Computed Tomography (CT-Scan)

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Computed tomography scans deploy x-rays to obtain a cross-sectional image of the body. Current CT scanners have very advanced imaging capabilities such as the introduction of multidetector CT, which provides excellent heart images compared to conventional CT scanners. A 16-cm-wide 320-row multidetector CT scanner makes it possible for physicians to take a full image of the heart every single beat! The clinical usability of such a temporal resolution is questionable, but we believe it can make whole body CT scans very convenient in the primary survey of trauma patients.

Brain Imaging and Computed Tomography Scanning in Stroke Patients

Brain imaging studies in stroke patients have two important goals. To exclude hemorrhage and to confirm the diagnosis of stroke. Computed tomography scans in the acute setting are very helpful in excluding:

- Hemorrhagic stroke
- Intraparenchymal hemorrhage
- Epidural hematomas
- Subdural hematoma
- Brain contusions
Unfortunately, computed tomography scans rarely show any specific signs of ischemic stroke in the acute stage. Computed tomography scans in the subacute and chronic stage of stroke are very helpful. They can show the infarcted part easily, which is appears as a hypodense lesion on the CT scan images. They can show the infarcted part easily, which is hypodense.

Perhaps the main goal of computed tomography in a stroke patient is to show hemorrhage as it might be a contraindication for thrombolysis and antiplatelet drugs. Regardless, all patients suspected to have a stroke should chew an aspirin before any further imaging is done as the risks associated with a worsening hemorrhage are way below the risks of not having the aspirin.

Contrast-enhanced CT

Contrast-enhanced CT has made it more possible for physicians to visualize the stroke in the acute stage. Contrast-enhanced techniques can be used to visualize and study the cerebral arteries in what is known as CT angiography.

Statistical perfusion maps obtained from contrast-enhanced computed tomography scans are very useful in the delineation of the stroke area and the obstructed or ruptured blood vessels.

CT or MRI

MRI imaging is superior in the study of soft tissues more so the brain. Thus, the use of diffusion-weighted magnetic resonance imaging in the acute setting of an ischemic stroke patient usually provides better results in the identification of the stroke region compared to computed tomography.

However, the MRI takes more time to perform and it is inferior to the CT scan in the study of fractures and hemorrhages. Therefore, the current recommendation is to perform a computed tomography scan first, to decide on thrombolysis, followed by a diffusion-weighted magnetic resonance imaging, to define the area affected by the stroke.

Computed Tomography Scanning in Lung Disease

Computed tomography scans of the lung are very helpful in studying certain lung diseases, such as bronchiectasis and emphysema. Additionally, a CT-scan of the lungs in sarcoidosis or lung cancer always makes the visualization of the affected lobules much easier.

Computed tomography scans of the lungs are also helpful in trauma patients. Small lung contusions and small hemothoraces can be easily identified on the scan.

CT for patients with interstitial lung diseases

The main benefit of computed tomography scans, however, is best observed in patients with interstitial lung diseases. After the introduction of high-resolution thin-section CT, it became possible to visualize the changes and patterns commonly seen in interstitial lung diseases, such as idiopathic lung fibrosis. In such patients, computed tomography scans of the lungs are helpful in identifying which parts of the lung are affected, the severity of the condition and in predicting the prognosis of the patient.
Helical CT resulted in very high-resolution, volumetric scans of the lung. The visualization of the abnormal changes in interstitial lung diseases is better appreciated with helical CT. More recently, quantitative CT emerged. The principle behind quantitative CT is that very high-resolution images can be obtained for the lungs.

Afterward, these images can be statistically compared to a population-based control to get quantitative information about the degree of abnormality in the different lung fields.

Computed Tomography Scanning and Liver Disease

Contrast-enhanced CT

The visualization of the liver by ultrasonography is excellent, but ultrasonography cannot differentiate between the different types of liver nodules with certainty. The malignant potential of liver nodules is dependent on the contrast-enhancement dynamics of the nodule, as based on the pathophysiology of the nodule.

Very few tumors can be visualized on a non-enhanced CT scan (NECT) because of the lack of differentiation between liver tissue and the tumor. The detected lesions contain calcifications, cystic components, fat, or hemorrhage. Thus, the need for IV contrast. It is important to understand that the liver derives its blood supply from the portal vein (80%) and hepatic artery (20%) and therefore, contrast enhancement is seen in phases i.e. arterial, equilibrium and venous phase.

Thus, hyper vascular tumors such as primary liver tumors will enhance on the arterial phase and become obscured on the venous phase standing out above the liver parenchyma that is hypodense on the arterial phase and hyper dense on the venous phase.

Inflammatory and cancer nodules are more likely to have hyper perfusion, compared to sclerotic or other lesions.

Cystic lesions have a density near that of water, sharp margins and do not enhance on contrast. If it takes up a contrast, then its most likely a hemangioma. Therefore, contrast enhancement patterns on computed tomography scans of the liver are very beneficial in the differentiation between the different types of liver lesions.

Nowadays, CT scans of focal liver lesions are standard procedure. CT scans can identify the nature of the lesion, can show the extent and size of the lesion, and can visualize the relationship of the lesion of the circulatory phase. Additionally, CT scans of the abdomen are very helpful in tumor staging.

Computed Tomography Scanning and the Traumatic Patient

Computed tomography is helpful in excluding lung contusions, bowel, viscus, liver, pancreatic or another abdominal organ injury, intracranial bleeding and other forms of injuries in patients who sustain polytrauma.
Additionally, computed tomography scans are very sensitive and specific for spinal column injuries, cervical injuries, pelvic injuries and other skeletal fractures and injuries. The visualization of the spinal cord in the acute stage of spinal cord injury is better with a magnetic resonance imaging; however, a computed tomography scan can be helpful in excluding a spinal cord contusion or epidural hematoma.

**Computed Tomography and the Acute Abdomen**

CT scans of a patient with acute abdominal pain can help in the evaluation of kidney stone disease, acute small bowel or large bowel obstruction, acute pancreatitis and acute appendicitis.

In fact, the value of CT scans in the evaluation of acute pancreatitis is tremendous. The patient’s prognosis, mortality, and severity scores are largely dependent on findings obtained from the CT scan.

**Computed Tomography and Cancer**

Computed tomography scans are virtually indicated in all cancer patients to identify lymph node status and direct extension of the tumor into adjacent structures. In fact, many tumors are better visualized and staged with a computed tomography scan compared to a magnetic resonance imaging study. For instance, suprarenal gland tumors have been previously debated to be better visualized with a computed tomography scan.

Early breast cancer lesions that have microcalcifications are better visualized with a computed tomography scan compared to a magnetic resonance imaging study – especially if the patient is a young woman.

Most nuclear studies, such as positron emission tomography (PET) and single-photon emission computerized tomography, also acquire a CT scan for co-registration purposes. Implantation of brain electrodes, pacemakers or other devices can be checked and reviewed usually with a CT scan as many of the components can be MR incompatible.
In summary, CT scans are very helpful in the emergency and elective care of our patients and our diagnostic workup plans are largely dependent on them.

References


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