TECHNOLOGY HISTORY

For over 130 years, Toshiba has been a world leader in developing technology to improve the quality of life. Our 50,000 global patents demonstrate a long, rich history of leading innovation. It might surprise you to learn about some of the things we’ve invented.

1915 Japan’s first X-ray tube
1954 First digital computer
1977 First cardiac ultrasound scanner
1985 First helical CT scanner
1986 First series computer
1990 First radial CT scanner
1993 First workstation CT scanner
1999 First open MRI
1999 First 64-slice multidetector CT
2002 First 8-slice CT scanner
2004 First quantum denoising software
2007 Dynamic volume CT scanner
2009 First 88-row detector CT
2010 First iterative recon technique for 320 detector row CT
2002 First 400 ms CT scanner
2004 First Quantum Denoising Software
2007 Dynamic volume CT scanner
2009 First 88-row detector CT
2010 First iterative recon technique for 320 detector row CT
2002 First 400 ms CT scanner

WARNING: Any reference to x-ray exposure, intravenous contrast dosage, and other medication is intended as a reference guideline only. The guidelines in this document do not substitute for the judgment of a healthcare provider. Each scan requires medical judgment by the healthcare provider about exposing the patient to ionizing radiation. Use the As Low As Reasonably Achievable radiation dose principle to balance factors such as the patient’s condition, size and age, region to be imaged, and diagnostic task.

Disclaimer: In clinical practice, the use of the AIDR 3D feature may reduce CT patient dose depending on the clinical task, patient size, anatomical location and clinical practice. A consultation with a radiologist and a physicist should be made to determine the appropriate dose to obtain diagnostic image quality for the particular clinical task.

Due to local regulatory processes, some of the products included in this brochure may not be available in each country. Please contact your local Toshiba sales representative for the most current information.

TOSHIBA MEDICAL SYSTEMS CORPORATION
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MCATCT0303A 2014-12 TMSC/D

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Dear Reader,

SURESubtraction™ Lung, the newest addition to our suite of Adaptive Diagnostics Clinical Solutions, provides diagnostic blood flow maps for routine pulmonary CTA studies. These blood flow maps are very useful for evaluating the extent of perfusion deficits, but even more importantly are able to show the perfusion defects caused by small or occult pulmonary emboli. This means that SURESubtraction Lung helps to solve clinical challenges — the challenges faced by reporting physicians every day.

As is the case for all our Adaptive Diagnostics Clinical Solutions, the idea behind this development was conceived by our clinical partners. Professor Mathias Prokop (a world-renowned radiologist from UMC Radboud in Nijmegen, the Netherlands), who had experience working with our deformable registration algorithms, immediately recognized the great promise and potential clinical benefits of adapting this technology specifically to the lungs. As a result of prompt, close collaboration, SURESubtraction Lung was released as a clinical product a short time later.

It is with great enthusiasm that I introduce this newest addition to our suite of Adaptive Diagnostics Clinical Solutions. I would also like to express my sincere thanks to Professor Prokop, his team and the members of our engineering teams, who together have developed yet another application that will reduce diagnostic reading times, improve diagnostic confidence, and most importantly, improve patient care.

Let us all work together to achieve further improvements in diagnostic imaging.

Wataru Taguchi
General Manager
CT Systems Division
Toshiba Medical Systems Corporation

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Reference for Radiation Dose Calculation
Calculation of the effective doses in this brochure is based on the conversion coefficients for patients given in the following publication:

American Association of Physicists in Medicine (AAPM) Report 94.
*The Measurement, Reporting, and Management of Radiation Dose in CT*.
SURE Subtraction Lung Introduction — Pulmonary Blood Flow Mapping

The Clinical Challenge
Pulmonary CTA is a well-established examination to evaluate patients for acute pulmonary emboli. This procedure is widely available, can be performed quickly, and requires as little as 30 ml of contrast medium with modern CT scanners. However, many of these studies are equivocal because small subsegmental emboli may be difficult or impossible to identify. For cases in which there is a strong suspicion of embolic disease, additional functional imaging tests may be required.

Blood Flow Mapping With CTA
As an aid to diagnosis in pulmonary CTA examinations, advances in technology have made it possible to identify iodine within the lung parenchyma and to display this information as a color blood flow map. This can be achieved with a dual energy approach or with Toshiba’s unique SURE Subtraction Lung software. Dual energy scanning identifies iodine based on the difference in the attenuation of iodine between scans performed at two different kVp settings. However, since both the high- and low-kVp scans contain polychromatic X-rays, there may be significant overlap between the attenuation values, resulting in artifacts. In addition, complex image-based or raw data-based processing is then needed to generate a color overlay to show the distribution of iodine in the lung parenchyma. Toshiba, in cooperation with our clinical partners, has developed a much simpler and more accurate solution employing a subtraction technique with highly accurate deformable registration technology.

To perform subtraction, an ultra-low-dose precontrast scan is performed as the subtraction mask, followed immediately by a low-dose pulmonary CTA scan. SURE Subtraction does not require a complex scan mode and can be performed with up to 50 cm FOV. The SURE Subtraction Lung processing is fully automated as part of the scan protocol, producing blood flow maps with zero additional work from the technologist.

SURE Subtraction lung provides blood flow maps that have more than three times the signal level as compared to a dual energy scan. The reason for this is that SURE Subtraction Lung is able to exploit the HU difference between non contrast & post contrast scans compared to the limited HU attenuation difference that is available with dual energy techniques.

SURE Subtraction Lung for pulmonary CTA scans can be applied in routine clinical practice, providing blood flow maps to aid diagnosis right at the reading station. Such blood flow maps permit under perfused areas in the lungs to be easily identified, providing valuable clinical information concerning the extent of flow deficits to improve the diagnosis of pulmonary embolic disease.

Advanced Deformable Registration
The key to high-quality subtraction is to employ a highly accurate deformable registration algorithm. In the development of this application, Toshiba’s advanced visualization scientists fine-tuned the deformable registration method to target the lung parenchyma in order to correct for any motion that might occur between the two scans. Due to the opposed motion of the rib cage and the lungs, the lungs are first segmented from the chest using atlas-based segmentation, which makes it possible to generate a stable warp field that canmorph the precontrast anatomy to the postcontrast anatomy in order to ensure accurate. After the two datasets have been accurately registered, subtraction is performed. A color overlay is then applied to produce a blood flow map of the iodine within the lungs.
SURESubtraction Lung is a perfect addition to Toshiba’s suite of Adaptive Diagnostics Clinical Solutions, which are designed to solve your clinical challenges with simplified workflow and to provide results of consistently high quality.

Thromboembolic disease is associated with significant risks, and patient outcomes are greatly improved by correct diagnosis and treatment. Routine diagnosis with blood flow maps enhances diagnostic capabilities to improve patient outcomes.

Subtraction imaging adds diagnostic power to the routine evaluation of patients undergoing pulmonary CTA examinations. Ongoing studies also suggest new opportunities for the evaluation of interstitial lung disease and COPD, where knowledge about blood flow information may aid in diagnosis and treatment planning.

Prof. Mathias Prokop
Radboud University Medical Center, Nijmegen, the Netherlands
Pulmonary Embolism & Tumor

Patient History

This 60-year-old man with a known right upper lobe tumor and mediastinal, hilar, and distant metastases presented with dyspnea and an elevated D-dimer blood test result.

Findings

The tumor in the right upper lobe is clearly demonstrated in the axial images. The tumor is compressing the pulmonary arteries, causing wedge-shaped perfusion defects in the iodine map images. In addition, pulmonary emboli are seen in the right lobar arteries, causing perfusion defects in the middle and lower lobes of the right lung.
Perfusion Defect

Patient History

This 84-year-old woman presented with dyspnea.

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Findings

The iodine maps demonstrate a perfusion defect involving the entire left lower lobe. It is assumed that bronchopathy and atelectasis are causing hypoxic vasoconstriction, resulting in the perfusion defect. No pulmonary emboli are seen.
Emphysema

Patient History
This 64-year-old man with known emphysema presented with right sided chest pain.

Findings
The CT images demonstrate severe emphysema in both lungs, with corresponding patchy perfusion defects seen in the iodine maps. No pulmonary emboli are demonstrated.
**Metastases**

**Patient History**
This 52-year-old man with metastases from rectal carcinoma presented with increasing dyspnea.

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**Findings**
Multiple metastases are seen in both lungs in the coronal images. The tumor in the left hilum is causing compression of the pulmonary artery, resulting in wedge-shaped perfusion defects in the upper lobe of the left lung. These findings may be the cause of the patient’s dyspnea.
Pulmonary Embolism & Infarct

Patient History
This 74-year-old man presented with known venous thrombosis. A routine chest X-ray demonstrated an enlarged hilum. A CT scan was requested to further investigate the chest X-ray findings.

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Findings
Extensive pulmonary emboli are seen in the pulmonary arteries bilaterally, with associated wedge-shaped perfusion defects seen in the iodine maps. A pulmonary infarct in the left upper lobe is demonstrated in the coronal iodine map with a typical enhancing rim.
Normal

Patient History
This 67-year-old man presented with chest pain and an elevated D-dimer blood test result.

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Findings
The lungs appear normal, with no evidence of pulmonary emboli. A normal ventrodorsal perfusion gradient is seen in the sagittal iodine map images.
Emphysema

Patient History
This 65-year-old woman with very severe COPD (GOLD stage IV) presented with chest pain, dyspnea, and an elevated D-dimer blood test result.

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Findings
Severe emphysema affecting both lungs is seen in the lung images. The iodine maps show patchy perfusion defects corresponding to the emphysematous regions of the lungs.
Pulmonary Embolism

Patient History

This 59-year-old man with a history of amyotrophic lateral sclerosis (ALS), ulcerative colitis, and pulmonary emboli presented to the emergency department with recent onset of dyspnea.

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Findings

Multiple emboli are seen in the pulmonary arteries, extending to all pulmonary lobes. The iodine maps do not show any perfusion defects, indicating that the emboli are nonocclusive.
**Emphysema**

**Patient History**
This 84-year-old man presented with emphysema, pulmonary hypertension, and hemoptysis.

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**Findings**
Emphysema can be seen in both lungs, with associated patchy perfusion defects demonstrated in the iodine maps. The pulmonary arteries appear slightly enlarged in the CT images, indicating pulmonary hypertension. Overall perfusion in both lungs is reduced. No pulmonary emboli are observed.
Perfusion Defect

Patient History
This 42-year-old man presented with dyspnea and chest pain following surgery 2 days previously.

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Findings
An area of low density is seen in the left lower lobe in the CT images, with a corresponding perfusion defect in the iodine maps caused by mucus plugging and associated hypoxic vasoconstriction.