratory tests, and sonography, diagnosis is uncertain in 20-33% of patients who present with atypical symptoms (Grade X)

Spiral CT is useful in the diagnosis of acute appendicitis in these patients and in complicated appendicitis.

The location of the appendix has wide individual variability, and the limitations of McBurney's point as an anatomic landmark should be recognized. Three-dimensional multi detector computed tomography (MDCT) can provide useful information to help surgeons customize appendectomy incisions.

3. Bowel Obstruction

Helical CT is used to assess intestinal obstruction when contrast studies are inconclusive. (Grade X)

Spiral CT confirms presence of obstruction, the level of obstruction, the cause of obstruction, the severity of obstruction, presence of simple or closed loop obstruction and presence of strangulation or ischemia present. It is important to differentiate between simple- and closed-loop obstructions because the former can be treated conservatively, whereas the latter requires prompt surgical intervention.

. CT is most helpful in patients with internal and external hernias, neoplasms, gallstone ileus, various forms of enteroenteric intussusception, and afferent-loop

obstruction after a Billroth II operation. If no mass, hernia, intussusception, abscess, or inflammatory thickening is present, adhesion is the most likely diagnosis.

In patients with high-grade small-bowel obstruction, CT has a reported sensitivity of 90-96%, a specificity of 91-96%, and an accuracy of 90-95% CT is less accurate in patients with low-grade obstruction.

4. Intestinal Ischemia

Cross-sectional imaging techniques are becoming a preferred noninvasive alternative to conventional selective mesenteric angiography with arterial and venous phase imaging.

(Grade X)

The presence of focal pneumatosis or thrombus in the superior mesenteric artery or vein permits a specific diagnosis to be made.

Air in the bowel wall mesentery and portal venous system has grave prognostic implications for patients with ischemic bowel.

CT is far more sensitive than radiography in detecting pneumatosis and portal venous gas

5. Peptic Ulcer Disease

Spiral CT is not very useful unless perforation has occurred.

(Grade X)

Miscellaneous Gastrointestinal Disorders

6. Epiploic Appendagitis

This unusual condition occurs when an epiploic appendage of the colon develops inflammation, torsion, or ischemia. Epiploic appendagitis can simulate appendicitis and right- and left-sided diverticulitis clinically and on CT scans.

7. Mesenteric Adenitis

Benign inflammation of the ileocolic lymph nodes can cause mesenteric adenitis, which often simulates clinical appendicitis. . On CT, the mesenteric lymph nodes are enlarged (>5 mm) and there may be inflammatory change in the surrounding mesentery and a specific diagnosis can be made.

8. Small-Bowel Diverticulitis

This rare condition is caused by the inflammation of a jejunal or ileal pseudodiverticulum or Meckel's diverticulum. CT findings are nonspecific

9. Typhlitis

Neutropenic enterocolitis is an acute inflammatory and necrotizing process that affects the cecum or terminal ileum and appendix of immunocompromised patients with profound neutropenia. In this disorder, ulceration of the mucosa is followed by bacterial and fungal invasion.

10. Inflammatory Bowel Disease

True emergencies are uncommon; however, emergencies are associated with high rates of morbidity and mortality. Bowel obstruction and abscess formation are the most common emergencies in Crohn's disease, whereas fulminant colitis, toxic megacolon, and perforation develop in patients with ulcerative colitis.

In patients with fulminant ulcerative colitis, CT is the preferred noninvasive means of assessing the status of the bowel wall and detecting early perforation in toxic megacolon. (Grade X)

11. Perforation

Plain radiography remains the first imaging study and may be followed by intraluminal contrast examination. (Grade X)

Helical CT can detect pneumoperitoneum that may be overlooked on chest or abdominal radiography. (Grade Y) Also help with the correct diagnosis of the presence, level, and cause of perforation by helical CT.

Detection of the site of perforation is often difficult

12. Intra abdominal Sepsis

Helical CT is an accurate imaging examination for the diagnosis of intra abdominal abscesses. This has to be requested only when ultrasound scan is inconclusive. (Grade X)

13. Acute Cholecystitis

Sonography is the preferred method for diagnosing acute cholecystitis. (Grade X) CT is not indicated as 1st line investigation (Grade X) Helical CT can also depict complications of acute cholecystitis including perforation and gangrene. Intramural or intraluminal gas is present in emphysematous cholecystitis.

14. Pancreatitis

Helical CT plays a vital role in the assessment and staging of patients with acute pancreatitis. (Grade X)

15. Aortic Aneurysm Rupture (Dissection)

Helical CT is the imaging procedure of choice in patients with suspected aneurysm dissection and rupture. Un enhanced images are initially obtained to search for signs of impending rupture (Grade X)

On CT, direct signs of rupture include a retroperitoneal hematoma or frank extravasations of IV contrast material

16. Abdominal Hemorrhage

Spiral CT with angiography may identify an active site of hemorrhage and provide a useful guide for subsequent angiographic embolization (Grade X) Bleeding may occur into the rectus sheath or the psoas muscle.

17. Hepatosplenic Vascular Disease

Patients with hepatic venous (Budd-Chiari syndrome), portal venous and hepatic arterial thrombosis and areas of infarction are demonstrated.

Helical CT has become an important noninvasive imaging tool to diagnose acute abdomen and answer the questions posed above.

2.4.4 Spiral Computed tomography in the Evaluation of the Liver

Spiral CT is a very useful modality for evaluating suspected liver disease.

Unenhanced CT is useful in a few cases, especially for detecting lesions with

- Calcification and Hemorrhage
- Melanoma
- Steatosis
- Metastases from neuroendocrine tumors.

Contrast enhanced CT of the abdomen detects

- primary and secondary focal lesions
- presence of diffuse liver disease and biliary duct abnormalities

Spiral CT surveys the entire abdomen for potential lymph nodal and peritoneal lesions.

It is also used in mapping the vessels for surgery or chemotherapy pump placement.

Indeterminate lesions on CT can be evaluated with MRI. Diffuse liver disease and fatty infiltration limit the sensitivity of CT in lesion detection.

2.4.5 Imaging Of Focal Liver Disease With Spiral CT

Aim of imaging is to confirm the presence of a focal liver disease and to try and get the definite diagnosis. (Grade X)

1. Hepatic Cysts

Are accurately diagnosed by spiral CT. Any enhancement on CT or MRI indicates infection, inflammation, or neoplasm. In complex cysts further investigation depends of CT classification.

2. Hemangiomas

Demonstrates classical filling in sign on dynamic CT study. Spiral CT characteristics can overlap with some neoplasm. Large hemangiomas show varied imaging features due to internal hemorrhage and fibrosis.

3. Focal Nodular Hyperplasia

Even relatively large lesions may be missed if an arterial phase study is not obtained. . Small lesions may be difficult to differentiate from other malignant lesions.

4. Hepatic Adenomas

The imaging characteristics of hepatic adenoma overlap with those of hepatomas, including the presence of intracellular fat, and sometimes it may be difficult to differentiate these two entities on imaging.

5. Hepatic Adenomatosis

The number of adenomas varies between 10 and 50, and these tumors demonstrate similar imaging features to hepatic adenomas.

6. Benign Lipomatous Tumors

Benign lipomatous tumors include

- lipoma,
- myelolipoma,
- angiomyelolipoma.

Their imaging features depend on the amount of fat in the lesion. Angiomyelolipoma shows enhancing soft tissue in addition to fat. CT features can overlap with those of HCC.

7. Other Benign Tumors

Mesenchymal hamartoma is a rare benign lesion that occurs in children less than 2 years of age.

Hemangioendotheliomas occur in infants less than 6 months of age. These lesions are large and well defined and show an enhancement pattern similar to that of hemangioma.

Bile duct hamartomas are incidental lesions and may be confused with metastases on CT. They measure <1.5 cm and are irregular and hypodense on unenhanced CT, with no enhancement on contrast study. .

Biliary cystadenoma and cystadenocarcinoma are rare and consist of a large solitary cystic mass with a well-defined thick fibrous capsule, mural nodules, and internal septae

8. Malignant Hepatic Lesions

- Hepatocellular Carcinoma

CT helps detect tumor extension into the portal vein or hepatic veins and the presence of biliary obstruction, regional nodes, and peritoneal implants. It is difficult to differentiate tumor thrombi from bland thrombi; however, enhancing thrombi favor tumor thrombi.

CT is also useful in guiding percutaneous biopsy and follow-up after surgery or radiofrequency ablation for detecting recurrence.

Fibrolamellar HCC is distinct from other forms of HCC and is more common in patients with no existing diffuse liver disease, and in women. The tumor is usually large at presentation.

- * Cholangiocarcinomas

The associated biliary ductal dilatation is well demonstrated on CT. The tumor itself may not be visible on CT.

- * Metastases

Metastases comprise the most common malignant liver neoplasms Multidetector CT is superior to conventional CT, and its sensitivity reaches that of CT arterioportography in evaluating liver metastases.

2.4.6 Imaging Of Diffuse Liver Disease

The aim of imaging in diffuse liver disease is to characterize some of these conditions, detect early hepatic neoplasms, and to differentiate benign lesions from their malignant counterparts in the presence of diffuse liver disease.

1. **Hemochromatosis**

The sensitivity of CT at diagnosing hemochromatosis is high if iron overload exceeds five times the normal value, and the sensitivity falls dramatically if the overload is less than 2.5 times normal

2. **Steatohepatitis and Fatty Liver**

Radiologically, steatohepatitis cannot be reliably distinguished from other causes of fatty liver. The presence of >33% fat on liver biopsy was shown to be optimal for detecting steatosis on radiological imaging

3. **Cirrhosis**

Imaging is not reliable in the diagnosis of cirrhosis. The role of imaging in cirrhosis is the early detection of HCC and the differentiation of regenerative nodules from dysplastic nodules and HCC. It is not possible to differentiate dysplastic nodules from HCC Spiral CT also assesses the vascular bed in portal hypertension.

2.4.7 Screening for Liver Tumors in Diffuse Hepatic Disease

There is no formal recommendation of a single imaging test for the screening of liver tumors in patients with diffuse liver diseases such as cirrhosis, hemochromatosis, and hepatosteatosis. Screening for HCC with CT is a cost-effective strategy in transplant-eligible patients with cirrhosis secondary to chronic hepatitis C viral infection. Screening with alpha-fetoprotein (AFP) for HCC was found to be more useful in patients with cirrhosis with nonviral etiologies Though US can be used for initial screening, CT or MRI should be used once cirrhosis sets in(Grade X). In patients with equivocal findings on CT, MRI with liver specific contrast agents is useful for its ability to accurately identify fatty infiltration and small HCCs

Recurrent neoplasm in the liver

CT is the imaging modality of choice to assess tumour recurrence following resection and tumour response to intravenous chemotherapy, intra-arterial chemoembolization, ethanol ablation, or radiofrequency ablation. The presence of enhancement along surgical margins usually represents postoperative changes, but nodular enhancement or a discrete soft-tissue mass at the surgical margins indicates recurrence. (Grade X)

Conclusion

Hepatic imaging is usually undertaken to search for primary or metastatic liver disease and to assess diffuse abnormalities. it surveys the entire abdomen for potential primary disease, metastatic disease in the lymph nodes and peritoneum.

2.4.8 Spiral CT in the Evaluation of the Pancreas

1. NEOPLASM

The spiral CT scan is considered to be state-of-the-art in this regard, as it provides information about the nature and location of tumors, as well as their resectability (Grade X)

The helical ("spiral") CT scan provides information about the nature and site of the lesion (e.g., pancreatic vs. other periampullary tumors, bile duct tumors), its resectability (e.g., liver metastases, vascular invasion), and vascular anatomy.

CT scanning can be used to direct fine-needle aspiration of pancreatic masses(Grade X)

2. Pancreatitis

This is generally not indicated for patients with mild pancreatitis unless a pancreatic tumor is suspected (usually in elderly patients).

CT scanning is always indicated in patients with severe acute pancreatitis and is the imaging study of choice for assessing complications. (Grade X) Scans are seldom needed within the first 72 hours after the onset of symptoms unless the diagnosis is uncertain, because inflammatory changes are often not radiographically present until this time

Dynamic spiral CT scanning is used to determine the presence and extent of pancreatic necrosis and useful in predicting the outcome of acute pancreatitis.

CT scan is useful to confirm the diagnosis of chronic pancreatitis when ultrasonography is equivocal specially in obese patients.

3. CT-guided needle aspiration

This procedure is used to differentiate infected necrosis and sterile necrosis in patients with severe necrotizing pancreatitis. (Grade X)

2.4.9 Spiral CT in the Evaluation of the Kidney

1. Renal cell carcinoma

Tumor size is accurately determined by CT, Perinephric tumor extension (T3a) is often more difficult due to nonspecific perinephric stranding.

Dynamic enhanced Computed tomography is 50-100% sensitive for detecting caval thrombus according to the literature.

For larger primary tumors (>3 cm), multidetector, multiphasic CT of the abdomen with chest CT is the diagnostic modality of choice. (Grade X)

2. Renal stones

Overall sensitivity is reported at 94-100%, with accuracy rated at 93-98%.

The only exception is stones made of various metabolites of medications. These stones are not visible on CT scans.

- ***Advantages***

  i. Spiral CT scans allow for anatomical 3-dimensional image reconstruction, which may be useful in the evaluation and pre treatment planning of large staghorn stones prior to percutaneous nephrostolithotomy. CT estimates the overall size, width, and location of a stone in anatomical terms.

- ***Disadvantages***

  i. High cost and radiation
  ii. Difficulty in identifying a stone if the patient exhibits limited hydronephrosis
  iii. Difficulty to differentiate multiple calcifications in the pelvic cavity from lower ureteric calculi.
  iv. CT scan measurements of stone widths have an error rate as high as 12%.

It is less accurate and reliable in measuring ureteral stone length compared with a simple KUB radiograph. (Grade X)

3. CT Angiography for Renal and Renovascular Imaging

- ***Indications***

  i. In renal transplant donor evaluation
  ii. Staging of renal carcinoma
  iii. Selection of candidates for partial nephrectomy
  iv. Evaluation of suspected renal artery stenosis.

- ***CT Angiography would demonstrate***

  i. The arterial map of the renal arteries.
  ii. Number of arteries,
  iii. Location of arteries and branching pattern
  iv. The renal venous system (number of veins, branching pattern, and location).
  v. The appearance of the ureters.
  vi. Any occult renal pathology

CT Angiography can accomplish all of these demands in a single study instead of the classical multi exam sequence (IVP, catheter angiogram and either CT or ultrasound). (Grade X)

- ***Accuracy and advantages***

  i. CT arteriography is as accurate as conventional arteriography at revealing the number of vessels.
  ii. Use of CT angiography, plus conventional radiography instead of excretory urography and conventional arteriography can result in a 35-50% reduction in cost of imaging studies in potential renal donors
  iii. Spiral CT angiography enables accurate assessment of renal artery stenosis in patients with possible renovascular hypertension and assist in selecting patients for interventional treatment

2.4.10 Spiral CT in the Evaluation of the bowel

1. Bowel neoplasm

Spiral CT is useful in assessing extra luminal spread, nodal and other abdominal metastases (Staging)

2. Spiral CT colonography

Detects colorectal polyps

The sensitivities for polyp detection is 50%–91% for polyps of 10 mm or greater and 33%–82% for polyps of 5–9 mm size. Morphologies of the pedunculated and larger sessile lesions are well depicted. The smallest 3 x 1-mm sessile polyp is not depicted. Intermediate-sized polyps are well depicted when the rippling artifacts are not present The introduction of multiple–detector row CT could fundamentally advance CT colonography with improved depiction of smaller or sessile lesions There is poor sensitivity for the detection of flat adenomas with spiral CT colonography.

3. CT enteroclysis,

The proximal and distal jejunum, ileum, and proximal and terminal ileum are evaluated separately.

The lumen, contrast enhancement of the mucosa and the other bowel wall layers, inflammatory changes and increased vascularity, separation of bowel loops, and possible lymphadenopathy are demonstrated. The length and location of stenotic areas, the presence of fistulae, ulcerations, pseudo-diverticulae, and polypous changes of the mucosa can be demonstrated.

4. Chrons disease

Intestinal imaging with helical CT-enteroclysis or CT-enterography has improved appreciably, leading to reports that it is complementary or even superior to barium studies for the detection of involved segments. Its ability to detect extramural complications (abscess, fistula, sacroiliitis, gall stones, renal calculi) is an added advantage.

CT is accurate in complicated Chrons disease especially for the detection of fistulas, abscesses, and phlegmons.

Laparoscopy may be necessary in selected patients, especially when the differential diagnosis of intestinal tuberculosis is being considered.

2.4.11 Spiral CT in the Evaluation of the Female pelvis

1. Carcinoma cervix

- The most important issue in staging cervical cancer is to distinguish early disease (stages IA and IB) that can be treated with surgery from advanced disease that must be treated with radiation alone or combined with chemotherapy.
- Imaging modalities are directed to solve this clinically important question
- Chest CT is superior to plain chest radiographs in identifying pleural effusion or pulmonary metastases.

The value of CT increases with higher stages of disease. Spiral CT has limited value (a positive predictive value of 58%) in evaluating early parametrial invasion. However, it has an accuracy of 92% in depicting advanced disease. The major limitation of CT in local staging is its inadequate differentiation between tumor and normal cervical stroma or parametrial structures. Therefore, CT is mainly used in advanced disease and in the assessment of lymph nodes. CT is also performed to detect distant metastases, for radiotherapy planning, and for guiding interventional procedures.

2. Ovarian cancer

Spiral CT is increasingly being employed in the overall assessment and in the management of patients with ovarian cancers; CT scan is now more frequently used for the staging and follow-up of such masses. (Grade X)

CT can detect

- lymph node metastases,
- involvement of the omentum,
- presence or absence of ascites,
- metastases in the liver.

Thus, it can be used for both diagnosis and staging of the disease.

Exploratory laparotomy is the mainstay for the staging of ovarian malignancy. (Grade X) Laparotomy has the advantage that it also provides the specimen for histologic diagnosis and allows for maximum cytoreduction (debulking), which is a prognostic indicator.

Preoperative CT scans can help to determine the amount and extent of cytoreduction that will be required to optimize chemotherapeutic response. In advanced cases of ovarian cancer, it may be necessary to treat first with chemotherapy and perform debulking surgery at a later stage (say, after 3 cycles of chemotherapy). In such cases, CT is usually helpful in monitoring tumor response and determining the timing of surgery. In addition, CT scanning is used to monitor tumor response to chemotherapy after debulking surgery and to determine the timing of further surgery if indicated.

CT is frequently used to detect persistent or recurrent ovarian cancer.

Tuberculous peritonitis, primary mesothelioma of the peritoneum, and metastatic uterine carcinoma can mimic metastatic ovarian cancer on CT scan.. Many times, the clinical presentation and CT findings are identical to those of metastatic ovarian cancer, and the diagnosis is made only at laparotomy.

In summary, CT has a major role in ovarian cancer imaging. It is cost-effective, has high spatial resolution, the examination time is fast. It can be used for both staging of the primary disease and subsequent follow-up for the detection of either persistent or recurrent disease. The only potential setback is the amount of radiation exposure. However, on the basis of a risk-benefit analysis, this amount of radiation exposure may be considered irrelevant in patients with ovarian cancer or any other malignancy.

2.5 References

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