# Computed Tomography: A Half-Century of Progress

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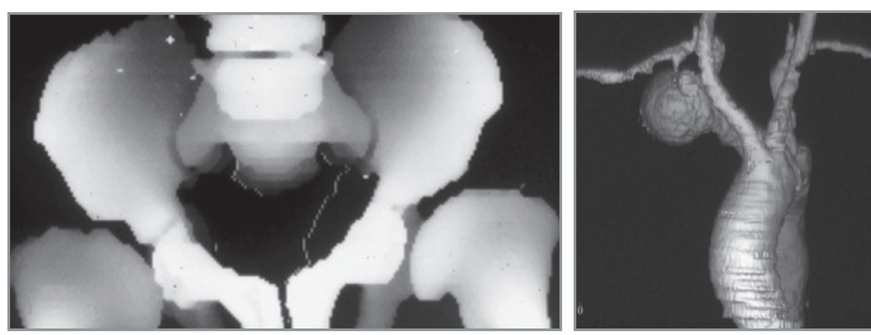
*Editor's note: This is one in a series of articles being published to mark the 50th anniversary of* Applied Radiology.

It is difficult to overstate the progress and impact of computed tomography (CT) on medicine over the past 50 years.

State-of-the-art trauma care, for example, relies on CT and its ability to execute swift, whole-body scans and deliver unparalleled accuracy in the detection and evaluation of brain, musculoskeletal, gastrointestinal, and pulmonary injuries. The modality also plays a leading role in oncology, where its ability to detect and stage disease, and to help measure patient treatment response, are a hallmark of high-quality cancer care. Peripheral and cerebrovascular imaging with CT angiography and venography have replaced many invasive procedures.

Today's clinicians depend on CT's ability to evaluate patients with alterations in neurological state; detect inflammatory and neoplastic disease in the gastrointestinal tract and the genitourinary system; evaluate the lungs for primary or metastatic disease and interstitial disease; and to evaluate and classify mediastinal masses. Evaluation of the febrile patient is a hallmark of CT, for example.



*Three dimensional images from the early 1980's using 5mm thick CT sections and early rendering techniques.*

The evaluation of hematuria and the ability to in a single exam evaluate the kidneys, ureter, and bladder are unprecedented with CT. Screening for lung cancer in patients with smoking history or evaluation of coronary artery calcification are two of the recent developments that impact on the role of radiology and radiologists and show how CT can be used successfully in a screening mode. Results with virtual colonoscopy have also shown the value of CT in screening.

Virtually every physical medical discipline has been touched in some way by this three-dimensional medical imaging modality, making it almost hard to believe it has only been around for 50 years in the clinical realm.

Computed tomography was essentially discovered by Sir Godfrey Hounsfield in 1967 while working on various aspects of radar pattern recognition at the EMI Corporation in London, England. "The idea occurred to me," Sir Hounsfield later explained, "which was eventually to become the EMI Scanner and the technique of computed tomography."

The first CT scan on a live patient took place four years later, in September 1971, at Atkinson Morley's Hospital in London. The technology and its potential impact on medicine were obvious to many; the Mayo Clinic quickly purchased an EMI Brain Scanner and began scanning patients clinically less than two years later, with whole-body

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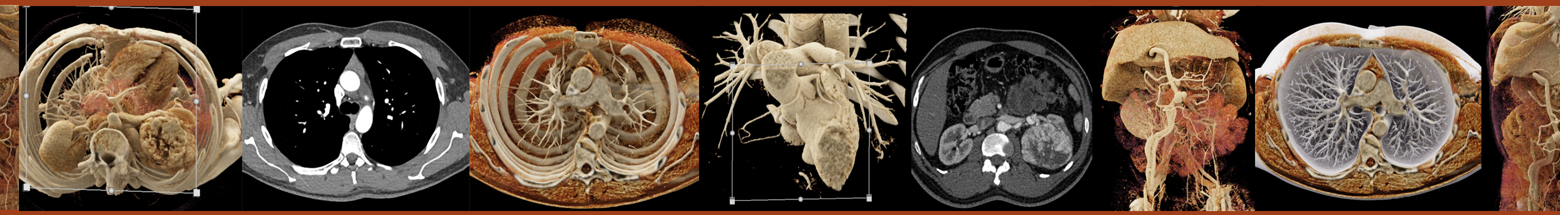
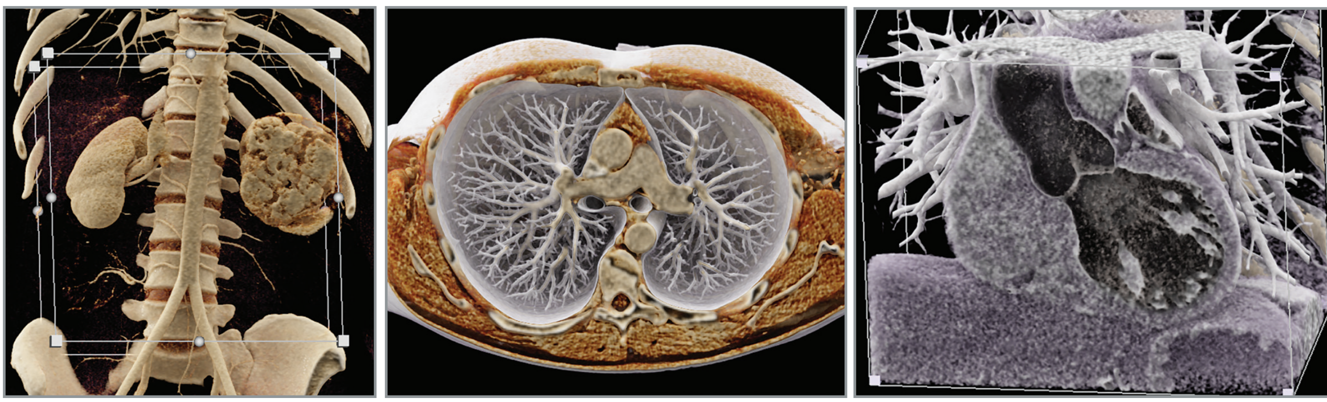


## *CT's role in planning therapy or predicting patient outcomes will only increase as new artificial intelligence algorithms are developed.*



*Renal cell carcinoma, thymic hyperplasia, and anomalous right coronary artery off the left cusp defined with maximum intensity projection and 3D cinematic rendering showing the advantages of modern gated CT scanning, including an intraluminal look into the aorta.*

CT imaging following in 1975. Sir Hounsfield would go on to share the 1979 Nobel Prize in Physiology or Medicine with South African mathematician Allan M Cormack, who had also been working on concepts related to 3D imaging at around the same time as Sir Hounsfield.

Thanks in part to computer technology, achievements in CT scanning have since included ever-faster scanning, higher spatial resolution, faster data reconstruction, and falling radiation dose, as well as a range of data processing techniques: perfusion CT and dual-energy CT. We have witnessed the evolution from the non-spiral/helical units through four-slice, 16-slice, 32-slice, and 64-slice scanners. Even higher slices, no doubt, are yet to come.

Each advance in scanner technology, moreover, has resulted in new applications and improvements in classic applications. These are largely the result of research and development by companies ranging from early adopters like EMI, Pfizer, and Johnson & Johnson, to today's largest medical imaging technology vendors, including Siemens Healthineers, GE Medical, Philips, and Toshiba. In addition, it must be noted that underpinning these breakthroughs are advances in computer technology from companies including HP, Intel, Microsoft, and Nvidia.

Yet computed tomography's success has not been achieved without challenges. The use — and what some would call overuse — of CT has been the subject of discussion in the medical imaging community for many years. Concerns over radiation dose have also been an issue, but these also have led to advances in detector material, computer electronics, and post-processing techniques to help lower the dose to patients.

### The Future for CT is Bright

Indeed, many would argue that CT has been nothing short of a game changer in medicine. Prior to the widespread adoption of the modality, exploratory surgery was common for a wide range of clinical presentations when classic examinations could not find an answer. Thanks to CT scanning, exploratory surgery has been largely eliminated.

Looking ahead, the next 50 years should be just as productive, particularly as artificial intelligence makes its mark on CT protocoling (and reduced radiation dose), contrast delivery, and serving as a primary or second reader. Computed tomography's role in planning therapy or predicting patient outcomes also will only increase as new artificial intelligence algorithms are developed. Image post-processing, with 3D printing or new volume-rendering techniques like cinematic rendering as well as augmented reality are certain to drive expansion of CT's role well into the future.

Indeed, the best is yet to come.

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