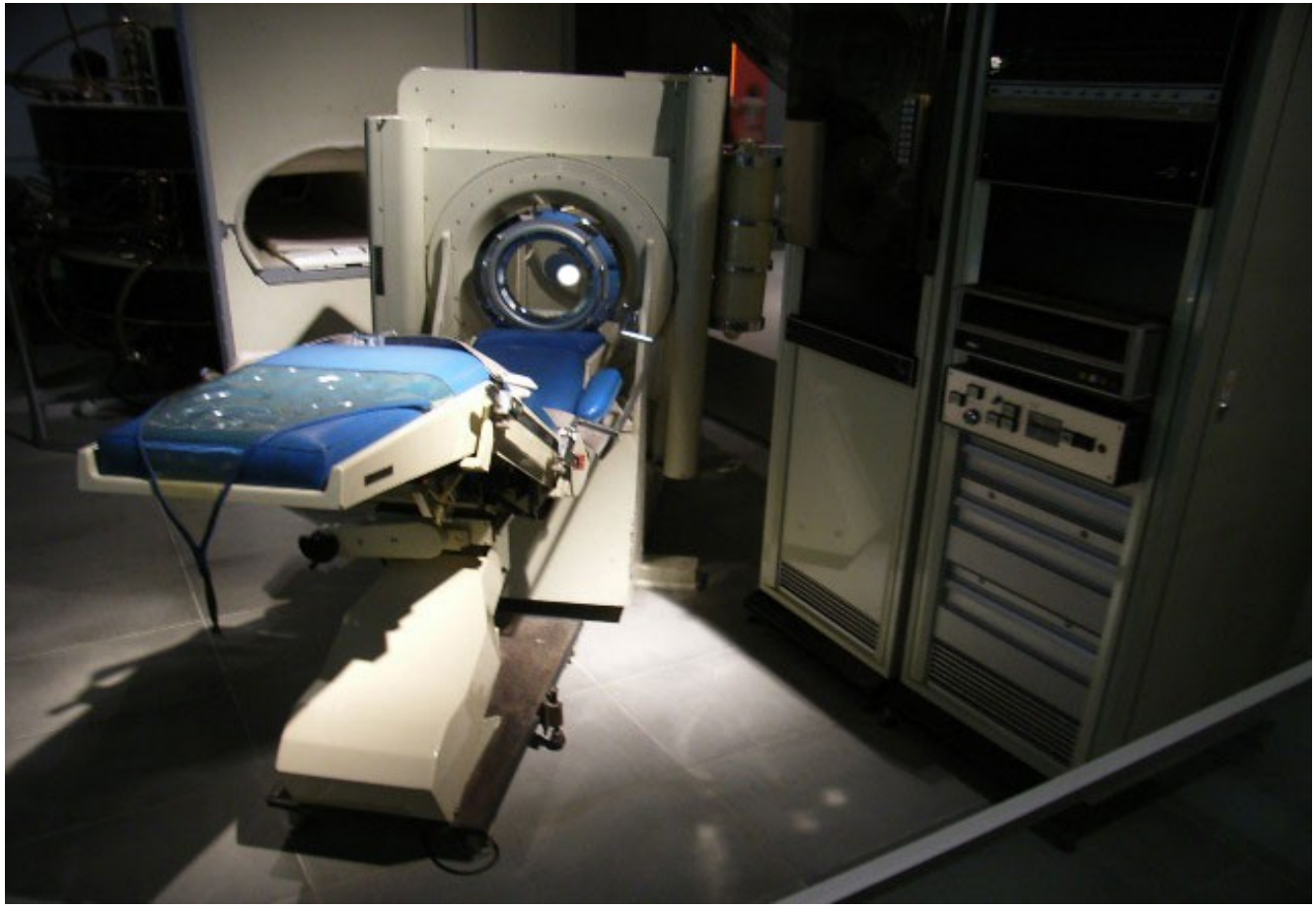
COMPUTED TOMOGRAPHY (CT) AND VISUALIZATION OF HUMAN ORGANS

- Introduction
- CT scanner
- CT image
- Diagnostic use
- Three-dimensional reconstruction

Introduction

- The word *tomography* is derived from the Greek *tomos* (“part”) and *graphein* (“to write”)
- Computed tomography (CT) produces a 2D images of the structures in a thin section of the body

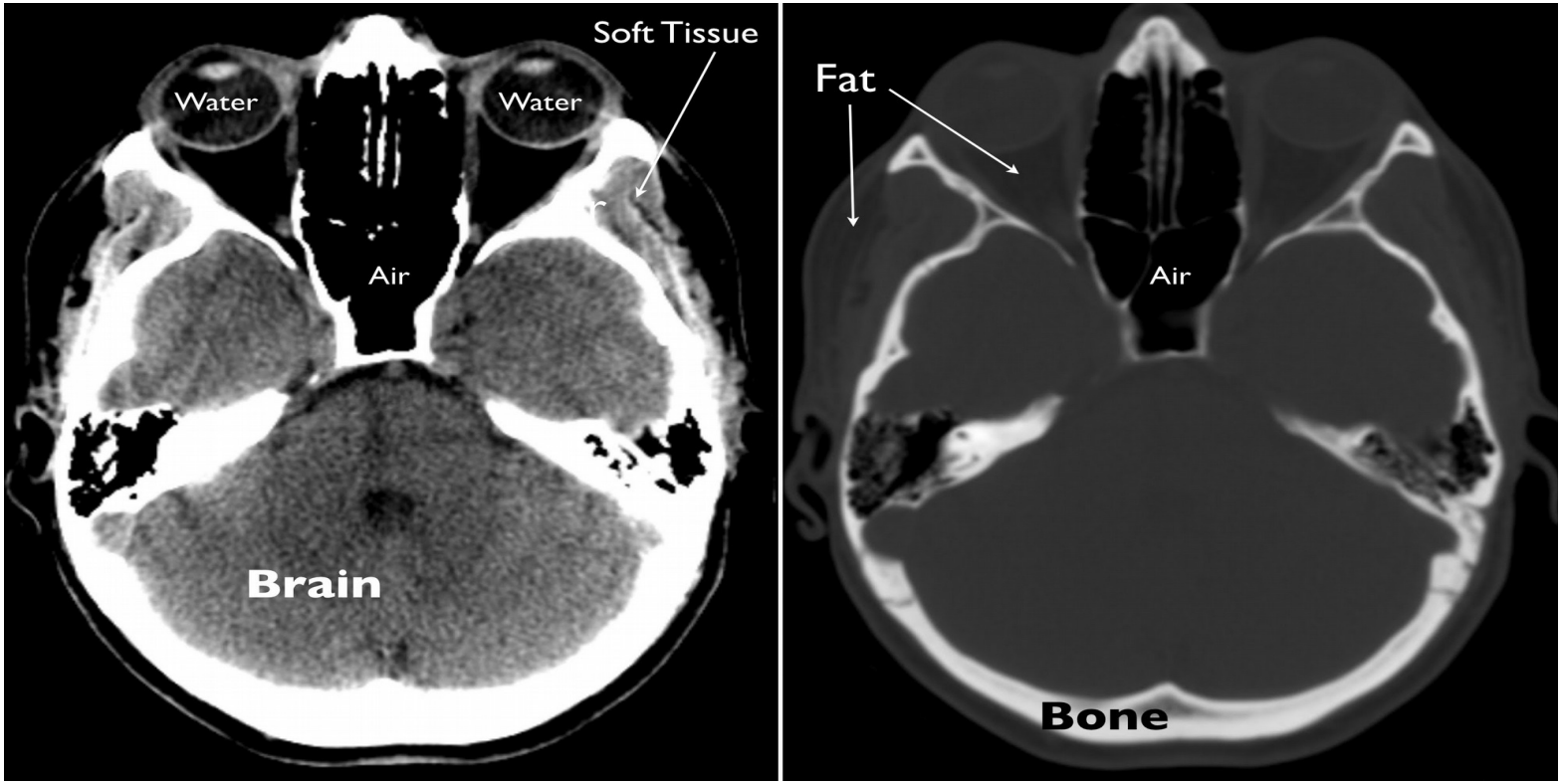
CT scanner



CT scanner

CT image

- The primary physical quantity that is captured with CT is density, or mass per unit volume. Prior to display and storage of CT images, pixel intensities are mapped to a standard numerical scale to allow reliable discrimination between different densities of tissue. Dense material, e.g., metal or bone, appears bright, less dense material, e.g., water, appears dark.

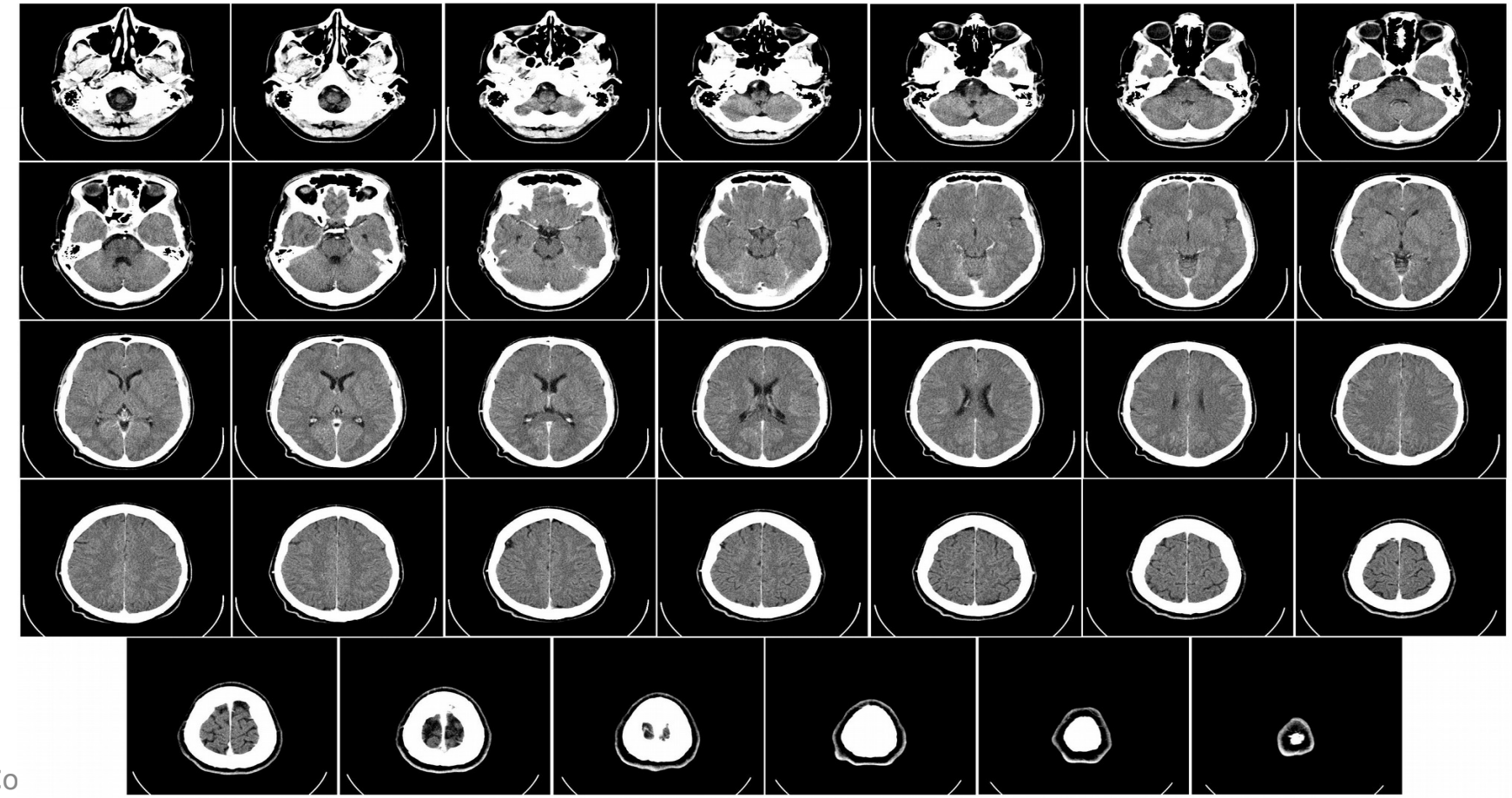


Diagnostic use

- CT has become an important tool in medical imaging to supplement X-rays and medical ultrasonography. It has been used for preventive medicine or screening for disease for patients with, e.g., high risk of cancer, or full-motion heart scans for patients with high risk of heart disease.
  - Head
  - Cardiac CT
  - CT cardiac angiography
  - CT lung screening
  - Abdomen and pelvis

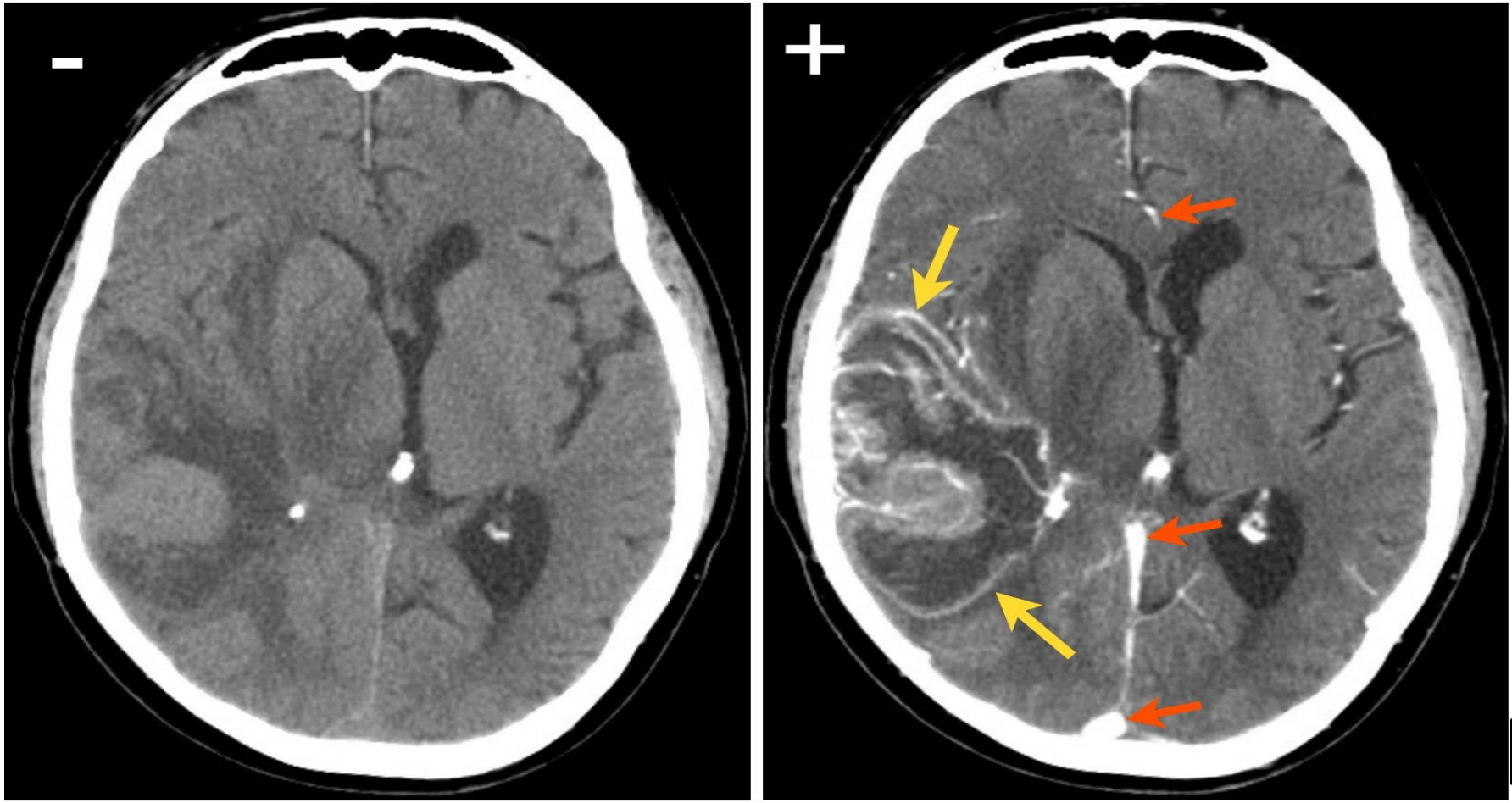
Diagnostic use

- Head, CT scanning is typically used to detect infarction, tumors, (dark, calcifications, hemorrhage and bone trauma, (bright)



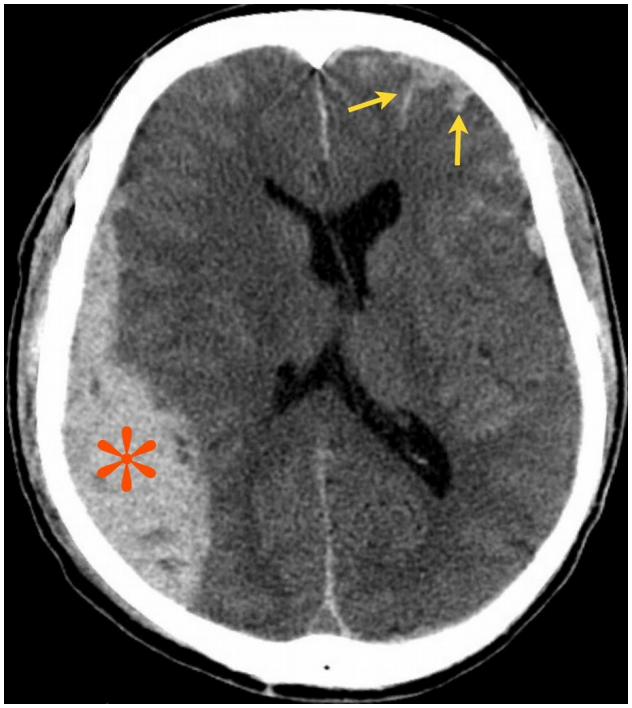
Diagnostic use

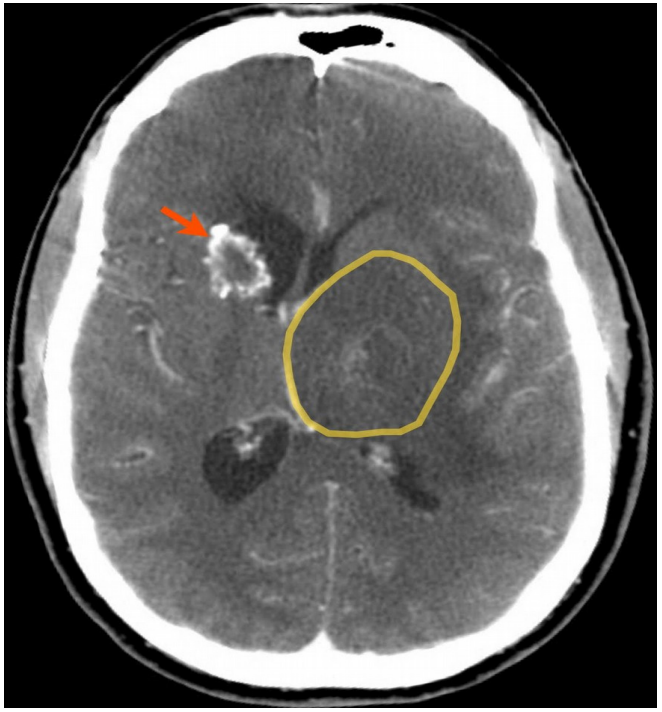
- Head, unenhanced (-) and contrast-enhanced (+) images from CT. Normal blood vessels (red), tumor (yellow)



Diagnostic use

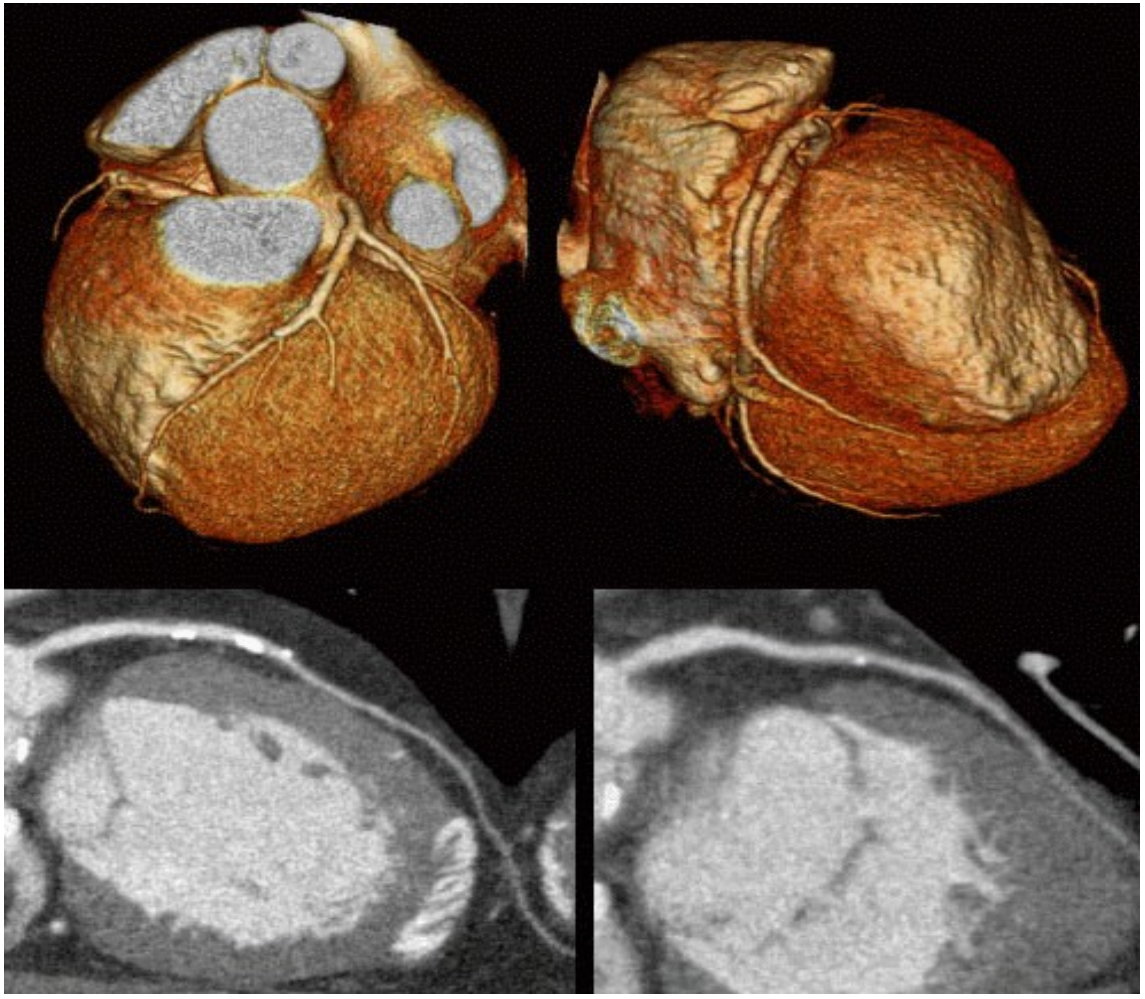
- Head, (a) Traumatic brain injury (a large subdural hematoma (*), a collection of blood between the brain and skull, subarachnoid blood (arrows) in the patient who fell from a second flor); (b) Immunocompromised patient (HIV+ patient – calcification (arrow) and more subtle enhancement (circle) are due to recurrent infection (toxoplasmosis))





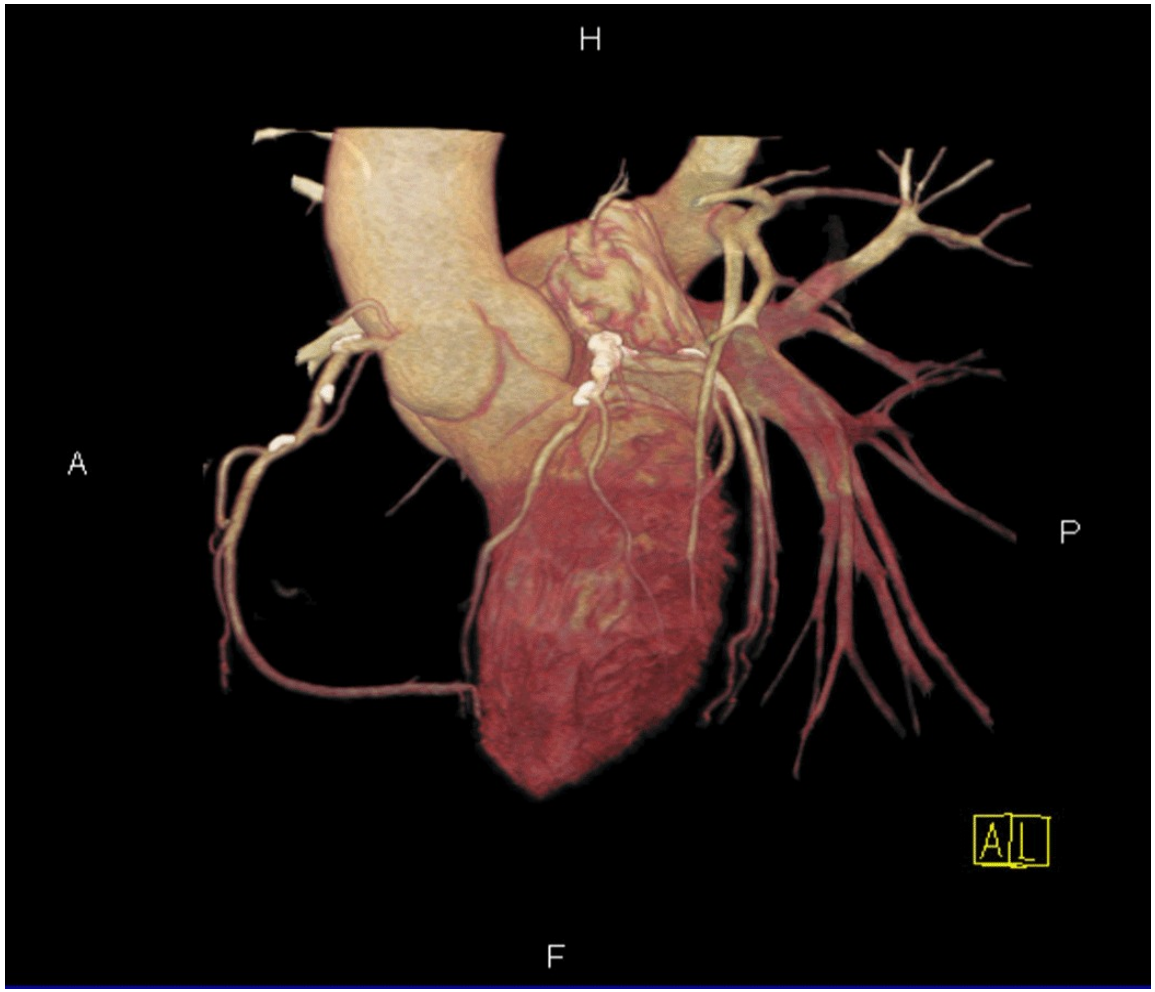
Diagnostic use

- Cardiac CT,
  cardiac CT showing calcified plaques



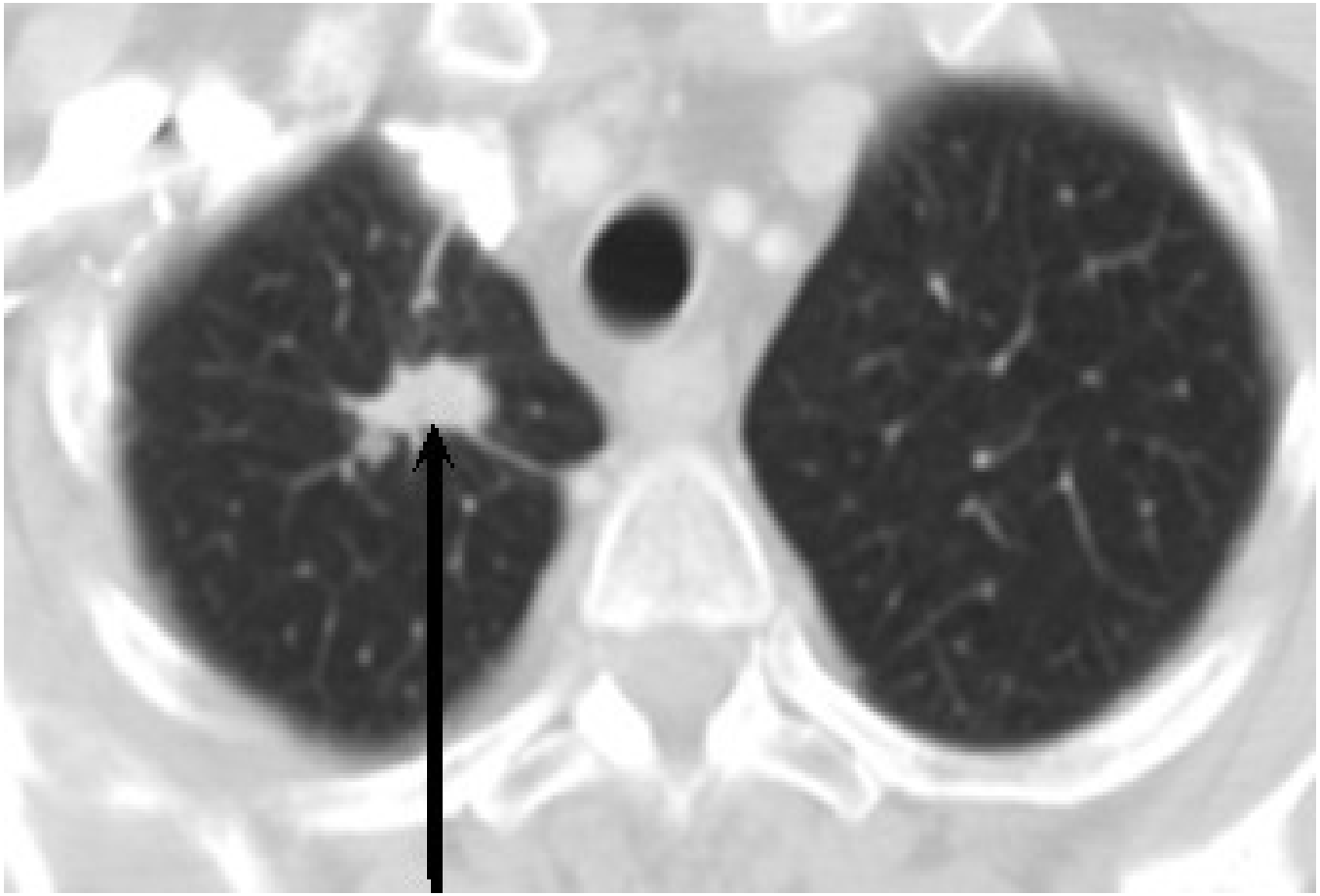
Diagnostic use

- CT cardiac angiography, CT coronary angiography showing plaque as white in the center of the image of the heart



Diagnostic use

- CT lung screening, Lung cancer



Diagnostic use

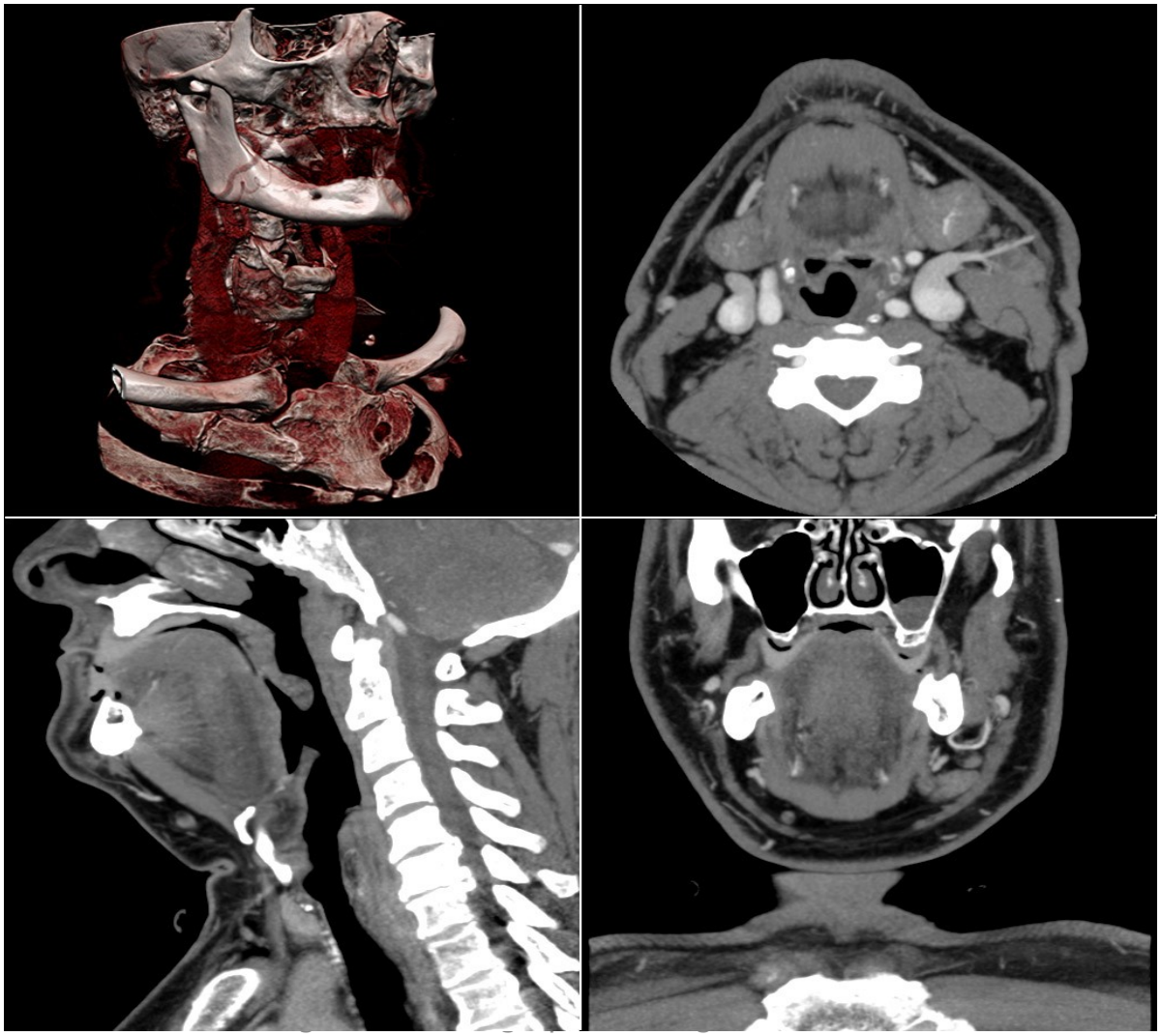
- Abdomen and pelvis

Three-dimensional reconstruction

- Multi-planar reconstruction
  - A volume is build by stacking the axial slices
- 3-D rendering technique
  - Surface rendering (A threshold value of radio-density is set by the operator, e.g., a level that corresponds to bone. A 3-D model can be constructed using edge detection image processing algorithms. Multiple models can be constructed from various thresholds, allowing different colors to represent each anatomical component)

Three-dimensional reconstruction

- Screen layout for diagnostic software, showing one 3-D and three multi-planar views



Three-dimensional reconstruction

- Volume rendering of a 3-D set of CT images shown as a 2-D projection. Extremely thin slices were created from the original scan and sent to a another computer which transformed them into these 3-D images.