CT Imaging
in the Emergency Department

WHAT YOU WILL LEARN: In this article, you'll read about a hospital in Germany that upgraded their emergency department (ED) with a Revolution™ CT and ASiR-V™, GE's blended Iterative Reconstruction algorithmEmpowered by these technologies, the hospital has created a new set of clinical protocols called "the Big Five," that combine stroke and chest pain management in the ED to further enhance patient care and increase clinical confidence. You'll also learn how one hospital in Spain installed Revolution™ EVO and ASiR-V to increase efficiency and accuracy in CT scans while lowering dose for thousands of stroke and polytrauma patients each year.

Jena University Hospital

At Jena University Hospital in Thuringia, Germany, Professor Ulf Teichgräber, MD, MBA, Institute Director at the Institute for Interventional and Diagnostic Radiology (IDIR), has worked with his colleagues to develop clinical algorithms for determining the appropriate use of CT across a multitude of patient conditions. Chest pain, caused by cardiac, aortic, and pulmonary disease, represents 12% and suspicion of stroke represents 3% of the yearly ED/trauma visits.

In the ED, CT is critically important, helping clinicians address these complex patient cases quickly and confidently. Recognizing this, Jena has a Revolution™ CT located right in the center of the trauma bay, ready to provide clinicians with the information they need to treat patients and save lives.

"We established in our ED department certain algorithms for how we use the scanner," Professor Teichgräber says. In a department that sees an average of 33,000 patients each year, proper CT utilization is a key factor. "We want the right patient in the CT scanner."

Patients without suspicion for ACS undergo fast ultrasound on the CT table and then Triple Rule Out CT. Patients that are hemodynamically stable are further triaged by biomarkers and clinical risk scores and undergo dedicated CT for coronary artery, aorta, and pulmonary artery assessment.

"Stroke patients often have underlying heart conditions," Professor Teichgräber explains. "So we established a new protocol to combine stroke and chest pain management. To do it we need the right technology; for us, Revolution CT provides the technical capabilities to perform this new protocol."

The new protocol is called the Big Five. "It's a combination of the ECG gated heart CTA, combined angiography of the thoracic aorta and cerebral arteries, and CT brain perfusion," says Lucas Lehmkuhl, MD, PhD, Modality Manager for CT at Jena University Hospital.

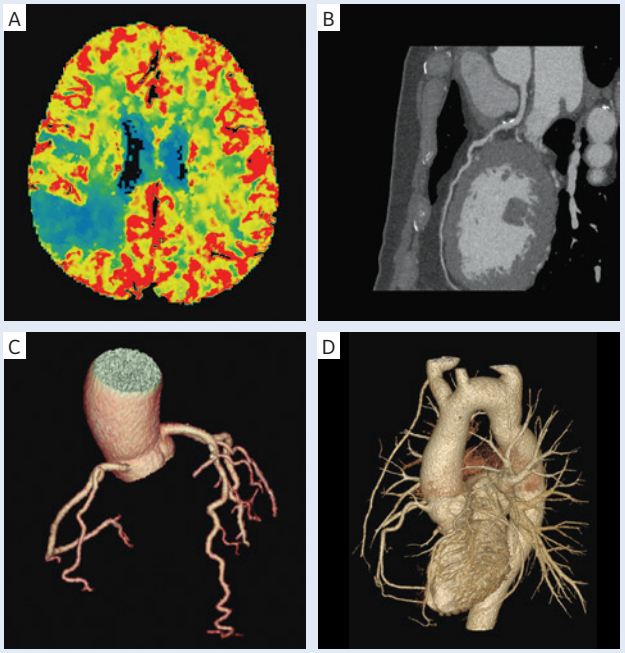

Figure 1. Jena University Hospital has developed the Big Five protocol, which includes ECG gated heart CTA, combined angiography of the thoracic aorta and cerebral arteries, and CT brain perfusion. (A) Brain perfusion for stroke; (B, C) ECG gated heart CTA demonstrating calcified plaque; (D) combined angiography of the aorta and pulmonary artery.

Images courtesy of Jena University Hospital, Thuringia, Germany.

According to Professor Teichgräber, Revolution CT is critical to the implementation of the Big Five protocol. "The new Revolution CT, with the large detector and high rotation speed, enables us to perform an angiography protocol from the chest up to the brain in one exam lasting a few seconds. This is completely new to combine these two protocols into one—historically we usually look at either the chest or brain but not both."

A new option on Revolution CT that also plays an important role in ED imaging is ASiR-V™, GE's new blended IR algorithm. With younger patients, ED clinicians were previously more inclined to wait for lab reports before CT, Professor Teichgräber explains. However, with Revolution CT, the patient radiation dose is 50% less1 than with prior CT technology, so ASiR-V is used on all patients and in all protocols at Jena University Hospital. In pediatric patients, it is possible to go with even lower doses, he adds.[1]

"We know that using CT in the ED has a clinical impact in decision making," explains Dr. Lehmkuhl. "With an immediate diagnosis, we have a clear decision for patient care and also for discharge. With Revolution CT, there is the ability to image higher heart rates and still have sharp images of the aorta."

University Hospital Donostia

Located in the Basque Country of Spain, University Hospital Donostia is a 1,100-plus bed hospital that serves as the main reference center for the 700,000 residents in the province of Gipuzkoa. Since January 1, 2015, the hospital has been part of the OSI Donostialdea Integrated Health Organization.

With more than 88,000 emergency department visits each year, the busy ED relies on CT imaging to aid with rapid patient evaluation. In fact, the stroke red code can be activated as often as eight times each day. Neuro CT is the most common indication, accounting for approximately half of the daily CT procedures performed in the hospital's ED. On an average day, at least 30 ED patients are scanned; however, that number can often jump to 50 patients.

In October 2016, University Hospital Donostia replaced an older, 16-slice CT scanner with Revolution™ EVO, a 128 multi-detector-row system featuring GE Healthcare's latest innovation in low dose imaging, ASiR-V™ iterative reconstruction.

"CT is the most accurate and most important exam for emergent cases and it is essential to have this capability in the ED," says Gorka Arenaza, MD.

It is often said that "time is brain" in stroke cases. Revolution EVO is enabling a new level of efficiency in patient diagnosis.

"Now, we can perform the CT study faster, with more information and at a lower radiation dose," Dr. Arenaza says. "The power of Revolution EVO is the accuracy of the imaging study—the higher resolution and image quality along with the longer coverage in perfusion at 8 cm is making a significant difference."

For example, stroke patients immediately receive a CT neuro, CTA, and if needed CT perfusion with a diagnosis in less than 30 minutes from the moment they enter the ED. In addition to the speed of Revolution EVO, University Hospital Donostia is notified by the ambulance service of a patient in route—along with their specific symptoms—so the ED team can complete any CT study in progress and reserve the scanner for their arrival.

Revolution EVO enables a 0.35-second routine rotation speed for faster scan times and the 8cm perfusion coverage helps clinicians detect ischemic brain lesions quicker. Dr. Arenaza explains that with some neurology patients, it can be difficult to locate the ischemic lesion. The longer coverage and higher resolution enables him to view more brain anatomy in less time with higher clinical confidence.

Most impressive, however, is the ability to generate higher quality images at lower doses than the hospital's prior GE scanner. In addition to lower dose, ASiR-V also provides up to 135% improved low-contrast detectability and 91% less image noise compared to FBP reconstructions.[1,2]

"We also now have the capability to perform coronary CT coronary angiography so this has allowed us to provide this new service to chest pain patients," adds Dr. Arenaza. The hospital has just started implementing CCTA on patients with chest pain and a low or intermediate probably of coronary disease.

References

1. In clinical practice, the use of ASiR-V 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.
2. Low contrast detectability (LCD), image noise, spatial resolution and artifacts were assessed using reference factory protocols comparing ASiR-V and FBP. The LCD measured in 0.625 mm slices and tested for both head and body modes using the MITA CT IQ Phantom (CCT183, The Phantom Laboratory), using model observer method.

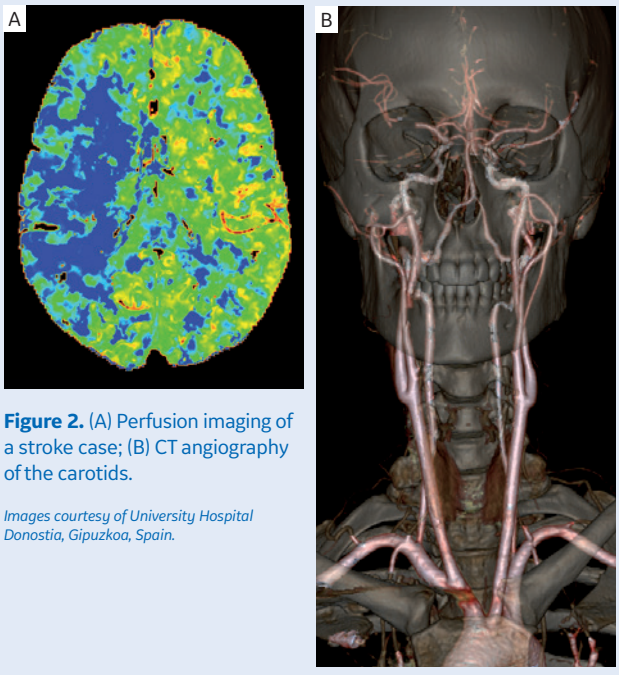

Figure 2. (A) Perfusion imaging of a stroke case; (B) CT angiography of the carotids.

Images courtesy of University Hospital Donostia, Gipuzkoa, Spain.